NET ZERO CITIES

EU MISSION PLATFORM | CLIMATE NEUTRAL AND SMART CITIES

Climate City Contract

2030 Climate Neutrality Action Plan

2030 Climate Neutrality Action Plan of City of Trondheim

TRONDHEIM MUNICIPALITY

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Summary

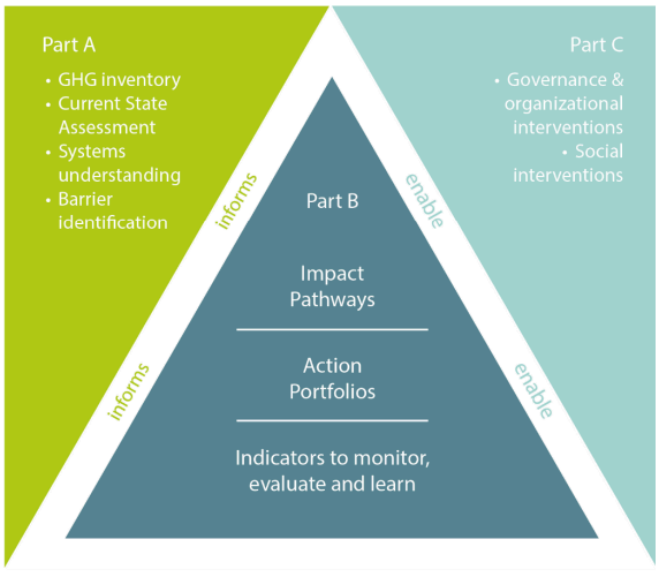
Summary

"Together we create Trondheim." This is the slogan for *Trondheimsløftet*, the municipal master plan for 2020-2032. As one of the three main goals, Trondheim shall assume responsibility for a greener and more circular city. After being selected as one of the 112 climate-neutral and smart cities in the EU Cities Mission, Trondheim aims to become climate neutrality by 2030.

The mission platform NetZeroCities provides methodologies such as the Climate Transition Map and the Theory of Change framework, which have been adopted in planning Trondheim's climate transition since spring 2022. The timing was good. Trondheim was about to revise the fourth energy and climate plan. *Klimaløftene* was adopted by the City Council in April 2024. The Climate City Contract (CCC) Action Plan has then been drafted in hope to realise the political ambitions and transition strategies.

Trondheim has over two decades of experience in climate governance. Our first energy and climate plan was adopted by the City Council in 2001. As the technological capital of Norway, Trondheim is known for its capacity to innovate. Still, the exercise of drafting this CCC Action Plan has given us both insight and a roadmap to accelerate the systemic changes needed. The direct GHG emissions in Trondheim have been reduced by approx. 20 percent during 2009-2022. Our ambition is to reduce 80 percent by 2030. There is still a huge gap to act upon.

Fig. S1: Overview of contents and relationship of the different parts in CCC Action Plan



This CCC Action Plan contains three main parts. Part B is the centrepiece. Trondheim's transition towards climate neutrality is detailed in 5 impact pathways, 33 actions planned in 14 portfolios and 28 indicators for monitoring, evaluating and learning. Part A informs, with greenhouse gas (GHG) emissions baseline inventory, assessment of current policies and strategies, systemic barriers and opportunities, and a mapping of key stakeholders. Part C enables, with a description of governance innovation and social innovation interventions.

The five focus areas or impact pathways in Trondheim's climate transition are 1) energy systems, 2) mobility and transport, 3) built environment, 4) waste and circular economy, and 5) viable nature. These are also important aspects of the citizens' everyday life. For us, the CCC AP is both an instrument for coordinated climate governance and an instrument to activate the ecosystem for change. Actions, actors and assets are the three indispensable elements for successful implementation of our planned portfolios. With this first CCC AP in place, we are to start a new chapter in our transition journey.

Abbreviations and acronyms

The list of abbreviations and acronyms contains **abbreviations** (a shortened form of a word used in place of the full word) and **acronyms** (a word formed from the first letters of each of the words in a phrase of name) used in the CCC Action Plan.

Abbreviations / acronyms	Definition
AFOLU	Agricultural, Forestry and Land Use
BAU	Business as Usual
CCC	Climate City Contract
CCC AP	Climate City Contract Action Plan
CDP	Carbon Disclosure Project
CH4	Methane
CICERO	Centre for International Climate Research
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
CCS	Carbon Capture and Storage
EGD	European Green Deal
GHG	Greenhouse Gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
ICLEI	Local Governments for Sustainability
IPPU	Industrial Processes and Product Use
KDD	Norwegian Ministry of Local Government and Regional Development
KPA	Municipal Master Plan, Land-Use Section
KPS	Municipal Master Plan, Societal Section
LPG	Liquefied Petroleum Gas
LNG	Liquefied Natural Gas
NEA	Norwegian Environment Agency
NGO	Non-Governmental Organisation
NIR	National Inventory Report
N2O	Nitrous Oxide
NTNU	Norwegian University of Science and Technology
NVE-RME	Norwegian Energy Regulatory Authority
NZC	NetZeroCities
PED	Positive Energy District
R&D	Research and Development
SDGs	Sustainable Development Goals
SECAP	Sustainable Energy and Climate Action Plan
SF6	Sulphur Hexafluoride

Introduction

The introduction outlines the local geographic and policy context in which the city's 2030 Climate Neutrality Action Plan is being developed and describes the gap it addresses in broad terms.

Introduction

"Together we create Trondheim"

The City of Trondheim is the third largest city in Norway and the regional centre of Mid-Norway. Its administrative territories cover 528 square kilometres. The population size in 2024 is 215,121. The city was founded in 997 and has over 1000 years of history. And at the same time, Trondheim has the reputation of being the technological capital of Norway as the city hosts the headquarters of the Norwegian University of Science and Technology (NTNU) and SINTEF, one of Europe's largest research institutes. Greater Trondheim is an incubator for good ideas. There are 37,000 students, 5,000 researchers/academics and a Nobel Prize for medicine. Nowhere else in Norway does society invest more per capita in research and new knowledge.

Trondheimsløftet, the municipal master plan for 2020-2032 - the societal section, was adopted by the City Council in November 2022. It is difficult to translate "Trondheimsløftet" directly into English because "løftet" has two meanings in Norwegian, both equally important to the cause. Firstly, the word means "to lift" or "to elevate" the city to a higher level". Secondly it is also "a promise", "an agreement" that we and our inhabitants must work together to achieve the goals in the plan.

The knowledge base for the making of the master plan consists of the following:

- The UN's 17 Sustainable Development Goals (SDGs)
- 14 perspectives on Trondheim today, and the challenges and opportunities we face
- Insight into what the inhabitants and employees think is important
- Recommendations from the Trondheim Panel

The 14 perspectives on Trondheim gives a systematic description about the city's conditions, categorised in social, environmental and economic dimensions. These are some of the issues the report points out:

- 16.2 % of Trondheim's residents have psychological symptoms or disorders.
- 21 % of the residents 0-17 years old live cramped with little space.
- 3.3 % of Trondheim's residents are over 80 years old, and the percentage is growing.
- 6.9 % of the households in Trondheim are considered low-income.
- 10 % of Trondheim's main streets are monitored digitally.
- 98 % of the inhabitants live within 300 metres from open space and green urban spaces.
- Each resident of Trondheim is responsible for approx. 37 kg of food waste at home per year.
- There are 19,169 companies in Trondheim, 92.55% of which are small- and medium-sized.

Trondheimsløftet is a product of massive co-creation with the citizens. Digital wish tree, involvement through local arenas and libraries, innovation camp at schools with 8th graders, future workshops with municipal staff and dialog meetings with business actors were some highlights. In addition, a citizens' assembly, the Trondheim panel, was established to discuss important dilemmas. They gathered and came up with recommendations relating to well-being and sustainable societal development in Trondheim.

As a result, Trondheimsløftet came up with:

- 1 vision - Together we create Trondheim
- 3 main societal development goals

- 15 subgoals
- 86 strategies that says what we as a municipality are going to do
- 84 strategies that says what all citizens can contribute with

The three main goals for Trondheim are the following. These are presented in a wheel together with the 15 subgoals, a good system for us to connect the co-benefits of climate actions to.

1. Trondheim shall assume responsibility for a greener and more circular city.
2. Trondheim shall be a diverse city with a strong community.
3. The knowledge and technology capital Trondheim shall be a power centre for a better world.

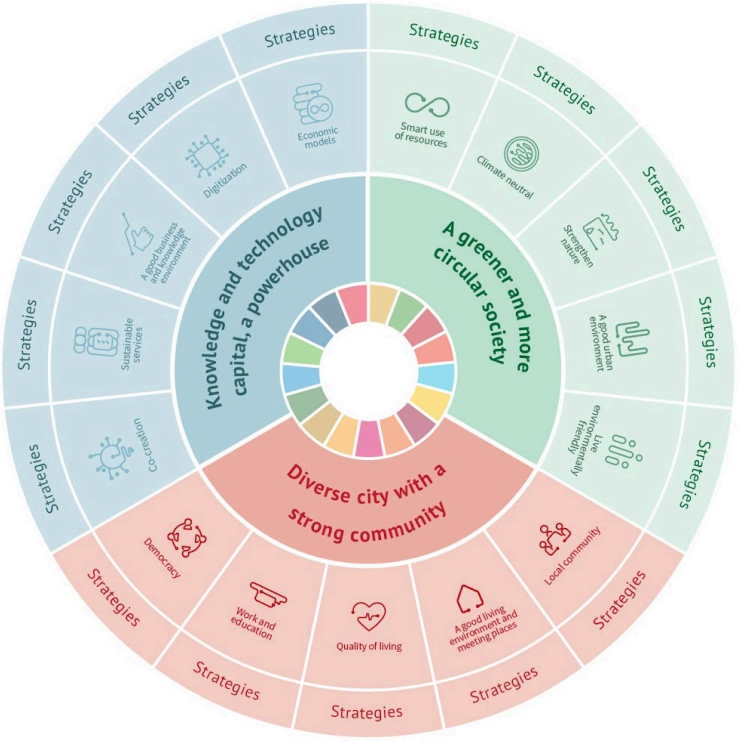


Fig. I1: Wheel of development goals in Trondheimsløftet

The municipal master plan consists also of a land-use section, which is being made for 2022-2034. The version after public hearing is finalised, but still pending for approval at the City Council (as of September 2024).

After the local election in September 2023 (electoral participation 65.7%), the political leadership shifted from the centre-left coalition led by the Labour Party to the centre-right coalition led by the Conservative Party. In addition, a history change in Trondheim's political landscape came soon after in June 2024: The municipality turned into the parliamentary governance model, after 187 years of chairmanship model. The municipal administration is re-structured, and it takes time for the organisation to adjust to new routines. However, our commitment for the climate transition and the Cities Mission remains the same and is strongly supported by the new political leadership.

Trondheim's climate governance

Green is one of three main colours in the Trondheimsløftet wheel of goals. The five subgoals are:

- Trondheim is a climate-neutral city
- We use our resources smarter in Trondheim

- Everyone in Trondheim has a green and attractive urban environment
- It is easy to live environmentally friendly in Trondheim
- The nature in Trondheim is viable and robust

During the last few centuries, Trondheim has suffered from the environmental tragedy of the commons. Examples are deforestation in Bymarka, waste and littering problems, including in the harbour, and poor air quality from fossil-based traffic and wood burning. Today, Bymarka is protected, the waste treatment is up-to-date, the harbour is cleaned up, and the local air quality is very good with a few days' exceptions (mostly in winter due to use of studded tires). Still, the greater tragedy of the commons is yet to come. ***The City Council declared a crisis situation for climate and nature in 2019.*** This is a result of greenhouse gas emissions, overconsumption of resources, pollution and nature degradation on a global scale. To cure these symptoms, we have to dare to come to the core. And as a city situated in the richer West, Trondheim needs to take a larger share of responsibility - for change.

Trondheim City Council adopted its first municipal energy and climate plan in 2001, in light of the Kyoto Protocol from 1997. The plan emphasised the connection between greenhouse gas emission, energy and local air pollution. Years later, the Norwegian government launched a national planning guideline. All Norwegian municipalities, big or small, have been required to include mitigation, adaptation and energy in their planning processes, either as part of the master plan or in a dedicated plan. In Trondheim, climate-related issues are considered and prioritised in the municipal master plans, both the societal section (KPS) and the land-use section (KPA), and in a dedicated municipal energy and climate plan. Trondheim's municipal energy and climate plan has later been revised several times, with approvals in 2010, 2017 and 2024.

The third version of the municipal energy and climate plan (adopted in 2017) laid an important foundation for Trondheim's climate governance. Climate actions became more structured and visible in various management platforms. In 2018, Trondheim made its first climate budget as a dedicated chapter in the municipal annual budget plan, one year after the global pioneer Oslo. This has since then become an annual practice until 2024. The climate budget is based on emissions scenarios for the four-year budgeting period. A baseline scenario is used to estimate the effect of concrete measures that are in the implementation phase. Together these calculations enable us to calculate an "action emissions pathway", which is compared to a "target emissions pathway". The yearly update of the climate budget enables a process of continuous evaluation, reporting and improvement where the goal is to close the "emissions gap" between the "action emissions pathway" and the "target emissions pathway".

Oslo, Hamar and Trondheim have jointly developed a guideline for climate budgeting for all Norwegian local governments at municipal and county level. This project (2019-2021) was sponsored by the Klimasats program of the Norwegian Environment Agency. The result was recognised as Local Climate Measure of the Year in 2021, run by the ZERO Foundation.

The municipal energy and climate plan (2017) was focused as the environmental aspect for Trondheim Municipality's ISO 14001 certification. The implementation of the plan has been reviewed by an external revisor yearly, with follow-up and improvement suggestions. This practice has ensured ownership and engagement of the CEO and top administrative leadership.

Trondheim is a signatory of the Global Covenant of Mayors. The commitment has been renewed by the City Council in 2022. The municipality has reported to the CDP platform since 2015. Many cities are building on the momentum in their environmental action, making it mainstream to their operations. In 2022 and 2023, the City of Trondheim received the highest score for the transparency and bold climate action and came on the CDP's annual cities A List.

"100 Climate-Neutral and Smart Cities" is one of the EU's five missions under the Horizon Europe 2021-2027. The Cities Mission takes a cross-sectoral and demand-led approach, creating synergies between existing initiatives and basing its activities on the actual needs of cities. It aims to involve local authorities, citizens, businesses, investors as well as regional and national authorities for joint actions. It echoes well to what Trondheim needs, and the timing was good. When the call was launched, Trondheim was about to start the revision of the municipal energy and climate plan, for its fourth version.

Since Trondheim was selected as one of the 112 mission cities in spring 2022, the journey has been enriching and motivating. The mission platform NetZeroCities is both resourceful and supportive. Trondheim has adopted Climate City Contract as the backbone for the revision of the energy and climate plan. The tools such as *Climate Transition Map* and the *Theory of Change* framework have been incorporated during the revision process. And now the newly adopted energy and climate plan (2024) will be the backbone of Trondheim's Climate City Contract.

Fig. I2: NZC Climate Transition Map

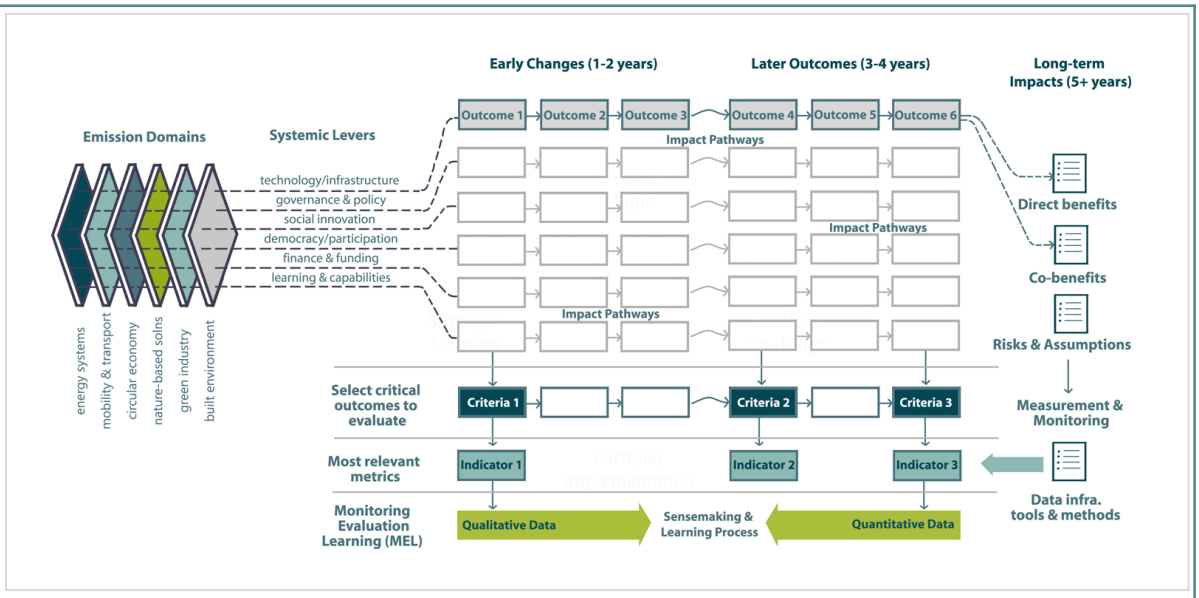


Fig. I3: The Theory of Change framework, NetZeroCities

The most important climate issues in Trondheim

Three-quarters of emissions in Trondheim come from three sources: transport (around 35 %), the construction sector (15 %) and district heating (25 %).

Within the transport sector: Trondheim has already experienced emissions reductions, thanks to the Miljøpakken, a multi-level partnership for sustainable transport in the Trondheim region, and a rapid uptake of electrical vehicles that make up 20 % of the passenger car fleet. The municipality is well underway in transitioning to zero emissions vehicles in its own vehicle fleet, and a similar transition can be achieved for other commercial stakeholders through a combination of policy incentives, public procurement and the investment in charging and other zero emissions infrastructure. The municipality has already carried out a comprehensive assessment of infrastructure needs in this field, and has begun allocating funding to new charging points and energy stations with biogas.

Within the construction sector: The City Council adopted a three-step vision in 2020: the municipality's own building projects shall be fossil-free in 2021, these shall be completely emission-free by 2023, and the whole of Trondheim's construction sector shall be emission-free by 2030. The municipality's own role as public procurer with around 10-15 % market share is key to kick starting this process, already setting in motion innovative projects such as the development of 13-tonne mobile "battery containers" to enable the hyper-charging of large construction machinery on-site. Going forward, policy innovation will be key. Tronndheim has in concert with other Norwegian cities actively lobbied for municipalities to be given greater planning powers to enforce emission standards on private developers. Circularity of this sector is also of high focus.

Waste-to-energy in Trondheim is a vital part of treating waste produced in the whole of central Norway, dramatically reducing the need for landfill. It also covers approx. 30 % of Trondheim's heating needs. In dialogue with the municipality, the plant owner is actively assessing the feasibility of carbon capture at the plant. An assessment has been made about the value chain for carbon capture and storage (CCS) in mid-Norway. CCS would also capture the biogenic emissions from waste-burning, enabling Trondheim to become carbon neutral already with current targets. Trondheim has an on-going project in the NetZeroCites Pilot Cities Programme about this.

EU project Positive City Exchange (2018-2023) has developed and showcased innovative solutions for positive energy districts (PEDs). As the Norwegian capital of technology, Trondheim has a good

track record of innovation. Together with partners across Europe, Trondheim became the lighthouse for energy transition. The massive electrification of the transport sector is supported by the fact that Norway produces almost all its electricity from renewable energy sources. However, this might become challenges in the energy systems, for example, lack of grid capacity. During the project, two operational PEDs, Sluppen and Brattøra, were established. Bold City Vision "Trondheim Energy Positive City 2050" was anchored and integrated in the municipal master plan Trondheimsløftet.

Trondheim's goals for climate transition

In April 2024, Klimaløftene, the fourth municipal energy and climate plan, was adopted by the City Council. The name Klimaløftene can be seen as an extension of Trondheimsløftet, the municipal master plan. It can be translated as our *Climate Pledges* for the future. This brand new policy instrument serves as the strategic foundation for Trondheim's engagement in the Cities Mission. It sets the goals, strategies and guidelines. The climate budget and other operational routines for climate management will be re-structured accordingly.

The four climate pledges and the related goals are:

Trondheim is Climate-Neutral

Together we create a zero-emission society

1. The direct greenhouse gas emissions shall be cut by at least 80 percent by 2030, compared to 2009, and the city will be emission-free by 2050.
2. By increasing natural carbon sequestration and industrial carbon capture and storage, we shall achieve climate-neutrality by 2030 and become climate-positive by 2050.
3. We will reduce our share of the carbon footprint in line with the 1.5-degree target.

Trondheim is Energy-Smart

Together we make the best use of our renewable energy resources

1. All fossil energy that can be phased out has been phased out to achieve the goal of an 80 percent reduction in direct greenhouse gas emissions by 2030.
2. Energy resources are utilised smartly and flexibly to ensure sufficient energy and power for climate transition while simultaneously minimising the loss of nature.
3. Everyone has stable and secure access to energy and power at an affordable price, allowing for population growth and economic development.
4. The municipality is facilitating space for energy infrastructure necessary for the green transition

Trondheim is Circular

Together we take care of the resources and create a circular city

1. We take care of what we have and limit our resource consumption to the planetary boundaries.
2. Circular and shared solutions are the norm in 2030.
3. The waste is handled in a climate and environment friendly way, where resources are kept in circulation for as long as possible.

Trondheim is Climate-Resilient

Together we create a sustainable society

1. Our natural and urban areas are prepared to withstand climate change, and we have emergency preparedness for extreme events.
2. The population stands together against climate change in a just energy and climate transition, which promotes public health and community.
3. Local value creation and employment increase through the energy and climate transition.

In order to achieve the above-mentioned goals, 9 focus areas were mapped out with specific actions towards 2030:

1) Nature and land use: We aim to develop an area-neutral, attractive, and climate-resilient city.
2) Energy and power: We will phase out fossil energy, increase local renewable energy production, and utilise energy resources smartly and flexibly.
3) Mobility and transport: We will streamline and modernise the transportation sector and make it nearly emission-free.
4) Buildings and constructions: We will develop buildings and infrastructure for a climate-resilient, emission-free, and circular future.
5) Consumption and waste: We will develop a circular city where we preserve resources and reduce our consumption.
6) Carbon sequestration for climate neutrality: We will compensate for the direct emissions we cannot eliminate.
7) Climate adaptation and civil preparedness: Together we shall make the city and nature more climate resilient.
8) Just transition and public health: We will promote equity and solidarity in the fight against climate change.
9) Business and workforce: We will be a driver for value creation that safeguards environmental and social sustainability.

These 9 focus areas serve as the foundation of the Trondheim Climate City Contract, with a bit of restructuring. The climate actions will be categorised and elaborated in five focus areas or impact pathways in accordance with the NetZeroCities Theory of Change framework, while the remaining are included as either enabling factors or co-benefits.

1) Energy systems
2) Mobility and transport
3) Built environment
4) Waste and circular economy
5) Viable nature

Other climate-related instruments in Trondheim's policy landscape

Trondheim's climate planning consists mainly of the following elements:

(1) Trondheimsløftet: municipal master plan, societal section
(2) Klimaløftene: a theme plan for energy and climate
(3) Climate budget in the annual budget plan

In addition, there are many other policy instruments that are of high relevance and come into interplay. Module A-2 in this document will provide a more detailed description and assessment. Some examples can be mentioned here.

The GHG emissions from the transport sector is highly connected to spatial planning and land-use policy. The master plan, land-use section, sets the prerequisites for urban development. In the City Development Strategy for 2050 (2020), it is stated that Trondheim should aim to become a denser and more pedestrian-friendly city. Miljøpakken has also made strategies for walking og cycling, respectively.

Multi-level governance and collaboration across different levels in public administration is considered vital in systemic changes for climate transition. Miljøpakken, established in 2009, provides a good example. It is a partnership with municipalities in the Trondheim region, county and state that jointly invest in new infrastructure to facilitate increased biking, walking and use of public transport. The goals are cutting queues and greenhouse gas emissions, as well as facilitating easy

and safe travel. Urban Growth Agreements between the state, counties and municipalities is an instrument to enhance the integration of land use and transport policy in order to achieve a national goal of zero growth in personal car transport. They include considerable state financing of transport projects in order to promote public transport, biking and pedestrians. The Zero Growth target in personal car use and introduction of zero emission cars combined, will contribute to significant GHG-reduction. Today, five Norwegian city regions have such agreements, among which the Trondheim region (2023-2029). The measures executed by Miljøpakken are part of this agreement.

Journey along the Climate Transition Map

Cities are leaders in the transformation of the way people work and live. By joining the Cities Mission, Trondheim embarks on an ambitious journey to become the first 112 cities to reach climate-neutrality by 2030. A systemic and transformative approach is needed to accelerate decarbonisation. This approach is embodied and described by NetZeroCities' Climate Transition Map. Below is a short status of the Trondheim journey, covering the first three phases leading to our first iteration of Climate City Contract.

- ***Built upon a strong mandate***

Build a strong mandate	Within city government	Set up / strengthen the internal team
		Mobilise resources and capacity
	Within the local ecosystem	Develop a multi-actor Transition team
		Build new collaborative governance structures and networks
	With the other government levels	Strengthen buy-in
		Clarify mutual commitments

What we do/have done:

- The internal climate team was set up and strengthened across different departments
- The political commitment was confirmed, through Klimaløftene
- Massive stakeholder engagement during the revision of the energy and climate plan
- The citizen survey about Trondheim's climate efforts, yearly since 2017
- Trondheim Municipality is member in green (business) network, such as Klimapartnere Trøndelag and Renergy
- Trondheim Municipality collaborates actively and strategically with RoI institutions NTNU and SINTEF
- Trondheim Municipality and Trøndelag County Authority meet regularly about climate measures
- The four major Norwegian cities (Oslo, Bergen, Trondheim, Stavanger) meet regularly to share experiences, discuss common challenges and make joint statements in the media.

How we can be better:

- To ensure internal coordination for climate actions in the parliamentary governance model
- To develop a multi-actor transition team with external partners through new collaborative governance structure
- To strengthen collaboration with national government (This is being carried out by the Ministry of Local Government and Regional Development and DOCA through the Cities Mission)
- In our PilotCities project we are testing citizen panel for concrete climate measures

- ***Understand the system***

Understand the system through	Data	GHG emissions inventory
		Analyse actions and gaps needs
	Connections, relationships	Map the system and resources flows
		Identify key obstacles
	Future scenarios	Identify levers of change
		Model options, capital formation, funding strategies

What we do/have done:

- The Norwegian Environment Agency publishes yearly direct GHG emission statistics for all municipalities, covering CO2, CH4 and N2O.
- Trondheim's climate management is recognised by CDP Cities A List in 2022 and 2023.
- A knowledge base is updated and made for the revision of the energy and climate plan, identifying challenges and opportunities in each focus area and levers of change.
- An assessment (Roadmap for GHG reduction in Trondheim) is made by CICERO, analysing actions and gaps.

How we can be better:

- To connect better actors, actions and assets in system mapping
- To get better insight on capital formation and funding strategies, beyond the municipality

- ***Co-creating a portfolio***

Co-create a portfolio	Explore actionable pathways	Clarify possible actions and financing / funding options
		Estimate co-benefits and impact
		Select impact indicators
	Connect interventions across...	Actions with quantified impact
		Policy
		Finance

What we do/have done:

- The importance of co-benefits is clearly addressed in Klimaløftene. "Just transition and public health" is one of the focus areas.
- Trondheimsløftet (the master plan) and Klimaløftene (the energy and climate plan) are clearly linked, at a strategic level.

How we can be better:

- To select impact indicators, measure them and cross-analyse them
- To relate climate actions with the other subgoals in Trondheimsløftet (GHG reductions should also be a co-benefit of other life-quality improving measures.)
- To communicate and co-create a city-wide investment plan for climate transition

Climate City Contract for Trondheim's climate transition

Plan, act, evaluate - and then start over again. This summarises the management cycle. Trondheim's fourth energy and climate plan, Klimaløftene, was adopted in April 2024, and the parliamentary governance model was introduced in the municipality in June 2024. The timing is

good for Trondheim to step up and accelerate its climate transition. The Climate City Contract (CCC) includes three elements: commitments, action plan and investment plan. It should work as the basis for building a strong foundation, ambition, and effective implementation. The City of Trondheim aims to adopt CCC as a transformative instrument, well integrated with the strategic Klimaløftene and the operative climate budget.

CCC as an instrument for coordinated climate governance

Trondheim Municipality is experienced with climate governance. Implementation of the previous energy and climate plan (2017) has resulted in good routines. Now when Klimaløftet, our energy and climate plan 4.0, was approved, the routines will also be revised and strengthened, among others the annual climate budget and CDP reporting.

In addition to Trondheimsløftet and Klimaløftene, the municipality has several political decisions that are highly relevant to the city's climate transition, including the Municipal Plan for Natural Diversity and the Action Program for Sustainable Value Creation, to name a few. The CCC should be developed as a management tool that coordinates various societal goals and actions.

The CCC represents a holistic scheme to realise Trondheims ambition to become climate neutral in time for 2030. We aim to adopt the CCC as our sustainable energy and climate action plan (SECAP) for the Covenant of Mayors.

CCC as an instrument for activating the ecosystem for change

The city's climate transition requires much more than what the municipality alone can manage. We need to activate an entire ecosystem for change - and we need the whole diversity. They can each bring along their experience and expertise, resources and investments with them. The municipality should create the right conditions for all actors to participate and contribute:

- Internally in Trondheim municipality - staff, leaders and politicians
- Collaborative partners in Trondheim and the region - knowledge institutions, business communities, NGOs, social innovators, and last but not least, the citizens
- Multi-level governance - authorities at regional and national level, as well as the EU

Trondheim's first version of CCC Action Plan is a detailed assessment on how the goals in the municipal energy and climate plan, Klimaløftene, can be reached. The structure of the document is divided into three parts: A - current state of climate action, B - pathways towards climate neutrality 2030, C - enabling interventions. The documents are extensive, but we believe the process can help to strengthen the anchorage and share ownership, so that climate transition in Trondheim can increase in scope and speed.

Climate City Contract is neither legally binding nor a politically adopted action plan. It is a tool for Trondheim to realise the political ambitions towards climate-neutrality. Trondheim's CCC shall be implemented, reported and updated in close connection with the existing management routines such as annual climate budget and CDP reporting. Otherwise, our plan is to update the CCC every two years, at least partially, if not completely, to highlight both breakthroughs and improvements.

Table I-1.1: Sectors and scopes of the climate neutrality targets

Sectors	Scope 1	Scope 2	Scope 3
Stationary energy	Included	Included	Electricity is included
Transport	Included	Included	Electricity is included
Waste/wastewater	Household waste is Included	Not applicable	No data available

IPPU	Included	Not applicable	No data available
	F-gases are not included	Not applicable	No data available
AFOLU	Included	Not applicable	No data available
Other	/	/	/
Geographical boundary	**Same as city administrative boundary**	**Smaller**	**Larger**
(Tick correct option)	x		

Map - the administrative territories

The climate city contract covers all within the city administrative boundary, including the sea. The location of Trondheim in Norway (in grey) is marked.

Fig. I4: Map over Trondheim Municipality

Part A – Current State of Climate Action

Part A "Current State of Climate Action" describes the point of departure of the city towards climate neutrality, including commitments and strategies of key local businesses, and informs the subsequent modules and the outlined pathways to accelerated climate action.

Module A-1 Greenhouse Gas Emissions Baseline Inventory

Module A-1 details and describes the latest GHG inventory, where available from 2018 or more recent, referring to a clearly stated geographic boundary. The aim of this section is to establish the emission baseline and to establish the emissions gap to 2030 climate neutrality.

GHG emissions baseline inventory

Trondheim's greenhouse gas emissions inventory for territorial emissions dates back to 2009. The inventory is based on data for each municipality from the Norwegian Environment Agency (NEA). The whole time series from 2009 is recalculated every year, as both data assumptions and methodology are continually revised. The inventory provided by NEA includes all territorial emissions of CO2, CH4 and N2O within the municipal border, including emissions from the production of district heating (which occurs within the municipal boundaries). Trondheim Municipality has also made an inventory publicly available through CDP/ICLEI Track since 2019. In this inventory emissions from district heating are allocated to the stationary energy sector as scope 2 emissions, as per the requirements for GPC-reporting. Scope 2 data for electricity usage are collected from the Distribution System Operator (Tensio). Scope 3 data are limited to loss in the transmission of electric energy. Data on F-gases are only available at national level - national authorities will provide these data at a municipal level for the next iteration of the CCC.

The municipality considers the current inventory to be sufficient in scope to cover the current target of climate-neutrality, as outlined in the Mission's Info Kit for Cities. All main Scope 1 and 2 emissions sources are included and the obligatory Scope 3 sources are currently considered to be of marginal importance. Trondheim's climate strategy includes ambitions regarding the circular economy that currently lie outside the scope of the climate-neutrality goal as currently defined - these are nonetheless outlined in impact pathways 4 and 5 (see part B).

Trondheim Municipality adopted its first climate action plan in 2001. The climate plan has been revised several times since - in 2010, 2017 and 2024. In the period 2009-2022, the greenhouse gas (GHG) emissions declined 20 percent, from 605,000 to 485,000 tonnes CO2e (scope 1). Trondheim Municipality has for many years reported a GHG emission inventory annually in CDP/ICLEI Tracker, and this data can be collected by NetZeroCities for the use of CCC.

The inventory shows that the most important impact pathway is transport - a sector responsible for one third of Trondheim's emissions. Trondheim and Norway have very limited emissions from electricity production, and electrification of transport, processes and machinery are ongoing. Transport reduction, increased energy efficiency and additional electricity production will be needed to meet the increasing demand for renewable energy.

Another vital impact pathway is energy systems - both to fuel the climate transition with renewable energy and through carbon capture and storage (CCS) from the waste incineration plant. The plant is responsible for about one fourth of the city's emissions and covers one third of the city's thermal energy demand through the district heating network. As the plant emits substantial amounts of biogenic emissions, CCS can provide negative emissions for compensation of residual emissions.

A third impact pathway is buildings and constructions. Machinery related to construction sites are responsible for about 5 % of city wide emissions, with other off-road machinery contributing a further 5 %. The replacement of diesel construction and other machinery with emissions-free technology is a key impact pathway. There is also great potential for circular resource use, and to reduce our climate and nature footprint in this sector.

Waste and circular economy - our fourth impact pathway - sets out to reduce overconsumption of natural resources and to cut scope 3 emissions, by developing circular value chains that increase resource efficiency.

Our final impact pathway is to ensure a viable nature because we depend on ecosystem services. For climate mitigation through natural carbon sinks. For climate adaptation through e.g. flood regulation. For life in general.

Data on final energy use, emissions factors, baseline inventory of GHG emissions and key activity data are provided in the following tables. Please note that only loss in transfer of electric energy is included in scope 3 GHG emissions in this CCC AP: We need to explore how to get data on more scope 3 emissions for the next iteration of CCC AP. As shown in table A-1.2 we also lack information on F-gases: National authorities aim to make data on F-gases available on a municipality level for the next iteration of the CCC AP.

Table A-1.1: Final energy use by source sectors

Base year: 2022

Unit: GWh

	Scope 1	Scope 2	Scope 3
I. Buildings			
Municipal waste	534.83		
Biodiesel	6.49		
Biogas	4.6		
Biomass	1.15		
Diesel	195.54		
Electricity		2696.91	146.05
District heating		672.08	
Light heating oil	33.68		
Coke	44.13		
LPG	64.35		
Nature gas	9.83		
Paraffin wax	4.84		
Wood briquettes/pellets	90.80		
II. Transport			
Biodiesel	69.86		
Biogas	66.80		
Diesel	578.21		
Electricity		112.01	5.47
Ethanol	13.42		
Gasoline	125.80		
III. Waste	No data available		
IV. Industrial Process and ProductUse (IPPU)	Can refer to A-1.4 Activity		
V. Agricultural, Forestry and Land Use (AFOLU)	No data available		

Table A-1.2: Emission factors applied						
Unit: t/GWh except for Composting, which is reported in t/t waste						
Method used: national methods						
Primary energy/ energy source	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)	F-gases	Sulphur hexafluoride (SF_6)	Nitrogen trifluoride (NF_3)
Biodiesel*	0	0.036	0.00216	/	/	/
Biogas*	0	0.018	0.00036	/	/	/
Coke	402.95	0.036	0.0054	/	/	/
Composting	/	0.004	0.0003	/	/	/
Diesel**	264.78	/	/	/	/	/
Gasoline**	256.68	/	/	/	/	/
Light heating oil	264.78	0.036	0.00216	/	/	/
LNG	201.89	3.3012	0.00605	/	/	/
LPG	234.29	0.018	0.00036	/	/	/
Paraffin wax	264			/	/	/
Wood briquettes/ pellets/chips*	0	0.0396	0.0144	/	/	/

Data source: NEA (Miljødirektoratet) (2023). Greenhouse gas accounts for municipalities and counties (Klimagassregnskap for kommuner og fylker). National Inventory Report (NIR) 2024.

** Biofuel and biomass: Carbon dioxide (CO2) is treated as null due to the carbon-cycle.*
*** Diesel and gasoline: The values of Methane and Nitrous Oxide are small and dependent on driving patterns. Hereby CH4 and N2O are not reported.*

Table A-1.3a shows GHG emissions by source sectors. Data from Trondheims inventory in plain, *data from the NZC economic model in cursive*. Please note that for the NZC economic model, we focus on the transport emissions, since we need the results from the economic model to assess incremental costs in this sector only. Since the economic model does not follow the GPC protocol, we have still chosen to present our inventory in line with GPC and CDP reporting.

Table A-1.3a: GHG emissions by source sectors - 2022					
Base year: 2022					
Unit: tons CO2e					
		Scope 1	**Scope 2**	**Scope 3**	**Total (%)**
I. Buildings (+ o-r machinery) *Buildings / Electricity*		38 084 + 53 000 *157 998**	195 835** *53 535****	2775	289 694 (57) *211 533 (40)*
II. Transport + sea transport		**169 932** + 24 479 ***169 859***	1 268.5	104	195 783 (39) *169 859 (33)*
III. Waste		36 634	0	0 *13 802*	36 634 *13 802 (3)*
IV. Industrial Process and Product Use (IPPU)		2546	0	0	2546 (0.5)
V. Agricultural, Forestry and Land Use (AFOLU)	Sources (positive emissions)	16 541	0	0	16 541 (3)
	Sinks (negative emissions) ****	/	/	/	/
VI: Other (incl. sea transport, machinery, IPPU and AFOLU)		*125 845*			*125 845 (25)*
Total*****		341 216 *453 702*	197 103 53 535	2 879 *13 802*	541 197 *485 535 (100)*

** Includes district heating (app. 144 ktons), but not off-road machinery.*
*** Includes emissions from electricity (app. 51 ktons) and district heating from waste incineration and some additional fossil fuels (app. 144 ktons)*
**** Electricity includes all electricity consumption, not only in buildings.*
***** Currently there is no data available for carbon sinks in AFOLU.*
****** The differences between scope 1 and scope 2 for the two models are primarily explained by the allocation of district heating to scope 1 in the NZC economic model. The lower total in the NZC emission model can largely be explained by additional waste data included in the native Trondheim model.*

Table A-1.3b shows the business-as-usual scenario, according to the NZC economic model.

Table A-1.3b: GHG emissions by source sectors - 2030 BAU

Base year: 2030

Unit: tons CO2e

		Scope 1	Scope 2	Scope 3	Total
I. Buildings / Electricity		157 690	56 144*		213 834 (42)
II. Transport		160 735			160 735 (32)
III. Waste				8877	8877 (2)
IV. Industrial Process and Product Use (IPPU) *					
V. Agricultural, Forestry and Land Use (AFOLU)	Sources (positive emissions)				
	Sinks (negative emissions) ***				
VI: Other (incl. sea transport, machinery, IPPU and AFOLU)		125 845			125 845 (25)
Total		444 270	56 144	8877	509 290

** Electricity includes all electricity consumption, not only in buildings.*

Table A-1.4 shows GHG emissions categorised by activities in source sectors. Data from Trondheims inventory in plain, *data from the NZC economic model in cursive.* Please note that for the NZC economic model, we focus on the transport activities, since we need the results from the economic model to assess incremental costs in this sector only.

Table A-1.4: GHG emissions by activity in source sectors

Base year: 2022

		Scope 1	Scope 2	Scope 3	AD name*	Unit
I. Buildings**						
I.4 Energy industries	Incinerated waste amount	217 584				tons
II. Transport						
II.1 On-road transportation***	Passenger cars	576 925 *578 000*	236 792		Distance driven	1000 km
II.1 On-road transportation***	Light-duty vehicles	118 728 *123 000*	4434		Distance driven	1000 km
II.1 On-road transportation***	Heavy-duty vehicles	41 748 *42 000*	84		Distance driven	1000 km
II.1 On-road transportation***	Buses	35 266.47 *32 000*	3531		Distance driven	1000 km
II.3 Waterborne navigation		155 724			Distance sailed	nm

II. 5 Off-road transportation	Snow mobile	1892				number of vehicles
III. Waste						
III.2 Biological treatment of waste		12 989			Waste composted (dry matter)	tons
III.2 Biological treatment of waste		1107			Methane produced	tons
III.4 Wastewater		2 763 900			Organic carbon in sewage	Kg BOD
Collected waste	Within city boundaries			61 059		Tons
IV. Industrial Process and Product Use (IPPU)						
IV.1 Industrial process	Stone wool products	29 156			Main product volume	tons
V. Agricultural, Forestry and Land Use (AFOLU)						
V.1 Livestock	Cow/Cattles	2105				number of livestock
V.1 Livestock	Horses	336				number of livestock
V.1 Livestock	Sheep/Goats	2588				number of livestock
V.1 Livestock	Swine	496				number of livestock
V.1 Livestock	Poultry	253 503				number of livestock
Electricity and heating demand						
Electricity demand	Within city boundaries		2778 *2784*			GWh/year
Heating demand	Space heating & domestic hot water		*2333*			GWh/year
District heating	Waste incineration & additional renewable and fossil energy.		672		Produced energy	GWh/year

Main data source: NEA (Miljødirektoratet) (2023). Greenhouse gas accounts for municipalities and counties (Klimagassregnskap for kommuner og fylker), The Norwegian PRTR (Norske utslipp).

** AD name refers activity data name*
*** The amount of final energy use for buildings (energy source and fuels) is reported in Table A-1.1.*
**** Distance driven from on-road transportation in Scope 3 is reported in Scope 2.*

Module A-2 Current Policies and Strategies Assessment

Module A-2 lists and assesses existing policies, strategies, initiatives, or regulation from local, regional, and national level, relevant to the city's climate neutrality transition. This assessment contributes to identifying the gap between the emissions reduction due to existing initiatives and the city´s 2030 climate neutrality target.

Table A-2.1: List of relevant policies, strategies & regulations

Type	Level	Name & Title	Description	Relevance	Need for action
Holistic climate-related instruments					
Strategy	Local	Klimaløftene - Municipal energy and climate plan 2023-2030	A holistic strategy for Trondheim's climate transition	Strategic backbone for Trondheim's CCC	Climate budget 2025
Action plan	Local	Climate budget	Annual action plan connected to the municipal budget plan	City-wide: GHG inventory reporting and scenario modelling, action planning Municipal: budget allocation	annual update: planning, action & reporting
Strategy	Local	Trondheimsløftet - Municipal master plan, societal section	A holistic strategy for Trondheim's development, based on UN SGDs	Connect climate neutrality with other societal goals, links of co-benefits	action & reporting
Strategy	Local	Municipal master plan - land-use section (KPA)	The legally binding mandate for land use of different purposes: housing, business and nature	6 guiding principles, covering climate-friendly transport patterns, densification of housing and area neutrality	pending for approval
Strategy	Regional	Sånn gjør vi det - Regional strategy for climate transition	A holistic strategy for climate transition in Trøndelag County	Multi-level governance and collaboration, within buildings, transport, capacity building	action & reporting
Law	National	Climate change act	A law about Norway's climate targets for 2030 and 2050 and reporting	to promote the implementation of Norway's climate targets in the transformation to a low-emission society by 2050	in force since 2018 and amended later with updated targets
Policy	National	Norway's Climate Action Plan for 2021–2030, Meld. St.13 (2020–2021)	National action plan for ETS, non-ETS and LULUCF sectors	An overview of policy instruments and schemes	following up
Policy assessment	National	The transition to low emissions – climate policy choices toward 2050 (NOU 2023:25)	A report by the Climate Committee 2050, showing what it will take for Norway to become a low-emission society by 2050.	'In a low-emission society, virtually all emissions have been eliminated for good.“ Adopting the “avoid, shift, improve (ASI)”	to be followed up in national policy

				model in various sectors.	
Acton plan	National	Green Book - the National government's climate status and plan	Climate budget at national level. Climate status and action plan delivered in connection to national budget	Starting first in the budget year 2023, this is an important instrument for Norway's climate management.	annual update
Guideline	National	National planning guidelines for climate and energy planning and climate adaption	A planning guideline for local governments extended from Plan and Building Act	Through planning, contribute to reduction GHG emissions and increased environmentally-friendly energy transition	under revision, public hearing until june 2024
Strategy	EU	European Green Deal (EGD)	Core EU strategy to fight climate change and achieve climate neutrality	EGD aims to transform the EU into a modern, resource-efficient and competitive economy	drafting Trondheim Green Deal
Policy/ regulation	EU	Fit for 55	A policy package enabling 55 % of GHG reduction by 2030	The preparatory path to meet the targets of the EGD	Most of this will come to Norway via EEA
Agreement	International	Paris Agreement	A framework for climate action by the whole world, to limit global warming to 1.5°C	Each country brings their own nationally determined contribution (NDC). Countries may cooperate to implement their NDCs.	In action, annual COP meeting.
Sectoral instruments for Trondheim's 5 focus areas *(local only)*					
Agreement and joint action plan	Local/ regional/ national	Urban growth agreement for the Trondheim region 2023-2029	6 municipalities, 1 county authority and 2 ministries sign this agreement and plan joint actions for sustainable urban mobility.	To enhance the integration of land use and transport policy for a national goal of zero growth in personal car transport. This agreement includes considerable state financing of projects for public transport, biking and walking.	Miljøpakken follows the actions up. This is a good base for SUMP?
Strategy	Local	Mobility strategy for Trondheim	A strategy for sustainable mobility solutions that meets the population growth and cuts 20 percent of car transport.	Prioritising walking, bilking and public transport and planning seamless mobility connection.	action & reporting
Strategy	Local	Environmental strategy for buildings and constructions 2023-2026	A strategy for climate and environment in the municipal buildings and urban	Addressing GHG emissions from planning, building and operation, and	action & reporting

			infrastructures	climate footprint from energy and material use.	
Strategy	Local	Municipal plan for waste management 2018-2030	A strategy for household waste, waste from the municipality's own operations and waste in public spaces.	Covering waste reduction, recycling of resources and waste management.	action & reporting
Action plan	Local	Action plan for sustainable value creation 2023-2027	Connected to Strategy for value creation in the Trondheim region.	Under "green competitiveness", circular and sharing economy is in focus.	action & reporting
Strategy	Local	Municipal plan for natural diversity 2023-2032	A strategy for responsible nature management, both preservation and restoration	Synergy between climate and nature. Enhancing climate resilience.	action & reporting
Strategy	Local	Municipal plan for agriculture 2024-2034	A strategy to ensure food security and promote sustainable food production	Addressing food security, sustainable value creation, GHG reduction and climate resilience.	action & reporting

Description & assessment of policies

Description of the current climate policy context

Climate transition in Trondheim is affected by the policy context at different governance levels: international, national, regional and local. Table A-2.1 summarises some of the most important instruments.

Think global, act local. The city council in Trondheim has been engaged with international policy movements. Our first climate and energy plan was adopted in 2001 in light of the Kyoto Protocol. The UN Sustainable Development Goals (SDGs) and the Paris Agreement pointed out the direction for our city development - both in Trondheimløftet (municipal master plan) and in Klimaløftene (the newly adopted energy and climate plan).

The EU is an important partner for Norway. The European Green Deal brings opportunities for front-runners for change. Various directives and regulations in the "Fit for 55" package are to be harmonised in the Norwegian juridical system through the EEA mechanism. The EU Climate Pact, launched by the EU Commission as a part of the European Green Deal, has specified priority topics (here is an overview). .Trondheim has been a signatory of the European Covenant of Mayors since 2014. In 2018 Trondheim became an EU Lighthouse City through the SCC1 Positive City Exchange (+CityxChange) project, which successfully demonstrated the application of the "positive energy block" concept in several areas of Trondheim.

Norway's target of reducing greenhouse gas emissions by 55 % by 2030 compared to 1990, and 90-95 % by 2050. These targets are statutory in the Climate Change Act. In 2023, Norway's GHG emissions were 9.1% lower than in 1990, showing that the climate transition needs to accelerate more rapidly in Norway. A recent report done by the Climate Change Committee 2050 "The transition to low emissions - Climate policy choices towards 2050" provides a good overview:

"*In a low-emission society, virtually all emissions have been eliminated for good. Policy must be based on this objective. The question is not which emissions should be reduced, but which minor emissions remain in 2050. Everything else must go.*" - Martin Skancke, Chair of the Committee.

Since 2022, the Norwegian government has made their annual climate budget (Green Book) connected to the national budget process. This is an important policy document for the municipalities to follow up, regarding which measures are prioritised, and how they are financed.

Trøndelag County Authority at the regional level is a key collaborator in Trondheim's climate transition, particularly in transport and mobility as they are in charge of public transport. Their climate strategy puts focus on buildings, transport, food production and nature-based carbon sequestration. Transport and agriculture are two important non-ETS sectors.

The most important local climate policy instruments for Trondheim Municipality are Klimaløftene, the municipal energy and climate plan, and the annually updated climate budget. The Department for Climate and Environment has the responsibility to lead the "plan, act, evaluate" process of these documents, in close collaboration with other departments in the municipality. The climate policy in Trondheim is deeply rooted in the municipal master plan, both the societal section and the land-use section. The climate transition requires systemic changes in various sectors that influence the citizens' everyday life. The connection to master plan and overall development goals may allow us to better elaborate co-benefits.

One major gap to be pointed out here is the difference in climate ambition by 2030 at different governance levels: Norway (55 %), Trøndelag (50-55 %), Trondheim (80 %). This may lead to a general lack of means, resources and legal framework to support Trondheim's climate transition. The Cities Mission and Climate City Contract puts focus highly on multi-level governance. There is definitely room for improvement and better coordination. The Urban Growth agreements (*byvekstavtaler*) in Norway provide a good example for possible models.

Existing policy mix for the five focus areas

In addition to the overall policy context, there are many other sectoral instruments that are relevant for Trondheim's climate transition. Here is a short description of the five focus areas of Trondheim's CCC. These areas are structured from both the emission domains in the Theory of Change framework and the 9 focus areas in the municipal energy and climate plan. In each of these areas or sectors, there is a mix of existing policies from different levels of governance.

<u>Energy systems</u>

The local policy for this focus area is covered in the municipal energy and climate plan. The key measures are within energy efficiency, energy flexibility and renewable energy production. As Norway's electricity is mostly produced from renewable sources such as hydro and wind, the decarbonisation strategy highly depends on electrification. The power supply system is currently highly centrally regulated. Through the +CityxChange project, Trondheim applied for dispensation and piloted mechanisms at the district level. Through public hearing of the national planning guidelines, Trondheim Municipality advocated for the municipalities' mandate for energy planning in the Plan and Building Act.

District heating in Trondheim is controlled through a concession from the Norwegian Energy Regulatory Authority (NVE-RME) to Statkraft Varme, a division of the renewable energy company, Statkraft. It is further mandated in the municipal master plan - land-use section that new buildings of more than 500 m2 within the concession zone should be connected to the district heating network. It is possible to apply to the municipality for exemptions from this rule. The use of CCS to significantly reduce emissions from district heating production has been analysed by the Norwegian Environment

Agency but is not currently part of national climate planning or policy. The Trondheim City Council adopted resolutions on the importance of this climate action, and a collaboration agreement between the municipal administration and Statkraft Varme was signed in 2023.

National level: the Energy Act, ."Energy for work - long-term value creation from Norwegian energy resources" - Policy White Paper Meld. St. 36 (2020–2021), Action plan for energy efficiency in all parts of the Norwegian economy (2023)
EU level: EU energy policy | REPowerEU (affordable, secure and sustainable energy for Europe)

Mobility and transport

At the national level, there are targets for the sale of new vehicles: in 2025 all new private cars and light vans shall be emissions free, by 2030 all new trucks and lorries shall be emission-free or biogas-driven. Although ambitious, these targets are not mandated by sanctions or a ban on sales of diesel and petrol vehicles, and are not in and of themselves enough to ensure a rapid enough transition to zero-emission vehicles to meet Trondheim and other Norwegian cities' emission targets. There is therefore discussion around other policy instruments, such as zero emission zones (see A.3 Barriers and opportunities).

The national policy of removing or significantly reducing sales and other taxes on the purchases of new zero-emission vehicles has perhaps been the most important driver of Norway's success in beginning the transition from petrol and diesel-based road traffic. In recent years, the national government has introduced sales tax on electric cars over a certain value, and plans are under consideration for introducing a distance-based road tax on electric vehicles, to replace the current fuel-excise duty. This may contribute to slowing the transition.

At the local level, the county, highway authorities and municipalities (Trondheim and 5 neighbouring municipalities) collaborate on implementing the Urban Growth Agreement (Byvekstavtalen). Through this agreement it is possible to implement exceptions or reductions in road tolls for zero-emission vehicles (it is common in Norway for transport infrastructure to be partially financed by a city-wide system of road tolls). Historically, zero-emission vehicles have been exempt from all charges. Recently, this exemption has been removed for private cars, with gradual increase to 70 % of the full toll charge under implementation. This was done to avoid an increase in private car traffic, and illustrates the tension between policy levers directed towards traffic reduction and those designed to encourage the transition to zero-emission technology (see also A3). For commercial vehicles, a full exemption remains for zero-emissions vehicles and large trucks. The city council has in 2024 adopted a policy of declaring a minimum five-year period for this policy, in order to reduce the financial risk for commercial actors investing in new technology. This policy lever will need to be agreed by the other actors in the urban growth agreement in order to come into effect.

The current mobility strategy for Trondheim was adopted in October 2022. The scope of this strategy is passenger transport, and includes a target of 20 % reduction in car trips by 2030. Feasibility studies about goods transport have been made, and some initiatives have been taken into action.

A further policy instrument set in place by the municipality itself is to require the use of zero-emission or biogas vehicles for all deliveries and transport services in municipal contracts (from 2025 for light vehicles and 2027 for heavy vehicles). This policy was adopted and announced in 2022 in order to give the market time to adjust. In the intervening period there has been a significant increase in the sale and leasing of non-fossil commercial vehicles in the Trondheim area.

For city buses, there is a mandate for all new contracts to require emission-free vehicles from 2025. This will apply next time Trøndelag County Authority enters a new contract period with public transport providers in 2029. There are however provisions within the legal framework for exemptions from this requirement if there are difficulties in powering zero-emission buses. Given the challenges

in providing enough power to drive the electrification of the transport and other sectors in Trondheim, this is one of the reasons it is important to look at the transport and energy contexts in tandem (See A3 and elsewhere).

National level: National transport plan 2022-2033
EU level: Mobility and transport | Transport under climate action

Buildings and constructions

Trondheim Municipality is one of the largest developers and of property managers in the city. Environmental strategy for buildings and constructions showcases how we position ourselves as a front-runner. Zero-emission construction has been an important measure. The municipality has exercised its power of procurement as a good starting point - the municipality requires a minimum of fossil-free construction sites, and favours emission-free solutions when evaluating bids in the tendering process. Going forward, policy innovation will be crucial. Tronndheim has in concert with other Norwegian cities actively lobbied over many years for municipalities to be given greater planning powers to enforce emission standards on private developers and the government has put forward a change in regulations in this direction for public consultation.

National level: Regulations on technical requirements for construction works (TEK17) - considered as the minimum requirements
EU level: Green buildings

Waste and circular economy

The municipal plan for waste management covers the waste streams the municipality is responsible for: household waste, waste from the municipality's own operations and waste in public spaces. This does not cover waste streams from business and industry. Trondheim Municipality has also a Food strategy which puts focus on reduction of food waste. Norway is the latest of the three Scandinavian countries to come up with a national strategy for a circular economy. In recent years, reuse and resource efficiency is noticeably becoming a growing trend.

National: National strategy for a green, circular economy (2021)
EU level: Circular economy action plan

Viable nature

In 2019, the Trondheim City Council declared a crisis situation for climate and nature. In December 2022, the UN Biodiversity Agreement came into place in Montreal with four goals and 23 targets. The Norwegian government is following up and working on a policy white paper and national action plan. We see increasing discussion about concepts and instruments like land degradation neutrality, restoration of wild areas, and nature budgeting. It is important to consider climate and nature issues in close connection. This was the common topic for the four major cities in Norway in 2024 during Arendalsuka, the largest political gathering in Norway held annually since 2012. In Trondheim, two municipal plans have recently been adopted, on natural diversity and agriculture. Both are highly relevant for viable nature in the urban environment. Nature-based solutions should also be considered and adopted in climate mitigation, as a long-term measure for establishing new carbon-sinks for offsetting residual emissions, and also as an adaptation strategy. The municipal master plan for land-use is currently being revised; the version presented by the administration includes provision for a target of land degradation neutrality within the city boundaries.

National: Plan and building act on land use
EU level: Climate and nature | Land use sector

Interlinkages - synergies and conflicts

The five focus areas are often interconnected and cannot be treated as silos, for example:

- The decarbonisation of the transport sector requires innovation and upgrade in the energy systems
- The building sector is a key area for implementing the circular economy, in addition to being an important arena for emissions reductions within the city itself
- The waste-to-energy plant in Trondheim incinerates waste and produces energy for district heating, providing thermal energy, reducing strain on the electricity sector and preventing the need for landfill with concomitant methane emissions; at the same time it is the biggest single emitter of greenhouse gases in Trondheim.

The decision-making in climate transition can often result in conflict of interests, policy dilemmas and needs to prioritise. Here are some examples we brought up in the municipal energy and climate plan:

- Trondheim is growing and we need buildings, energy production and other infrastructure. At the same time, we must take care of arable land and the natural environment for food production, carbon absorption and other natural benefits. Densification is today's practice, but how can we best safeguard health, well-being and quality of life in a denser city?
- Electrification of the urban infrastructure will lead to increased demand for both energy and power. Who should get electricity? Hospitals, battery factories or large data centres? Will electrification lead to higher electricity prices and energy poverty?
- Rapid restructuring of road traffic will require strict regulatory measures, such as tolls and parking restrictions. What about those who depend on a car in their everyday life? Moreover, much needed incentives for the adoption of electric vehicles can lead to rebalancing the incentive structure towards private car use and away from public transport, cycling and walking. Finding the right balance of policies that simultaneously reduce traffic while ensuring a rapid technological transition is a key challenge within the Norwegian urban context.

Assessment of the GHG emissions reduction potential and remaining gap

The CCC Action Plan addresses what actions are needed to:

1. Cut 80 percent of territorial greenhouse gas emissions in 2030
   a. compared to the politically adopted baseline year 2009
   b. compared to the latest available baseline year (2022), as stated by *NetZeroCities*
2. Compensate for residual emissions.

The estimations show that:

- For the 2009-2030 politically adopted scope 1 emission reduction target, the existing and fulfilled plans can potentially cut 42 percent of territorial emissions, while the additional actions in this CCC Action Plan (AP) can lead to a total 88 percent emission reduction (Fig. A1a, Table A-2.3a).
- For the NZC climate neutrality scenario (scope 1-3, 2022-2030), the Trondheim model shows that existing plans can cut 27 percent, while the CCC AP can give a total reduction of 78.5 percent (Fig. A1b, Table A-2.3a).
- For the NZC climate neutrality scenario (scope 1-3, 2022-2030), the NZC economic model does not differentiate between existing plans and CCC AP, but predicts a total emission reduction of 77 percent (Table A-2.3b).

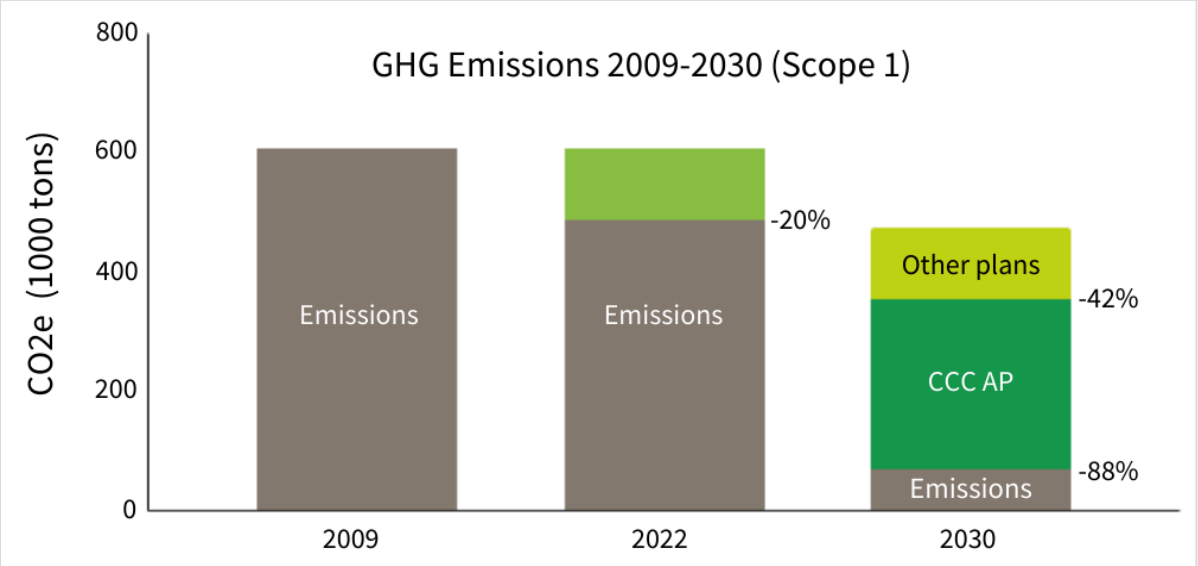


Fig. A1a: GHG emissions reduction potential - baseline 2009

Executed and planned scope 1 GHG reductions relating to the politically adopted goal to cut 80 percent of GHG emissions and become climate neutral by 2030, compared to 2009, according to the Trondheim model.

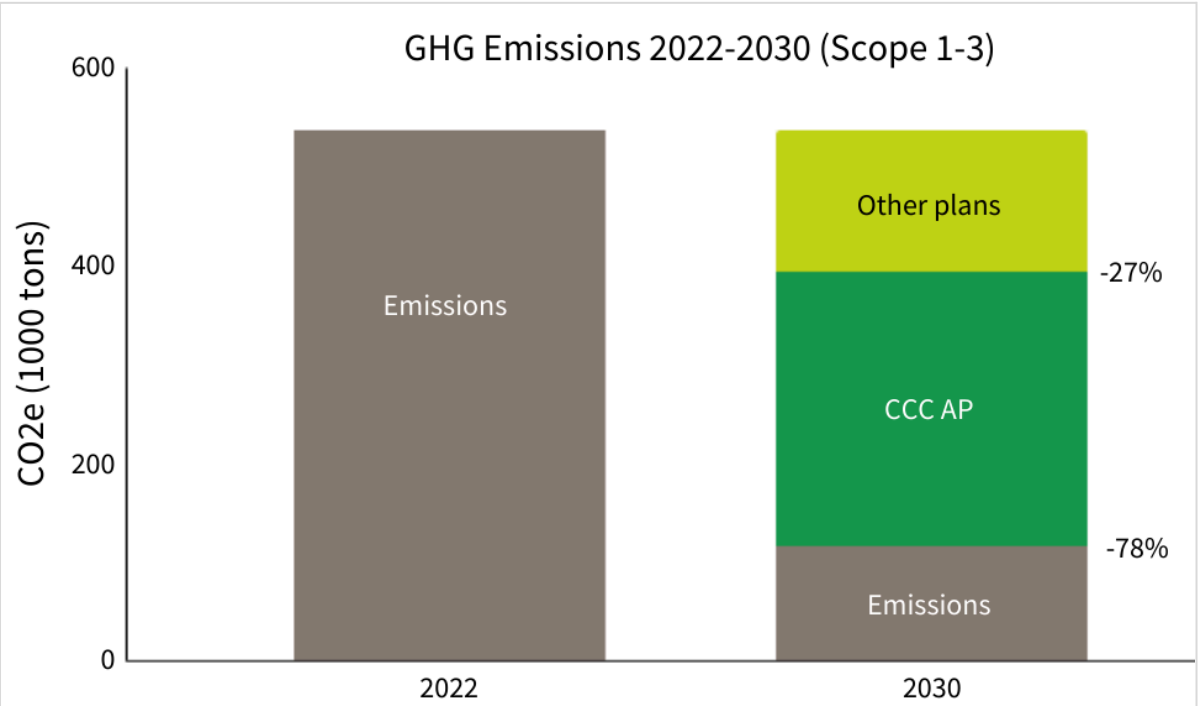


Fig. A1b: GHG emissions reduction potential - baseline 2022

Scope 1-3 planned GHG emission cuts in other plans and this CCC AP from 2022 to 2030, according to the Trondheim model.

NB. The NZC economic model does not differentiate existing plans from CCC AP, but predicts a 77 percent cut from 2022 to 2030 (scope 1-3).

The CCC AP will need to cut 38 percent and 231 thousand tons compared to 2009 and 53 percent and 286 thousand tons compared to 2022, including cuts in scope 2 and 3 (Table A-2-3a), according to the Trondheim model. Expected emission cuts from “other plans” are included in the annually revised climate budget or in a reference scenario for national policies, when they are ready for

implementation. Thus, they are not subject to double counting in the climate neutrality portfolio design (module B-2), which takes action following our baseline year 2022.

Comparison between the Trondheim model and the NZC economic model

Overall, the Trondheim model predicts an emission reduction of 78.5 percent (Table A-2.3a), while the NZC economic model predicts 80 percent (Table A-2.3b) from 2022 to 2030 (scope 1-3).

In the transport sector, which is the sector where we need economic estimations of widely shared costs, the Trondheim model predicts a 94 percent emission reduction, including sea transport according to GPC methodology. The NZC economic model predicts a 94 percent reduction, excluding sea transport. Sea transport represents approx. 25,000 tons CO2e in the baseline scenario (Table A-1.3a). Substantial emission cuts are made in sea transport both in other plans and in the CCC AP (10,000 tons CO2e, in the portfolio 3, Sea transport in module B-2.)

In the buildings sector, the results are wider apart. The Trondheim model includes most emissions from the electricity sector in the NZC economic model (about 50,000 tons CO2e), and emissions from machinery on building sites (app. 53,000 tons CO2e), according to GPC methodology. These emissions are in the “other” sector in the NZC economic model. Corrected for this, the results from the models differ about 15 percent in the baseline scenario. Still, the main action to cut emissions in this sector is to decarbonise the district heating system by CCS from the incineration of waste (action in CCC AP), and by phasing out fossil fuels (action in other plans). Thus, the economic estimations from the NZC economic model are not valid for the presented actions in this plan.

The waste sector of the two models differ in what they include. The NZC economic model includes GHG emissions from scope 3 estimated export of waste fractions. The Trondheim model contains scope 1 emissions from methane emissions from old landfills, sewage and biological treatment of sewage. Thus, these results cannot be compared.

Residual emissions

If the scenarios succeeds, Trondheim may cuts respectively:

- up to 88 percent of GHG emissions (scope 1) compared to 2009, leaving 71,000 tons of residual emissions, according to the Trondheim model (Fig. A1a, Table A-2.3a).
- up to 78.5 percent of GHG emissions (scope 1-3) compared to 2022, leaving 116,000 tons of residential emissions , according to the Trondheim model (Fig. A1b, Table A-2.3a).
- up to 77 percent of GHG emissions (scope 1-3) compared to 2022, leaving 115,000 tons residual emissions , according to the NZC economic mode (Table A-2.3b)l.

Module B-2 provides more details on the residual emissions in 2030 and how to compensate.

Table A-2.3a: Emission inventory - Trondheim model

Quantification of the emissions gap between existing plans and emission targets. Data: Norwegian environment agency*

A: Politically adopted emission reduction target for 2030, compared to 2009 (scope 1): 80 %

B: CCC emission target for 2030, compared to 2022 (all scopes): 80 % + offset residual emissions

	(1) Baseline emissions	(2) Emission reduction targets		(3) Emission reduction through other Action Plans**		(4) Emission Gap		(5) Emission reduction through the CCC AP to address the Gap		(6) Residual emissions to offset, compared to baseline	
		Cut 80 % from baseline year				(4) = (2) – (3)		% = (5 abs) / (1)		(6) = (1) – (3+5) % = 100 – (3) + (5)	
	Tons CO2e	Tons CO2e	%	(absolute)	%	(absolute)	%	(absolute)	%	(absolute)	%
Buildings	A: 272 918 B: 286 919	A: 218 335 B: 229 535	80	A: 71 750 B: 47 638	A: 26 B: 17	A: 146 585 B: 181 897	A: 54 B: 63	A: 177 490 B: 175 506	A: 65 B: 61	A: 23 780 B: 63 776	A: 9 B: 22
Transport (incl sea transport)	A: 268 095 B: 195 679	A: 214 476 B: 156 543	80	A: 164 040 B: 88 760	A: 61 B: 45	A: 50 436 B: 67 784	A: 19 B: 35	A: 97 770 B: 95 549	A: 37 B: 49	A: 6285 B: 11 371	A: 2 B: 6
Waste	A: 46 396 B: 36 634	A: 37116 B: 29 307	80	A: 17 485 B: 7724	A: 38 B: 21	A: 19 631 B: 21 584	A: 42 B: 59	A: 7340 B: 7240	A: 16 B: 20	A: 21 570 B: 21 670	A: 47 B: 59
Industrial Process and Product Use (IPPU)	A: NA B: 2546	A: NA B: 2036	80	A: 0 B: 0	A: NA B: 0	A: NA B: 2036	A: NA B: 80	A: 0 B: 0	A: 0 B: 0	A: 2546 B: 2546	A: NA B: 100
Agricultural, Forestry and Land Use (AFOLU)	A: 19 721 B: 16 541	A: 15 777 B: 13 233	80	A: 3507 B: 327	A: 18 B: 2	A: 12 270 B: 12 906	A: 62 B: 78	A: 0 B: 0	A: 0 B: 0	A: 16 214 B: 16 214	A: 82 B: 98
Total	A: 607 130 B: 538 318	A: 485 704 B: 430 655	80	A: 254 237 B: 144 448	A: 42 B: 27	A: 231 467 B: 286 207	A: 38 B: 53	A: 282 600 B: 278 295	A: 46 B: 51,5	A: 70 703 **B: 115 576**	A: (12) **B: 21.5**

* Please note that all historical data (here: 2009-2022) are updated every year, to avoid errors occurring from updates in methodology or data input in this nationwide inventory. Data from 2023 and onwards is from a comprehensive model made by CICERO and TØI on assignment from Trondheim municipality. The model is based on inputs from the nationwide inventory and additional data on planned actions in Trondheim

** A (2009-2030) includes historical emission cuts for 2009 - 2022 based on our annual inventory, and expected cuts through other plans for 2023 - 2030.

Table A-2.3b: Emission inventory - NZC economic model
Quantification of the emissions gap between existing plans and emission targets.

	Baseline emissions (BAU 2030)	Emission reduction from CCC AP		Remaining emissions		Residual emissions Offsetting*		Emission gap (necessary for net-zero)	
	(absolute)	(absolute)	(%)	(absolute)	(%)	(absolute)	(%)	(absolute)	(%)
Transport	161 000	152 000	94	9 000	6%	**9 000**	6%	0	0%
Buildings & Heating	158 000**	45 000	29	112 000	71%	55 000	35%	58 000	37%
Electricity***	56 000	0	0	56 000	100%	11 000	20%	45 000	80%
Waste	9 000	6 000	63	3 000	37%	2 000	20%	2 000	17%
Other (incl. IPPU & AFOLU)****	126 000	89 000	71	36 000	29%	25 000	20%	11 000	9%
Total***	509 000	292 000	57	217 000	43%	102 000	20%	**115 000**	**23%**

* Residual emissions consist of those emissions which can't be reduced through climate action and are being offset. Residual emissions may amount to a maximum of 20 % as stated by the Mission Info Kit.
** Comparison to Table A-2.3a: Includes district heating, but not off-road machinery (baseline: 53 000 tons CO2e) or emissions from electricity consumption (baseline: app. 50 000 tons CO2e).
*** Comparison to Table A-2.3a: *Electricity includes all electricity consumption, which is mainly in "buildings", but also in "transport" in Table A-2.3a.*
**** Emissions reduction target percentage for "Other" sector is assumed to be the same as for the other 4 main sectors unless updated by city. Activities and commitments to reduce these emissions are documented in the Climate Neutrality Action Plan.
***** Comparison to Table A-2.3a: The differences between scope 1 and scope 2 for the two models are primarily explained by the allocation of district heating to scope 1 in the NZC economic model. The lower total in the NZC emission model can largely be explained by additional waste data included in the native Trondheim model.

Module A-3 Systemic Barriers and Opportunities to 2030 Climate Neutrality

Module A-3 aims to document the conclusions of a systems and stakeholder mapping aimed at identifying systemic barriers and opportunities. In conjunction with the GHG inventory and the policy baseline analysis in the previous two modules of Part A, the analysis reported here serves as a basis for designing actions that address these barriers or exploit the underutilised opportunities in Part C.

Description of urban systems, systemic barriers, and opportunities

Description of main urban systems and systemic levers

To reach the goal of climate neutrality requires system changes in society. The system is a complex combination of various systems. The future's energy system, transport, living environment, consumption patterns and labour market are affected by politics and regulation, financial and investment trends, technology and not least people's behaviour and choices.

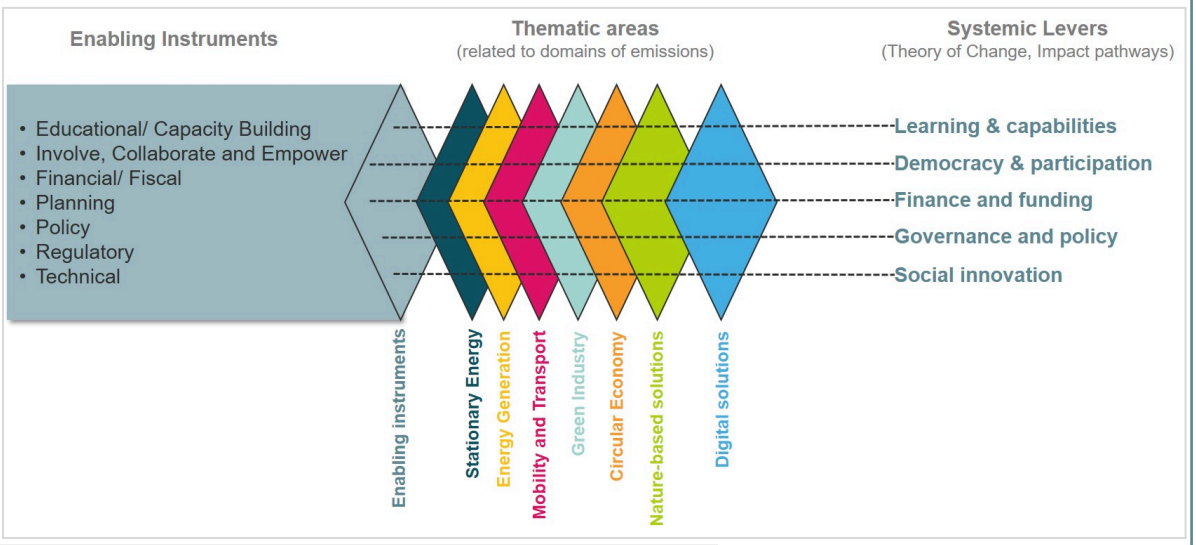


Fig. A2: Systems and systemic levers in the NZC Theory of Change

In order to drive forward the necessary system changes, we need to get a better understanding of the urban systems and what we have in our toolbox. During the revision of the municipal energy and climate plan, we worked on a knowledge base and did an exercise by highlighting the following tools, echoing the systemic levers of the NZC Theory of Change.

<u>Political instruments and legal framework</u>
This tackles the political and regulatory perspectives.
Political instruments in the form of both carrot and stick contribute to change, and the climate transition will require a good combination of these. As a planning authority, the municipality sets conditions for the city's development through spatial planning. However, current laws and regulations can also be barriers to the necessary energy and climate transition. In order to put in place a good framework for the low-emission society, the state, the regions and the cities must work together more closely.

<u>Finance and business models</u>
This tackles the financial and value-creation perspectives.

Who will cover the cost for climate transition, and how? The European Green Deal sets clear focus on sustainable finance, and the EU now has a taxonomy for investments in sustainable activities, which should also prevent greenwashing. Furthermore, there is a need for business models for green products and services, such as circular solutions that promote sharing and reuse. The municipality, with its great procurement power, must take the lead and set climate and environmental requirements that contribute to the necessary market transitions.

Research and innovation
This tackles both technological and social innovation.
Trondheim is recognized as a powerhouse for research and innovation. As a lighthouse city in the EU project +CityxChange, we have contributed several ground-breaking pilots. Innovation partnerships are crucial for climate change, and the municipality has established several strategic and long-term collaborations with NTNU and SINTEF. The city will be a living laboratory and test arena for energy and climate solutions.

Communication and awareness raising
This tackles the social and behavioural perspectives.
Good communication contributes to ensure that everyone in Trondheim makes good climate choices and prioritises sustainable and circular solutions. The municipality's annual climate survey provides knowledge about citizens' support for climate measures, as well as insight into self-reported behaviour. Through a varied selection of both digital and physical channels, we communicate with our own employees, partners and citizens to stimulate cooperation and behavioural change.

Collaboration arena and meeting place
This tackles the institutional and organisational perspectives.
The climate transition applies to everyone, and everyone must contribute. The municipality shall stimulate participation and co-creation. We will facilitate action-creating and binding collaboration arenas and meeting places for the city's business communities, researchers, organisations and citizens. Trondheim also participates in national and international networks for exchange of experience and interaction.

In addition, the systemic lever of Technology and infrastructure is also crucial. especially when Trondheim Municipality and many key stakeholders (see A-3.2) are responsible for planning, building and maintenance of various types of urban infrastructure. Digitisation and artificial intelligence in rapid development can be effective enablers of climate-neutral and smart Trondheim.

Barriers and opportunities in the Trondheim context

Here are some examples of **systemic barriers** at regulatory, financial and technological levels.

Regulatory: lack of regulatory powers. The probability of reaching climate neutrality by 2030 would be enhanced by either devolvement of legal mandates to the municipal level or changes to national regulation in order to create favourable local conditions for the climate and energy transition.

- The current Road Traffic Act includes the power to prohibit the use of specific vehicle technology from the road network. However, this power cannot currently be used locally to create “Zero Emission Zones”. After lobbying from the municipal level, the Norwegian Public Roads Administration produced a report on the subject where they concluded that devolving these powers would require changes to the law, but the national government has stated they will not follow this up in the current parliament.
- Similarly, the Norwegian Planning and Building Act mentions sustainability but provides no strong legal mandate for municipalities to be able to require that developers use

emission-free construction machinery. Here there has been some progress and regulations under the Pollution Act are currently under public consultation.

- At the national level the Energy Law, where the transfer of energy between buildings is limited, makes integration of local RES suboptimal and complicates the establishment of Positive Energy Neighbourhoods. The climate action with the largest single emissions reduction potential in Trondheim is CCS applied to waste incineration/district heating production. There is currently no national policy framework specifically directed at CC within this sector. State funding of CCS pilot projects has been limited to the industrial sector.

Financial: capital investment required for certain key climate actions.

- The owners of the waste-to-energy plant in Trondheim have estimated. Several hundred million euros are needed in order to implement carbon capture and storage (CCS). This project is also a good example of where climate action requires new business models and the development of large-scale policy frameworks to support these - new markets for sequestered carbon - especially for biogenic carbon, are required in order for the investment and running costs for CCS to be sustainable.
- Other smaller but collectively just as important capital investments are required, for example in electric construction machinery and heavy goods vehicles, together with the concomitant charging infrastructure.
- Recent changes in interest rates, the weak Norwegian currency and the generally uncertain economic outlook makes climate investments more challenging. This also applies at the level of the municipal administration itself, and the ability of the City Council to continue to prioritise climate action in the context of other pressing challenges, such as the need for health and social care provision to an ageing population.

Technological: how to scale up more rapidly? The technology for implementing most if not all of the climate actions required in Trondheim already exist, but there are challenges regarding the availability of these technologies and the time-scale for their uptake.

- Many stakeholders within the transport sector have reported long delivery times for electric commercial vehicles. Furthermore, the current throughput of new stock into the fleet of vehicles will make it challenging to reach a 100 % emission-ree fleet by 2030.
- This raises policy dilemmas around the themes of both sustainable consumption and a just transition. Policy seeking to increase the throughput of new vehicles into the fleet would in the short term increase consumption and the associated environmental footprint. Conversely, prohibiting any remaining owners of diesel vehicles from using their vehicles would from the perspective of some be tantamount to restricting their freedom of movement, independent of improvements in public transport.

Conflict of interests: the land use challenges. National/local policy has for many years been for urban densification. However, in a fast growing city with high demand for housing this can be challenging to implement in practice, including finding space for new zero-emissions infrastructure

Cross-cutting barriers: the example of electrification. For many if not most countries, the central and most pressing climate action is the decarbonisation of the electricity sector. Norway on the other hand has for many decades had ready access to plentiful electricity from hydropower. This ready access has however led to a large-scale reliance on electricity for heating, limiting the availability of electricity for use in the transport and other sectors that still require decarbonisation.

- This barrier is particularly acute in urban areas such as Trondheim where the challenge is not so much access to energy but rather to sufficient power when electric vehicles, machinery and infrastructure all require energy simultaneously. For example, the fully emission-free bus fleet that is currently at the pre-tender planning stage may require up to 25 MW of power in areas of the city currently poorly served by the electricity grid.

- Similar challenges face the harbour area, where greater access to shore power is urgently required to facilitate the electrification of shipping, in addition areas of Trondheim with a high concentration of logistics and delivery firms, where access to high-speed charging at the depot is deemed necessary by many of this stakeholders in order for a transition to electric vehicles to work.

When it comes to **opportunities**, here are some conditions for Trondheim to harness in order to achieve climate neutrality.

A strong cross-party commitment to climate transition: Trondheim has had a climate plan since 2001, through many local election cycles. In 2023, a left-orientated coalition was replaced by a coalition headed by the conservative party, Høyre. The political commitment to the climate transition remains high. The new energy and climate plan, Klimaløftene, was adopted by the City Council in April 2024 with broad support from across the political spectrum, and only one party voting against.

Support from the local population: Trondheim has been growing rapidly for several decades, and the population profile is young and highly skilled. The university and the surrounding commercial ecosystem attracts a high level of highly-skilled inward migration. Support for climate action is strong, with around 80 % of respondents expressing favourable views of the municipality's climate goals and the benefits these will bring to the city in the regular surveys mentioned above.

Favourable economic conditions: Wages levels and economic conditions in Norway are generally good by international standards, and Trondheim is no exception. Regional GDP growth has averaged around 3 % a year in the last decade, excluding 2020, providing a strong base for financing local climate action.

Renewable energy: Norway and Trondheim are net self-reliant on renewable electric energy, from wind and hydropower. In addition, Trondheim has a waste-to-energy plant providing district heating that covers one third of our heating needs, lowering the need for electric heating. Our transition shall put focus on energy saving and electrification.

Digitalisation: Trondheim, and Norway as a whole, are at the forefront of digitalization. This strong digital foundation provides significant advantages in accelerating the green transition through e.g. data-driven decision-making and smart energy management.

Research and innovation: The Norwegian University of Science and Technology (NTNU) and SINTEF, one of Europe's largest independent research organisations, are centres of excellence for climate transition. Trondheim Municipality is an active partner in many research projects and programmes, such as the Research Centre on Zero Emission Neighbourhoods in Smart Cities (FME ZEN) and the Norwegian Centre for Energy Transition Strategies (FME NTRANS).

Growing interest from the private sector: Trondheim Municipality has actively engaged with the private sector in the creation of both the municipal energy and climate plan and the Climate City Contract. A growing number of companies have made their own climate goals and sustainability strategies, and are keen to contribute to Trondheim's climate transition.

Climate team within Trondheim Municipality

The Department of Climate and Environment has the coordinating responsibility for planning and reporting of the municipal energy and climate plan. First and foremost, we should empower and mobilise our own municipal organisation. During the implementation phase of the previous municipal energy and climate plan (2017), one of the focuses was to increase the working capacity in other departments. This resulted in an enlarged climate team in Trondheim Municipality. The climate team is mainly spread in the organisational areas of “environment, business and transport”,

"city development" and "finance". This is to be reinforced in the new organisational structure after the parliamentary governance model was introduced in June 2024.

The roles of a Norwegian municipality are the following:

- Administrator of law and regulations
- Service provider (education, health care, technical services & more)
- Society developer

Taking a look at the Trondheim Municipality's annual report 2023, we may track these relevances for climate transition in the organisation. This overview is for us to leverage influence and co-benefits.

Table A-3.1 Overview of municipal functions in climate transition

Municipal function	Relevance in climate transition from the period goals
Upbringing and education	• co-creators of diverse meeting places
Health and welfare	• participation in work and social life
Sports and outdoor life	• a green city with varied nature
Business and procurement	• sustainable value creation • world-class innovation district • public procurement stimulating innovation and the development of circular solutions
Climate and environmental services	• clean water in the city's harbour areas • natural diversity • public health and noise level control
Transportation	• good health and active travels • space-efficient and environmentally friendly mobility services • mobility services that make business greener and more competitive
Planning and building services	• area-neutral urban development • a green and attractive urban environment • citizen participation and involvement
Technical services	• good air quality • good water, enough water and safe water • waste reduction, increased reuse and material recycling • management of household waste
Real estate services	• reducing direct and indirect greenhouse gas emissions • better environment and increased efficiency of property management

Key stakeholders in Trondheim's ecosystem of change

Partnership is the key to success for Trondheim's climate transition. A simple presentation was done in the EoI Trondheim delivered in January 2022. We follow the same structure and present a stakeholder mapping in the quadruple-helix manner in A-3.2. These are some of the most central stakeholders Trondheim Municipality are in contact/collaboration with for the time being. This list does not include an extensive list of private companies, the engagement of which is to be planned under the working title "Trondheim Green Deal". In addition, we shall explore initiatives with "financial institutions" for more bankable projects as part of the investment plan.

In addition to those in the local system, Trondheim should also strengthen collaboration with the national government and other cities in Norway and in the Cities Mission. The Ministry of Local

Government and Regional Development (KDD) is the national contact point for the Cities Mission. The Norwegian mission cities, Oslo, Stavanger and Trondheim, have had regular dialog meetings since August 2022. This cooperation is now strengthened with the involvement of DOGA, who has got the assignment from KDD to come up with concrete suggestions about a platform for municipalities. NetZeroCities has been resourceful to provide various types of exchange between mission cities.

Below is a map of stakeholders organised in the quadruple-helix manner. These are relevant actors Trondheim Municipality are in contact/collaboration with for climate transition.

Table A-3.2: Stakeholder mapping in quadruple-helix

Stakeholder	Focus area	Interest and influence
Public sector		
Trøndelag County Authority	all areas	Regional development, sustainable value creation, climate transition and public transport
Norwegian Energy Regulatory Authority (NVE)	energy	Promoting socioeconomic development and environmentally sound energy system with efficient and reliable transmission, distribution, trade and use of energy
Miljøpakken	transport	Promoting walking, cycling and public transport. One of 10 goals is to reduce GHG emissions.
AtB	transport	Planning, purchasing and marketing a provident public transport service
Norwegian Public Roads Administration (SVV)	transport	Developing efficient road systems that are accessible to all, and where transport does not cause serious damage to people or the environment.
Trondheim Harbour	transport	Operating and managing port areas on behalf of 14 owner municipalities, with environment and safety in consideration
Trondheim renholdsverk (TRV)	circular economy	Providing comprehensive and competitive waste and recycling solutions for citizens and municipal services.
County Governor in Trøndelag	nature & adaptation	State's representative in local counties. Climate and environment. Agriculture and food.
Innovation Norway Trøndelag	business & innovation	Helping Norwegian companies to grow sustainably and increase exports by providing access to competence, capital and networks.
Business and associations		
Statkraft varme	energy	Waste-to-energy plant. Trondheim's district heating started since 1982 and covers 30 % of heating needs today. Working on CCS at the facility.
Tensio	energy	DSO in Trøndelag, second largest in Norway. Preparing the future power supply in the Trondheim area and has several ongoing projects to strengthen and improve the power grid.
Trønderenergi, Aneo, NTE	energy	Energy producers, with focus on renewable energy resources such as hydro and wind.
Renergy	energy	Renewable Energy Cluster, facilitating high-value cooperation between parties and developing innovation projects and new energy business models.
Chamber of Commerce in Trondheim region (NiT)	business	Chairing Strategy for value creation in Trondheim region and promoting sustainability in their members by meetings, networks and projects
NHO Trøndelag	business	The Norwegian Confederation of Business and Industry. Prioritised political issues: infrastructure, competence,

		market access, business-friendly public sector, serious working life
LO Trøndelag	business	The Norwegian Confederation of Trade Unions. The labour movement plays an important role in ensuring democracy, economic growth and balanced redistribution for all citizens.
EBA Trøndelag	building and construction	Association of contractors in building and construction. Green transition in the construction sector.
MEF - Midt	building and construction	Federation for machine contractors. Green transition in the construction sector.
NLF - Region Trøndelag	transport	Federation for Norwegian truck owners. Green transition in the transport sector.
Trøndelag bondelag	nature	Association of farmers. Competence building for diverse and innovative agriculture in Trøndelag.
Research and innovation		
NTNU	all topics	Norwegian University of Science and technology. "Knowledge for a better world". Innovation district and campus development.
SINTEF	all topics	One of Europe's largest research institutes. "Technology for a better society."
Trondheim Tech Port	energy & digitalisation	Increasing Norway's innovation power through closer cooperation, starting with the actors in Trondheim.
NINA	nature	The Norwegian Institute for Nature Research (NINA) is Norway’s leading institution for applied ecological research.
NIBIO	nature	The Norwegian Institute of Bioeconomy Research. Food security and sustainable resource management.
Civic society		
Future in our hands - Trøndelag	circular economy	One of Norway's leading environmental organisations, promoting ethical and sustainable consumption.
Norwegian Grandparents Climate Campaign - Trondheim	all topics	A significant voice in the public debate on the state of Norway’s climate policy at home and abroad.
Friends of the Earth - Trondheim	all topics & nature	Environment and nature protection, through issues of area conservation, climate change, energy and transportation.
Forum for nature and outdoor life - Trøndelag	nature	A cooperation network between organisations for nature and outdoor life at regional level
Association of Cyclists - Trondheim	transport	Setting cyclists and pedestrians in focus for accessibility and traffic safety.

Part B – Pathways towards Climate Neutrality by 2030

Part B represents the core of the CCC Action Plan, shaped by local authorities, local businesses, and stakeholders, comprising the most essential elements: scenarios, strategic objectives, impacts, action portfolios and indicators for monitoring, evaluation, and learning.

Module B-1 Climate Neutrality Scenarios and Impact Pathways

Module B-1 first describes and contextualises the impact pathways, summarising their relationship with key priorities and strategic interventions and with the analysis developed in Part A and then list the impact pathways, selected from or inspired by the NetZeroCities Theory of Change, including early and late outcomes (strategic objectives) and levers of change structured along the fields of action.

Description of impact pathways

Impact pathways for Trondheim's climate transition

Five focus areas are identified, covering the main emission domains. These are also important aspects of the citizen's everyday life and the strategic impact pathways for systemic changes the municipality and other key stakeholders are to co-create.

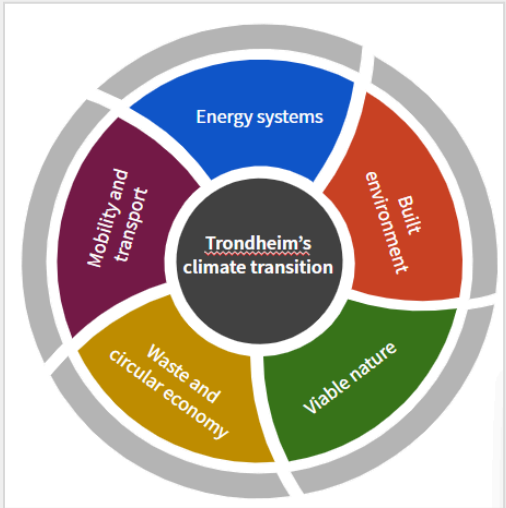


Fig. B1: Five focus areas in Trondheim's climate transition

Energy systems

Commitment: We will phase out fossil fuels, increase local renewable energy production, and utilise energy resources smartly and flexibly.

Where are we and why do we focus on energy systems?

The climate transition requires a swift shift from fossil fuel to renewable and emission-free energy sources. Norway is self-reliant on electricity, almost exclusively from renewable sources, but the demand for electricity will increase considerably, in order to phase out fossil fuels from various sectors, for example transport and industries. In Trondheim, the demand for electricity may rise up to 15 percent from 2022 to 2030, in order to phase out fossil fuels for actions in this action plan. Thus, access to sufficient electricity and grid capacity will be crucial for success. However, it takes

time to get new centralised power production and transmission capacity in place, and the facilities are often land-intensive and can lead to loss of nature or cropland. We must therefore create an integrated, efficient and flexible energy system that limits the demand for electricity and ensures enough renewable energy, with low use of nature and material resources, thus limiting indirect GHG emissions, costs and more - in line with *Klimaløftene*.

What about energy poverty?

Norway is self-sufficient in renewable electricity from hydropower and has had cheap energy for decades. Thus, “energy poverty” was a foreign concept until the European energy crisis in 2022. Unfortunately, “energy savings” has been a more or less foreign concept too - and in combination with the extremely strong Norwegian welfare system, the result is full coverage of the energy bill for households on welfare regardless of energy use. Actually, from 2022 *all* households are financially supported when the energy price exceeds a (low) threshold level. Still, there are support schemes for upgrading homes, but you need to own your housing and cover most of the expenditures. This combination of welfare and support schemes are problematic:

- The welfare and financial support on energy bills give most households little or no incentive to save energy.
- The support scheme for home upgrades favours high income households that generally have large, but energy efficient homes.
- Self-sustained low income households that *need* to save energy and improve their housing quality are *unable*: The support schemes for home upgrades are unavailable to them, since they generally rent their home and can’t cover the remaining bill for the home upgrade.

Trondheim needs to cooperate with other cities to address the shortcomings of the current situation at a national level.

How can we develop our energy systems sustainably?

- We need to save energy individually and as a society, and to ensure just energy transition.
- We need to reduce the use of electricity for heating purposes.
- We must map our energy systems and establish smart and flexible mechanisms in order to control and store energy, thus distributing the electrical power demand through the day and year. This will limit the need for more grid capacity, thus reducing the cost, material resources and nature degradation.
- We must produce more renewable energy - preferably in already developed areas.

What are the systemic levers in Trondheim’s energy transition?

- Technology and infrastructure: We must phase out fossil fuels from our district heating, realise CCS from waste incineration (the backbone of our district heating), establish infrastructure to store surplus heat and energy, strengthen our distribution grid and build more renewable energy in urban areas.
- Governance and policy: We need a national framework that encourages and enables local energy sharing/markets, and that speeds up the pace on e.g. solar energy. Then, we need to implement it locally.
- Social innovation: Test out local energy consultants from the grid owner Tensio, to distribute the power demand over time. Inform citizens on energy-smart solutions and test out how we can speed up the establishment of local energy production and flexibility.
- Democracy: Increase the understanding and engagement on energy and energy-related topics, like CCS, through communication.
- Finance and funding: We need to establish a business model that makes CCS from waste incineration economically feasible. This might also be a matter of national governance.
- Learning and capabilities: We must map our energy systems to fully integrate energy in the planning of a climate neutral and energy-smart city.

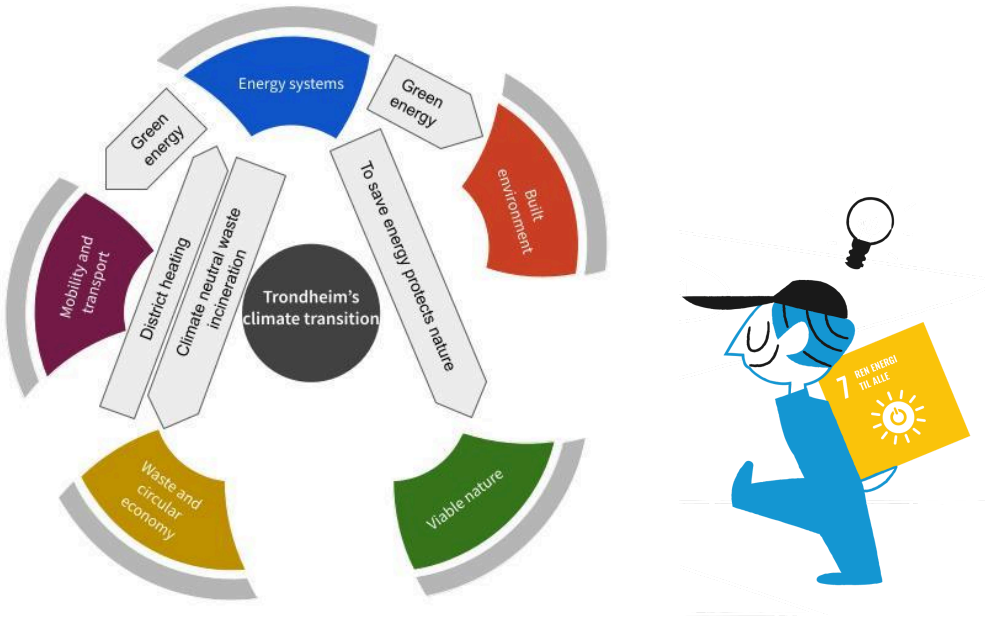


Fig. B2: Energy systems and other focus areas

How does this connect with other focus areas and desired outcomes?

The single most important action - making our district heating from waste incineration carbon neutral through CCS - is vitally important to cut emissions which could just as well be allocated to the impact pathway “waste and circular economy”. In addition, both district heating and other tools and actions that save electric energy reduce the need for new electric energy, thus reducing the pressure on nature and farm lands.

Combining energy, transport and area planning more closely will reduce the cost and climate footprint from transport and other infrastructure and also put lower pressure on nature and farm lands. Making the city more condense and walkable may also lower transport costs and provide other social benefits.

Finally, the energy transition literally fuels climate action - particularly in the impact pathways “mobility and transport” and “built environment” - by providing fossil and emission free energy for vehicles, vessels, machinery, buildings and construction sites. Together, the tools listed above can help us phase out fossil fuels in a just, energy-smart and resource efficient way, securing enough renewable energy for all at a reasonable price.

Mobility and transport

Commitment: We will streamline and modernise the transportation sector and make it practically emission-free.

Why and how do we focus on mobility and transport?

Transport is still the main emission source in Trondheim, despite a 30 percent cut in this sector since 2009. Transport is thus an important key to become climate neutral - and we have the technology and solutions:

- Technology: Norway and Norwegian cities are world leaders in adopting emission-free transport, from electric cars and trucks to ferries and high-speed ferries.
- National governance and policy, finance and funding: The Norwegian tax exemption for electric vehicles has made Norway an early adopter and test arena for electric cars and

trucks. National regulations making emission-free public transport mandatory both on sea and land take effect from 2025. Since 2023, zero emission cars and small trucks have been mandatory in public procurement.
- Governance and policy: There is a national-regional-local agreement - Miljøpakken - to limit car traffic and promote walking, cycling and public transport.

How are personal transport governed?

Through the national-regional-local agreement *Byvekstavtalen ("city-growth agreement")*, there is an action program *Miljøpakken* (see section A-2), where Trondheim and neighbouring municipalities aims for urban densification and have a goal of zero growth in car traffic, regardless of population growth. Despite strong focus on public and shared transport, walking and cycling combined with toll fees on car traffic, the traffic has increased slightly after the pandemic. Recently, the *Mobility strategy for Trondheim* (see section A-2) set an additional goal of reducing car transport in Trondheim by 20 percent compared to 2019 by 2030, to compensate for increasing regional transport. An upgraded tool kit to achieve this goal will be adopted through a new *Traffic plan for Trondheim* autumn 2024 or early 2025. It is expected that it will include toll fees on car transport to encourage behavioural change and provide funding for improved public transport services as well as infrastructure and other promotion of walking and cycling. Stronger regulations on car transport must also be expected. One important action will be implemented through national regulations on emission free public transport: The public transport services shall be improved and emission free from 2029.

Miljøpakken is in a special position: It is an existing policy with an adopted budget for 2024-2029, and thus the expected emission cuts are included in "other plans". However, since the *Traffic plan for Trondheim* - which will contain the actual actions to reach these goals - is yet not adopted, personal transport and regulation on car transport is listed in the impact pathway below. Miljøpakken is also mentioned as a portfolio, but no actions are included as they are under revision (and are considered an "existing policy", ref. module A-2). Key indicators are included in module B-3. The adopted cost framework and cost allocation between stakeholders is provided in table 7 in the investment plan. *Miljøpakken's* special position indicates that we will need to pay special attention to the coming action plan and its results on green personal transport.

What are the most important remaining challenges and opportunities?

We now have three challenges to reduce road transport and cut practically all emissions:
- Reduce car and truck transport by logistics optimization.
- Make the shift to emission free transport go even faster towards 2030.
- Make enough power available for electrification.

In Norway, we have a one-sided focus on a faster technology transition. This has a high cost that might create or reinforce social inequalities, and although it cuts direct GHG emissions in Norway, it requires non-renewable resources and generates indirect GHG emissions elsewhere during manufacturing. Thus, it is not ecologically, socially or economically sustainable. On the other hand, reducing the road transport will make the shift in technology less demanding, by covering the need for transport with fewer vehicles and less energy. Reducing the amount of transport in combination with a swift technology shift is in line with our targets in *Klimaløftene* - consuming less energy, materials and area in a fair climate transition.

How can we reduce emissions from transport, while still meeting our needs for transport?

- Governance and policy: To manage and limit road transport as a whole, the multi-level governance of Miljøpakken needs to address both personal transport and goods and utility transport. Miljøpakken should aim for local GHG emission targets.

- Governance and policy: Challenge national regulations, in order to adopt a zero-emission zone. Next, announce a zero emission zone for goods and utility transport a few years before implementation, to promote investments in streamlined zero emission transport.
- Technology and infrastructure: Find solutions and make infrastructure to support zero emission vehicles, and to streamline goods and utility transport, preferably through Miljøpakken.
- Social innovation: Make active, public and shared transport the default and preferred option.
- Social innovation: Promote a healthy and good lifestyle with less travel and consumption.
- Democracy and participation: Engage citizens and local businesses in initiatives to test and implement sustainable transport solutions.
- Finance and funding: Upscale emission-free and affordable public transport, and infrastructure for pedestrians and cyclists through Miljøpakken. Subsidise shared personal transport as well as infrastructure for emission-free and streamlined goods and utility transport through e.g. Miljøpakken as well as other local, regional and national funding.
- Learning and capabilities: Develop better practices through cooperation with research and development, and exchange best practice with other cities.

What about sea transport?

Sea transport is mostly a technical issue, and we have come far with hybrid public ferries from 2019. There is also available shore power for the Norwegian coastal route *Kystruten*. Remaining challenges are to make fully electric ferries and speed ferries, and the use of shore power and battery operation mandatory: Shore power must be made available for large cruise ships. This is mainly a question about infrastructure, (national) governance and funding. Infrastructure is the main local responsibility and the work is currently in progress. *Trondheim havn* - the local harbour - will address how to make more vessels able to use shore power. *Trondheim municipality* will continue to address the need for national regulations and financial support for new technology in vessels. Other potential contributors for reducing emission from sea transport towards 2030 are increased use of other fossil- or emission free fuels, energy saving technologies, technologies for carbon capture onboard vessels etc. From 2024 the Norwegian government has enforced a turnover requirement requiring a 6 % biofuel share added to the fossil marine fuel. The biofuel has to comply with sustainability criteria. It is also expected that the stricter environmental international governance and regulations (i.e. IMO, FuelEU Maritime etc) will contribute to reducing emissions from sea transport.

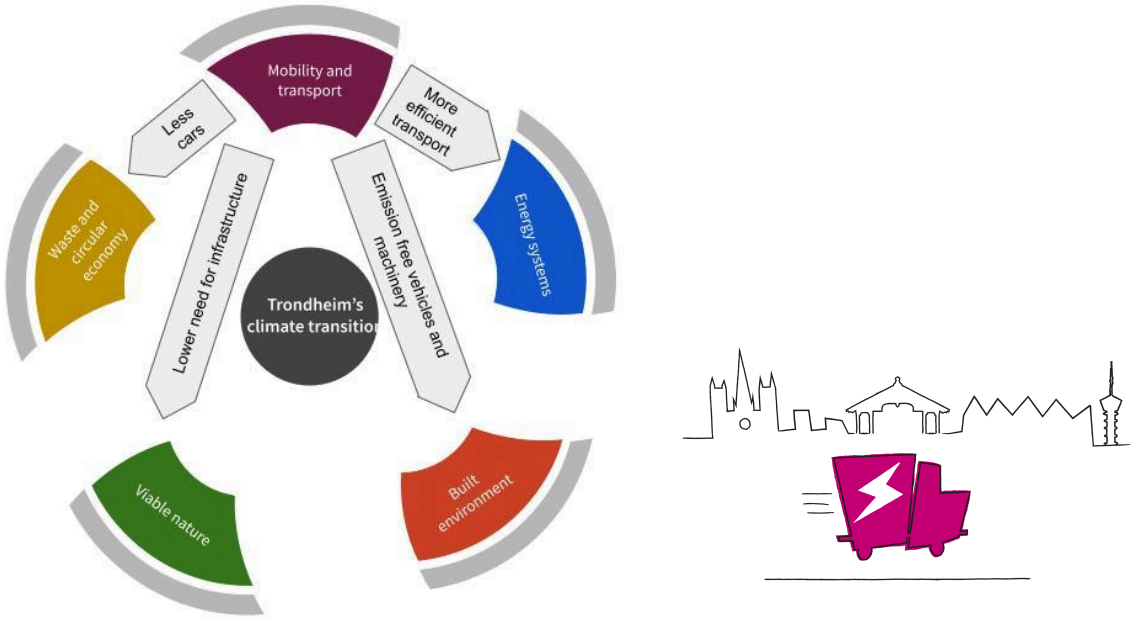


Fig. B3: Mobility and transport and other focus areas

How does this connect with other focus areas and desired outcomes?

Our goal to reduce car transport by 20 percent is combined with urban densification and improved infrastructure for public transport, walking and cycling. This makes the city more accessible, healthy and fair for everyone, while also protecting nature and farm land from urban sprawl in accordance with the impact pathway "viable nature".

Reducing car transport in favour of public and shared transport, combined with optimising truck transport will also save energy and materials, in line with the impact pathways "energy systems" and "waste and circular economy". However, the demand for *electrical* energy and effect will increase and should ideally be met by increased energy efficiency in the built environment. More reuse of building materials in the pathway "built environment" will contribute to reducing heavy duty transport.

In sum, co-benefits from this impact pathway include social benefits like increased accessibility for all, health benefits from active transport, improved traffic safety, preservation of nature and farmland, as well as reduced congestion, air and noise pollution.

Built environment

Commitment: We will develop buildings and infrastructure for a climate-resilient, emission-free, and circular future.

Why do we focus on the built environment?

The building and construction sector in Trondheim is responsible for:

- direct emissions from both construction and transport.
- indirect emissions from material and energy use.

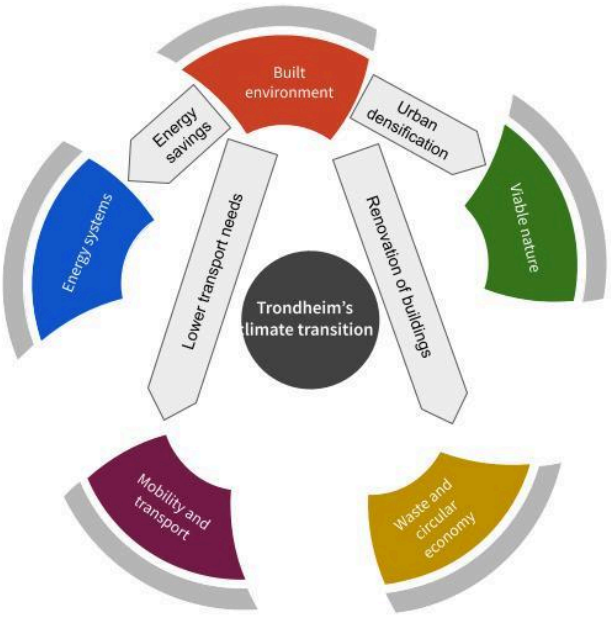
Our goal is to make this sector virtually emission-free, circular, energy-efficient and climate-resilient. We will take care of existing buildings and facilities, upgrade them sustainably and use them flexibly. When new construction is necessary, buildings and structures shall be designed for longevity, reuse, and a changing climate, and built with a low carbon footprint.

Where are we and where are we going?

- Along with Oslo, Trondheim is already requesting fossil and emission-free building and construction sites in our own projects. Practically all ongoing projects in 2023 were fossil free and most sites used at least some emission-free machinery. Our goal is that all municipal building and construction sites will be emission-free by 2025, while all sites city wide should reach this goal by 2030. This will require revising national regulations.
- Major municipal building projects must present climate budgets and cut at least 40 percent of their carbon footprint during the expected lifespan, compared to reference buildings representing national regulations. Our projects are ready for green loans. Our goal is to make the building and construction sector city wide more circular and resource efficient, by seeking to preserve, restore and upgrade buildings and constructions, or reuse building materials. Upcoming work on circularity in the built environment is covered in the impact pathway "waste and circular economy".
- The municipality's own net energy consumption shall be reduced by three percent annually, through upgrading energy systems, buildings and infrastructure, combined with energy production and storing in our buildings and infrastructure. This is an existing policy and not described further here.

How can we cut emissions and increase circularity further?

- Technology and infrastructure: Maintain and upgrade existing buildings, and use them more flexibly/ for more purposes.
- Governance and policy: Limit climate footprint for expected lifespan in area planning.
- Social innovation: The municipality will be a driver for establishing public and commercial reuse centres and platforms for building materials, elements, furniture etc.
- Democracy and participation, learning and capabilities: We will establish arenas and channels for closer dialogue with business actors and R&D, to find, share and effectively implement sustainable solutions.
- Finance and funding: The municipality's own projects will continue to receive financial support for emission-free, energy-smart and/or circular solutions. This support for procurement enables private actors to test and invest in green technologies and solutions.



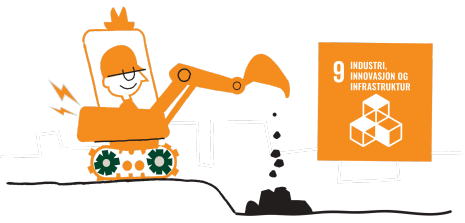


Fig. B4: Built environment and other focus areas

How does this connect with other focus areas and desired outcomes?

We have already observed that our focus on emission free construction sites has put life cycle analysis of emissions, energy and material (re)use on the agenda of the actors - in line with the impact pathways "mobility and transport", "energy systems" and "waste and circular economy". Please note that fossil free transport to and from construction sites; fossil free heating in buildings and on construction sites; and reuse of building materials are addressed in these three impact pathways. This is in line with *Klimaløftene* - cutting direct and indirect emissions, using less materials and energy, and supporting green jobs and businesses.

Next, life cycle analysis of buildings and construction sites in combination with urban densification leads to increased focus on efficient and flexible use of buildings and infrastructure. Besides protecting local nature from urban sprawl and global nature from overuse of resources, flexible use of areas can create new and better social arenas.

Other co-benefits from this impact pathways include less waste production and better working conditions due to less noise and air pollution on construction sites.

Waste and circular economy

Commitment: We will develop a circular city where we preserve resources and reduce our consumption.

Why do we focus on waste and the circular economy?

If everyone consumed renewable resources as we do in Norway, we would need 3.6 Earths, according to *Earth overshoot day* (*www.overshootday.org*). Our overconsumption is among the highest in the world. At the same time, The Circularity Gap Report has concluded that Norway is only 2.4 percent circular, and therefore among the least circular countries in Europe. This is a problem because of the amount of resources we use that also lead to waste, pollution and significant environmental destruction around the world, as well as an excessively large carbon footprint.

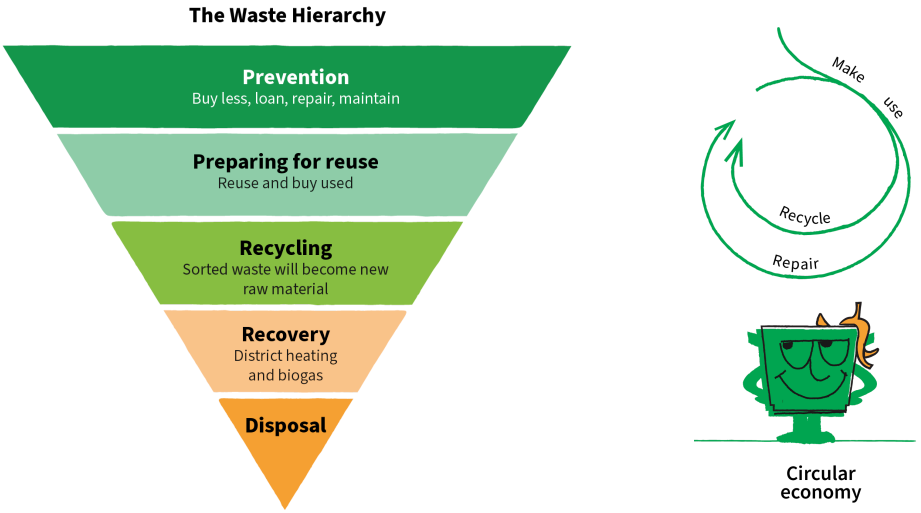


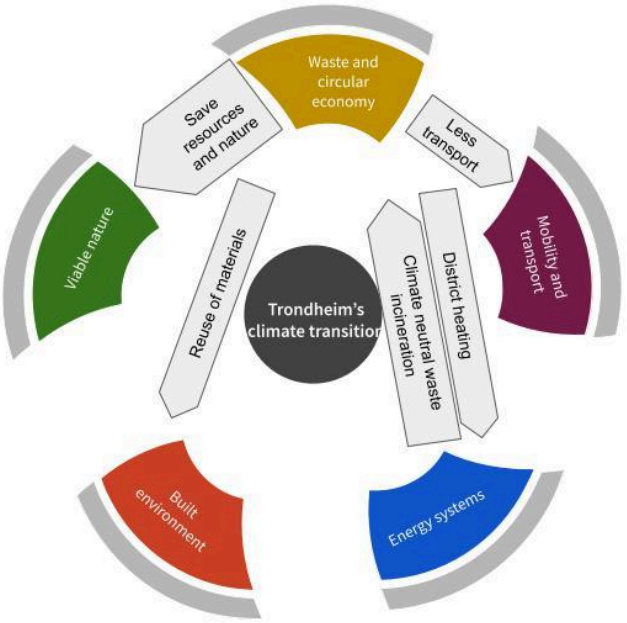
Fig. B5: The waste hierarchy and a rough idea of a circular economy.

What are we working on in Trondheim?

- Citizen involvement-activities to reduce consumption and increase knowledge about repair, and solutions for sharing, exchanging, thrifting and more.
- Set up a separate collection of food waste from households.
- Biogas and fertiliser from treating food waste.
- Improve the collection system for separate collection of glass and metals from households.
- Improve separate collection of textile waste.
- Increasing reuse of reusable household waste.
- Trade more reusable waste from households.
- Food loss projects in municipal units.
- Reducing food wastage from both households and the municipality.
- Sustainable procurement for all construction projects.
- A research project on reuse of load-bearing structures in municipal buildings.

How can we reduce our consumption and carbon footprint?

- Technology and infrastructure: Establish user-end sorting of food waste and establish a plant for post-sorting of plastic packaging and other waste fractions.
- Governance and policy: Public procurements must focus on dialogue with the market in order to set high, yet reasonable demands for circular and shared solutions in order to lower the carbon footprint and resource intensity.
- Democracy and participation: Involve organisations for nature and reduced consumption in our work to engage the citizens on these topics. Educate children on topics related to the waste hierarchy and circular economy.
- Social innovation: Public and private actors should offer - and consumers use - circular solutions where we share, borrow and fix things to make the most out of our common resources. For instance, we are planning to establish a marketplace for used building materials for private and public actors.
- Finance and funding: Waste treatment is financed by the waste owner, who must expect increasing costs on residual waste. Public procurement will help create and support circular solutions markets. Applying for various fundings (Inter regional, national, regional, from research organisations, EU, from organisations and more) will be necessary to be able to do research, test and work together.
- Learning and capabilities: We will explore how we can gain resources and workplaces efficiently within a circular economy. Amongst others we will conduct close and active collaboration with the university and institute sector, startups, innovation hubs and industries, to drive forward new circular business models.



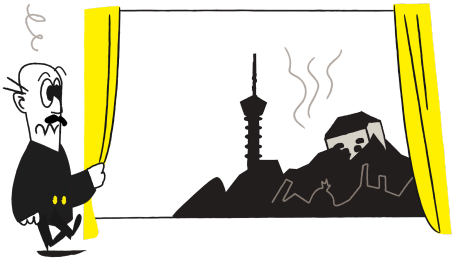


Fig. B6: Waste and circular economy and other focus areas

How does this connect with other focus areas and desired outcomes?

The focus on waste reduction and circular solutions is particularly strong in the municipality's work on construction sites, due to the extreme amounts of materials used in this sector. Please note that this portfolio of actions is addressed here, and not under "the built environment".

In contrast, the efforts to make the waste treatment climate positive, are handled in the impact pathway "energy systems". This is because the main action is to implement CCS at the waste incineration plant, which is the backbone of Trondheims district heating system.

All transport of household waste will be fossil free by 2025 in line with the impact pathway "mobility and transport". This policy is implemented through the current waste plan (module A-2).

Reducing residual waste and promoting reuse, repair and other circular solutions is in line with Klimaløftene, The Action Program for Sustainable Value Creation, The Waste Plan and EUs Waste Framework Directive: We need to follow the waste management hierarchy and focus on reducing our consumption and reuse and repair our stuff in order to stop wasting resources. This cuts our climate and nature footprint, in line with our impact pathway "viable nature". Furthermore, it creates social benefits, by lowering the social pressure on consumers, as well as creating social arenas and jobs through sharing, fixing and repairing.

Viable nature

Commitment: We will preserve and restore nature and its resources, make it resilient to climate change, and increase the overall carbon stocks.

Why do we focus on a viable nature?

Land and nature are limited resources, and how we use them affects both greenhouse gas emissions and their absorption. Building on our nature is like cutting the branch we're sitting on: it weakens both biodiversity and the ecosystem services we depend on, such as clean air, food, water, and other natural resources, as well as the absorption of greenhouse gases and flood and

erosion control (Fig. B7). Preserving nature is therefore crucial to how climate-resilient our society can become.

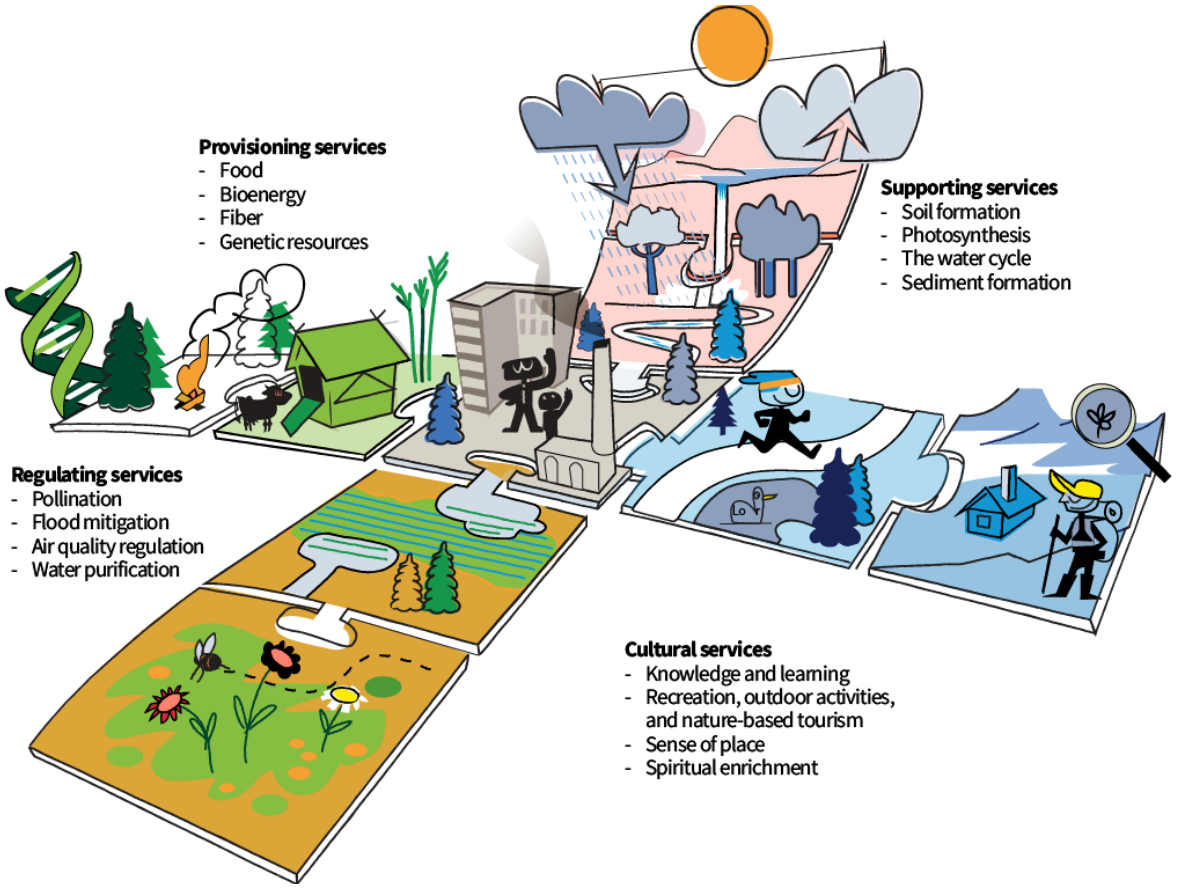


Fig. B7: Examples of ecosystem services that we rely upon

Where are we - how viable is our nature?

- Globally, in addition to *nature loss and degradation* caused by land use changes, our nature and environment is threatened by *global warming*, *pollution* and *overuse of resources* in what is known as the nature and climate crisis.
- Locally, we still lose, or *destroy,* nature and farmland bit by bit every year. Land use changes are the main cause of biodiversity loss. When we develop infrastructure on carbon-rich areas such as forests, wetlands, and farmland, the uptake of greenhouse gases stops and the existing stores are released to the atmosphere. We are also losing red listed ecosystems and habitat types: For instance, about half of Trondheim's ravines are already lost, but the filling, levelling and urbanisation persists.
- Huge parts of the harbour had to be cleaned due to *littering and pollution* in the project *Renere havn* (2011-2016).
- Trondheim's urban forest *Bymarka* has historically been cut clear of trees due to *overuse of this resource*. It is now reforested, but partly with monocultures with limited biodiversity.
- Norway and Trondheim have now, to a large extent, out-sourced the overuse of resources to other parts of the world: According to *Earth overshoot day* (*www.overshootday.org*) the world's annual production of renewable resources in 2024 is depleted by August 1. It would be depleted on April 12, if the world's population used resources like Norwegians do.

Global warming, land-use changes, pollution and overuse of resources lead to what is collectively known as *the nature and climate crisis*, acknowledging these crises must be addressed together.

How can we address the nature and climate crisis collectively in Trondheim?

- Governance and policy: We must make nature, farmland and area neutrality a key priority in our area planning. We will follow up our municipal plans on biodiversity, agriculture and climate adaptation, for example by mapping land use, assessing carbon stores and identifying areas with potential for nature restoration.
- Democracy and participation: Involve organisations for nature, agriculture and reduced consumption in our work to engage the citizens on these topics.
- Social innovation: Raise awareness on the importance of a viable nature and farmlands locally through e.g. restoration of nature and urban farming. Raise awareness on the global climate, nature and resource footprint of our consumption, for sustainable consumption.
- Finance and funding: We need to show the real cost of building on farmland and in nature. In addition, we need to raise (more) public and private funding to restore nature and decarbonize the agricultural sector.
- Learning and capabilities: Trondheim aims to become a regional resource centre for restoration of nature and sustainable agriculture.

These actions will help implement key elements like area neutrality, increased carbon storage and climate resilience in Trondheim as stated in *Klimaløftene*.

How does this connect with other focus areas and desired outcomes?

To combat the nature and climate crisis and maintain a range of crucially important ecosystem services (Fig. B7) for the future, we must make preservation of nature and farm lands the core of our area, energy and transport planning locally. Our impact pathways on “energy systems” and “mobility and transport” addresses this.

Furthermore, we must radically reduce our overconsumption of natural resources to limit our carbon and nature footprint and make our contribution to stop the loss of nature and biodiversity globally. Our impact pathway “waste and circular economy” focuses on this. It also includes actions to reduce overconsumption in the impact pathway “the built environment”.

Preserving nature is very important for a just transition locally and globally, due to ecosystem services ranging from clean air, food, water and energy for all; to resources, energy, inspiration and knowledge that generates jobs and businesses.

The illustrations above are designed for Klimaløftene, by Klipp og lim AS.

Table B-1.1: List of impact pathways					
Fields of action	**Systemic levers**	**Early changes** (1-2 years)	**Late outcomes** (3-4 years)	**Direct impacts** (GHG emission reductions)	**Indirect impacts** (co-benefits)
All	Governance & policy	Create a functional national cities mission platform.	An efficient framework for a just energy and climate transition across sectors	NA	Reduce energy poverty Create green jobs National policy upgrades
	Social innovation	Citizen science	Increased nature and climate awareness, engagement and activity among citizens and business and research actors Increased knowledge on how we can accomplish a just climate transition fast Increased green jobs and value creation		Acting in the face of the climate crisis preserves our mental health. Local engagement can create unity and other social benefits. Green jobs and value creation
	Democracy & participation	Participatory activities like citizen panels. Increase cooperation with and between NGOs. Increase cooperation with and between business actors.			
	Learning & capabilities	Communication campaigns Citizen science Research projects			
Energy systems	Technology & infrastructure	Collaborate with industry actors through the Trondheim Green Deal to focus on phasing out fossil fuels. Encourage citizens on how they can take part in the energy transition through Trondheim Green Life	Plans for CCS on waste-to-energy plants are ready. Plans on how to phase out fossil fuel at small and medium sized industry facilities. Upgrades of hydropower plants are in progress.	Trondheim model: 125 400 tons CO2e NCZ economic model (buildings and heating, not including 90 500	Emission-free district heating - which accounts for around 1/3 of Trondheim's heating needs. Negative emissions compensate for around

		Seek social and political acceptance for CCS through the Pilot City Programme on CCS.	Licence is granted for upgrading power lines and grid stations. Construction sites and buildings phase out fossil gas for heating purposes Implement energy solutions that save energy and strengthen the energy system. See also “Cross-sectoral actions”. A test arena for energy has been established in Trondheim.	tons CO2e from CCS at the waste-to-energy plant): 45 000 tons	130 thousand tonnes of fossil emissions. Make electric energy accessible for everyone in the green shift Technological developments
	Social innovation	Pilot projects for local energy production and flexibility. Collaborate with industry actors through the Trondheim Green Deal to focus on phasing out fossil fuels. Encourage citizens on how to take part in the energy transition through Trondheim Green Life.	Smaller industries and enterprises corporate in the Trondheim Green Deal to phase out fossil fuel. Develop methods to interact with and motivate behaviour change in target groups.		New business models Increased unity in neighbourhoods, social sustainability and inclusion. Lower energy and transmission costs
	Democracy & participation	Through the Pilot City Programme on CCS, citizen assemblies will provide a broader perspective on the challenges and opportunities that CCS represents for the inhabitant. Use the Trondheim Green Life as a channel for citizens to get insight and share perspectives on city-wide energy actions like the upgrade in the electricity grid. Encourage citizens on how they can take part in the energy transition in their daily life through Trondheim Green Life.	Increased participation for climate measures based on experiences and lessons learned from CCS. Increased interest and more initiatives among inhabitants and local companies for renewable and local energy production, and also smarter usage of the produced energy. See “Cross-sectoral actions”. Smarter energy usage and reduced load demands on the grid, has created smaller peaks and more balanced usage of energy. See “Cross-sectoral actions”.		Develop better processes and procedures for participation. Both increase, and maintain, trust in our society.

	Finance & funding	Data collection to perform a preliminary investment decision for CCS at the incineration plant in Trondheim. Finance power lines. Challenge national authorities on financial solutions that increase energy efficiency and lower the energy bill for low income households. “Green loans” become more available as banks and finance institutions integrate the taxonomy in their business	Final investment decision for CCS at the waste incineration plant. Financial solution to phase out fossil fuel et Rockwool Financial solutions for energy efficiency for low income households are established at the government level. New business models are developed that promote local energy production, flexibility, and efficiency. Citizens, neighbourhoods and businesses invest more in local energy production and smart energy use.		CCS: Emission-free waste incineration for much of central Norway Contribute to the establishing of regional and national value chains. New jobs and workplaces New cooperations between actors, which might not have occurred without the energy transition. New business models
	Learning & capabilities	Integrate capacity and bottlenecks in the energy system in the city’s digital maps, along with other geographical data related to urban planning, by performing an energy analysis. Cooperate with research actors on issues like how to address energy poverty.	Urban development at various scales aim to implement energy solutions that save energy and strengthen the energy system. Coordinated development of the energy systems and local energy sources and storage. Accelerate our governmental capacity to overcome other key barriers to become a climate neutral city.		Increased energy efficiency and utilisation of local energy sources according to local possibilities and constraints. Avoid inefficient investments in energy systems.
Mobility & transport	Technology & infrastructure	Strengthen infrastructure for pedestrians and cyclists in already built areas.* Expand charging networks. All taxis and practically all new cars are emission-free. Emission-free speed ferries	Zero-emission city buses are getting implemented for 2029.* Support establishment of charging and fueling infrastructure for emission-free energy carriers for both land and sea transport. Replaced infrastructure for fossil fuel with infrastructure for renewable fuels.	Trondheim model: 97 800 tons CO2e, including sea transport. (please note considerable emission reductions in	A more safe, healthy and livable city, without compromising nature. Better mobility and transport services Efficient use of space, energy and resources Tech development

			Improved infrastructure and flexible use of the grid. Practically all vehicles are emission free. City logistics hub pilot. Emission free ferries are on track for 2029. Shore power for cruise ships is on schedule for 2030.	other plans in table A-2.3a) NCZ economic model, not including 10 000 tons CO2e from sea transport: 152 000 tons CO2e (please note that this is compared to a BAU scenario, excluding the effect of other plans).	
	Governance & policy	Regulated parking for car-sharing - upscaling.* Collaborate with other cities to improve the national framework on green mobility and transport. Emission free transport required in public procurements. All public procurements which require transport are now using emission free vehicles. Electric speed ferries. Investigated zero-emission zones and streamlined city logistics. Challenge state and regional governments to maintain benefits and develop infrastructure for emission-free transport, as well as allow zero-emission zones for climate reasons. Created restrictive policies on fossil fuel vehicles.	Good progress reducing car traffic 20 % by 2030.* Created a parking plan for car-sharing.* Green and socially fair regulations and politics on mobility and transport. See “Cross-sectoral actions” Benefits for emission free transport are maintained nationally, regionally and locally. Restrictive policies on fossil fuel vehicles. We are allowed and ready to implement zero mission zones. All municipal vehicles that can be emission-free are emission-free. Public procurement must only utilise emission free transport. Mandatory use of available shore power for compatible ships.		Inspire neighbouring municipalities. Influence national politics in a climate-friendly and fair direction. Reduce the risk of accidents for other road users. Improved mobility accessibility for non-drivers. Demanding emission free transport in public procurements contributes to increased predictability for the market.
	Social innovation	Promotion and upscaling of active and public transport to work.*	Increased amount of people commute by walking, bike, other emission free micro-mobility		Health benefits. Increased safety.

		Financial incentives for not using car (hjem-jobb-hjem).* Piloted and experimented with urban logistics to find good strategies to increase efficiency.	or use public transport.* Increased amount of children walk or bike or use public transport to school.* Goods and utility transport are reduced in the city centre. Test new market models where city logistics with collaboration and sharing via hubs etc. become cost effective.		Lower energy use. Less noise and pollution. Increased amount of co-creation that enables new business opportunities and models.
	Democracy & participation	Organise new ways of participation Discussed and planned sustainable transport solutions Evaluated RnD project and pick the best practices for participation	Have established a citizen assembly on climate and environmental issues, where the citizens come up with action points and tasks. See also “Cross-sectoral actions”. Implemented systems for ongoing public feedback on transport initiatives, including zero emission zones. Engaged local businesses in initiatives to reduce transport emissions. See also “Cross-sectoral actions”.		Participation can give social and health benefits. Good participatory processes will strengthen the overall trust in our democracy.
	Finance & funding	Tolls and parking fees* Secured government funding for research, development, and deployment of sustainable transport technologies. The municipality continues financial incentives for businesses and individuals to adopt emission-free transport options.	Local and national financial support for emission-free transport are maintained and strengthened. Practically all vehicles are emission free.		Job opportunities New knowledge Innovations
	Learning & capabilities	Facilitate the exchange of best practices between municipalities and	New knowledge from the research and development community is applied in the mobility		Avoid inefficient investments.

		countries. Involve the research and development community.	and transport sector. Implemented learning from other cities.		Students can get a better understanding of a zero emission lifestyle by using the city as a living lab.
Built environment	Technology & infrastructure	Procurement continues: The municipality's own building and construction projects must be emission-free by 2025.	Heading towards emission-free construction sites city-wide by 2030, including related transport. Better technology and lower cost on emission-free machinery.	Trondheim model: 53 500 tons CO_2e. NCZ economic model: Does not evaluate actions on emission free construction sites/ machinery.	Technological developments Reduce restructuring risk for commercial actors. Less noise and air pollution
	Governance and policy	Promote a green and fair framework for climate transition through the national cities mission platform.	A green and fair framework for climate transition is formed through the national cities mission platform. See "Cross-sectoral actions". All public projects require emission free construction sites. Local authorities are allowed to demand emission-free private construction sites. Limit climate footprint for expected lifespan in area planning.		Influence national politics in a climate-friendly and fair direction. Reduce noise and air pollution at and near construction sites. Reduce consumption
	Social innovation	See "waste and circular economy".	See "waste and circular economy".		See "waste and circular economy".
	Democracy & participation	Start to create arenas for close dialogue with businesses.	Knowledge arenas for the construction industry are established to streamline emission free construction sites and circular solutions - see also "waste and circular economy" and "cross-sectoral actions.		Lower risk for small and medium-sized enterprises to invest because we have led the way by investing in emission-free technology.

	Finance & funding	Test different subsidy schemes for emission-free buildings and construction machinery	All public procurements require emission free construction sites. Emission free and circular construction sites are streamlined and cost effective.		By investing in emission-free machinery, businesses benefit from longer lifetime and lower operating costs of the machines.
	Learning and capabilities	Collaborate closely and actively with knowledge environments and the industry to drive forward new solutions.	Arenas for sharing experiences and knowledge in the industry.		Learning across sectors to find solutions that are flexible and sustainable.
Waste & circular economy	Technology & infrastructure	The SESAM plant: Plan created for location, regulations and investments in a mixed waste sorting plant to increase material recovery. Food waste: Mandatory food waste collection - upscaled to all households. Glass and metals: Improve collection system at inhabitants homes. Plan, project and rebuild buried waste solutions for better sorting by source. Reuse: Standardisation for reuse-mapping. Open marketplaces for marketing of the reused materials. More cost effective re-documentation methods. The "From waste to resources" portfolio working on projects that can contribute to a circular economy.	Started construction of the SESAM mixed waste sorting plant. Increased collection of food waste, plastic packaging, glass and metals. More waste from households is reused. More reuse of buildings and materials from buildings and constructions. Implementation of new or improved systems for waste sorting, material recovery and increased circular economy. Achieved climate positive waste treatment for 2030 (see "energy systems").	Trondheim model: 7300 tons CO_2e. NCZ economic model: 6000 tons CO_2e. Please note that none of the models quantify reductions in scope 3 emissions resulting from city-wide reductions in resource consumption.	Increased circularity and material recovery. Increased value creation, business development and green jobs. Improved waste management: Production of biogas and biofertilizer. Lower emissions from the waste-to-energy plant.

		Avoid demolishing of buildings, and facilitate multi-use and reuse of buildings Achieved fossil fuel free waste transport by 2025.			
	Governance & policy	Promote a green and fair framework for climate transition through the national cities mission platform. Household waste: Plan created for new or improved systems for source sorting and material recovery. Textiles: Investigated and piloted how to collect and/or recycle textile waste and reusable textiles in accordance with upcoming EU requirements. Textiles: An interregional project (Norway-Sweden). Used innovative procurements and strategic use of our purchasing power. E.g. framework agreement for used furniture within the municipality Reuse centre: Increased amount of reuse of building materials and furniture in both public and private buildings. Promote policies on conservation and renovation of buildings and constructions, to avoid demolition.	A green and fair framework for climate transition is formed through the national cities mission platform. See “Cross-sectoral actions”. Less waste produced. See also “Cross-sectoral actions”. Increased reuse from the recycling centre and local recycling stations. SESAM: Secured land areas regulated to industrial development and investments. Household waste: Improve systems for source sorting and material recovery to increase collection of food waste, plastic packaging, glass and metals. Regulatory changes: EPR (Extended Producer Responsibility) for clothes/textiles. Market stimulation to develop a circular market for building materials and furnitures. Policies on conservation and renovation of buildings and constructions, to avoid demolition.		Influence national politics in a climate-friendly and fair direction. Reduced consumption. Improved waste management. Increased circularity and upcycling. Less residual waste. Lower emissions from the waste-to-energy plant. Improved air quality. Green jobs and value creation.
	Social innovation	Promote and develop new solutions for repairing, reusing, sharing and borrowing.	More local businesses offer - and more residents use - repair services and other circular solutions. See also “Cross-sectoral actions”.		Residents and local businesses: Increased

		Local recycling station with new services, including the pilot of a local recycling station in dialogue with the local population and their needs. Continued education of children in school on topics related to the waste hierarchy and circular economy. Approved action plan for reducing food loss in the municipality's own units. Create a public and commercial reuse centre for building materials.	End pilot on local recycling station: Evaluate, improve and/or upscale to new/more locations. Continued educating children in school on topics related to the waste hierarchy and circular economy. Finalise plans for SESAMs as a competence centre for citizens. Less food waste. See also "Cross-sectoral actions". Contributed to the development of a marketplace for recycled materials, actively utilising reuse mapings, and testing other mechanisms for promoting reuse. Created a digital marketplace for reuse of surplus masses from construction sites.		circularity and reduced consumption. Local recycling station: Social sustainability can increase the sense of community. Enables inhabitants to join in on becoming more sustainable, by making it easier for them to participate. Knowledge-building - both inhabitants in general and the next generation. SESAM has increased residents' competence on waste management and circularity. Digital marketplaces for surplus and recycled materials: - Less transport. - Less landfilling of excavated masses - New job opportunities
	Democracy & participation	Create and facilitate networks for business and industrial stakeholders. A sustainability forum initiated by Næringsforeningen i Trondheim (Chamber of Commerce in Trondheim), where local businesses can discuss challenges and successes.	Established arenas where citizens and/or local businesses can interact on sustainability. See also "Cross-sectoral actions".		Increased participation across various groups of people. Made it easier for residents, and small and medium sized businesses to contribute and give feedback. New ideas are being

		Reuse centre: Involvement from local warehouses and wholesalers who sell new building materials and furniture today Reuse centre: Involvement of recycling and reuse operators and organisations who sell reusable waste. SESAM: Established a cooperation team between the 53 municipalities. Construction actors contribute to developing a circular industry.			created because of different actors across fields communicating. SESAM/Reuse centre:Increased value creation and employment related to material recovery and reuse in the region.
	Finance & funding	Apply for various fundings (Inter regional, national, regional, from research organisations, EU, from organisations and more).	Reuse centre: Self-financing through sale of reused building materials and furniture. SESAM: Construction phase financed by all involved municipalities. Granted various additional fundings (Inter regional, national, regional, from research organisations, EU, from organisations and more).		Social and educational arenas (reuse centre and SESAM). Reuse has economic benefits for citizens. Regional cooperation (SESAM).
	Learning & capabilities	Close and active collaboration with research actors, startups, innovation hubs and industries, to drive forward new circular business models, research projects and more. SESAM has finalised an ongoing research and development project on technology to sort and recover small waste particles (< 60 mm). Dialogue to learn from businesses with established circular financial models.	Develop, evaluate, learn and upscale new ideas. See also “Cross-sectoral actions”. Initiated or joined new collaborations and further developed existing ones. SESAM: Engineering and construction phase adapted for future development.		Actively invite students to participate in projects, internships or programmes. Outreach and communication of project results in public forums. Municipalities become better versions of themselves by sharing ideas and practices. Increased our social

		Exchange best practices between municipalities. Reuse: National knowledge arena in place to exchange experience with other municipalities and building owners.			sustainability by implementing more democratic processes that link various actors and municipalities in becoming greener.
Viable nature	Technology & infrastructure	Map areas in Trondheim with restoration potential, as stated in the nature restoration plan. Nature-based solutions (NbS) are implemented in our land management.	Natural carbon stocks are mapped and estimated. Efforts to restore nature are strengthened. Agriculture: Increasing self-sufficiency in both the municipality and the region through sustainable food production.	None of the models quantify natural carbon stocks or other vital ecosystem services.	Ecosystem services and nature's resilience against climate change strengthens. Improved mental well-being.
	Governance & policy	Promote a green and fair framework for climate transition through the national cities mission platform. The municipal biodiversity plan's goal of nature being a key priority in land use management is implemented. Climate change is being factored into city management and planning of the city and nature.	A green and fair framework for climate transition is formed through the national cities mission platform. See "Cross-sectoral actions". Nature is a key priority in land use management. National authorities provide clear guidelines on the municipalities role in spatial planning, to help achieve national climate and nature goals. The "objection mechanism" is strengthened, and land use management is governed more by regional authorities, according to the Climate Committee's proposal. Nature restoration plan.		Sustainable land use management. Protect biodiversity. The negative effects climate change has on biodiversity are reduced.
	Social innovation	Activities and campaigns like urban farming and citizen science mapping	More people appreciate the value of arable land, common and vulnerable nature.		Social activities in nature increase well-being.

		increase the engagement of the city's inhabitants. Targeted communication campaigns on nature restoration, local food production, climate adaptation on private properties, etc.	The population takes greater responsibility for their own food security and production. Arena for cooperation between professional agriculture and urban farming. More people engage in sustainable and nature-friendly use of private green space (see "Cross-sectoral actions"). Awareness on climate change adaptation and preventive measures are increased (see "Cross-sectoral actions").		Increasing awareness on food security and safety may contribute to increased food production and general preparedness in the population. Increased awareness and education about climate change adaptation may increase the population's resilience to shocks and disasters.
	Democracy & participation	Increase cooperation with NGOs.	Inhabitants have gained more knowledge about the value of nature and use it to get involved in taking care of nature (see "Cross-sectoral actions"). Inhabitants have gained more knowledge about their own food production and urban agriculture.		Increased food security. Improved public awareness on food production and security.
	Finance & funding	The municipality prioritises allocating funds to nature restoration and other nature-forward measures in their budget.	Funds are allocated for nature restoration, both from the public and business sector. Incentives have been implemented to restore more private land. The real cost of reducing nature and agricultural land is made visible in the early planning, and throughout, all projects.		Nature's resilience against climate change is strengthened, which also benefits climate adaptation and other ecosystem services.
	Learning & capabilities	Nature has no borders - share knowledge and management practices between cities, neighbouring municipalities and on all levels of management.	Trondheim is a resource in the region for practical nature restoration.		Inspire other cities and municipalities.

Module B-2 Climate Neutrality Portfolio Design

*Module B-2 contains a project description for **each action planned** in the CCC Action Plan. This includes interventions targeted at creating/enhancing carbon sinks to address residual emissions.*

- *Table B-2.1 includes planned interventions grouped per field of action, including interventions by local businesses and industry.*
- *Tables B-2.2-X outline each action. The table contains all information for implementation (e.g., topic, kind of intervention, emission sector, scope, allocation, responsible actors, GHG reduction by gases and estimated costs), including interventions aimed at addressing residual emissions (incl. carbon sinks) (B-2.2).*
- *Strategy for residual emissions summarises the planned actions and estimated impact.*

Table B-2.1: Description of action portfolios

Fields of action	Portfolio description	
	List of portfolios and actions	**Descriptions**
Cross-sectoral actions	0: Involve and engage ★ Trondheim Green Life ★ Trondheim Green Deal ★ National Cities Mission Platform	We aim to involve and engage: ● Citizens in cooperation with NGOs and research actors under the label " Trondheim Green Life". ● Business and research actors under the label "Trondheim Green Deal". ● National and regional authorities, as well as other cities, through the national cities mission platform, which is currently developing.
Energy systems	0: Involve and engage	Information campaigns to engage citizens and businesses in the energy transition - communicating best practice on how to improve the energy efficiency and flexibility and/or install solar panels in homes. Includes households of different income levels, businesses of various sizes, etc. Address a just and climate-friendly energy transition in collaboration with regional and national authorities, through the national cities mission platform. See ""Cross-sectoral actions".
	1: Energy analysis ★ Energy analysis	In order to integrate and develop our electric and thermal energy grids in an efficient and functional way, we will map our energy systems. Digital maps of the current situation will constitute the baseline for scenarios that will help decision making in urban planning, energy solutions in new and existing buildings, locations for charging stations, and more.
	2: Carbon capture and storage (CCS) from waste- incineration ★ Pilot City programme on CCS ★ E2.2: CCS from waste incineration	Capture and storage of CO_2 from incineration of waste from both fossil and biogenic origin, represents both an emission cut, and a carbon sink. Trondheim municipality cooperates with the plant-owner Statkraft Varme, to develop a feasible business model and plan for implementation and public acceptance.
	3: Phase out fossil fuels in industry and at construction sites: ★ In Rockwool facility ★ In small and medium sized industries ★ In heating of buildings and construction sites	We need to phase out fossil fuels in a Rockwool facility and some small and medium sized industries and to substitute gas for heating in some buildings and construction sites. Availability of electric power is crucial, but also utilisation of waste heat, local power production and flexibility solutions.
	4: Upgrades of hydropower plants and in the electricity grid ★ Upgrades of hydropower plants ★ Upgrades in the electricity grid	Upgrade our hydropower plants and gradually increase the local grid capacity to 132 kV. Establish a new 420 kV transformer in the transmission grid.

Mobility & transport	(*Miljøpakken)* 0: Involve and engage	*Miljøpakken* is the action plan of the national-regional-local *Byvekstavtalen* (the "city-growth-agreement"), aiming to limit urban sprawl and car transport. This is an existing policy, but it will be strengthened with the *Traffic plan for Trondheim* autumn 2024. Thus, it is listed here as a portfolio, but no actions are included. Key indicators are provided in module B-3. *Miljøpakken* also includes campaigns and activities to engage citizens and businesses. These can be included in *Trondheim Green Life*, see "Cross-sectoral actions".
	1: Tool kit for green goods and utility transport (PS 76/23) ★ T2.1 / 2.2: Improved logistics for goods transport ★ T2.3 / 2.4: Zero emission vans (procurement and infrastructure)	The municipality aims to: ● Make goods and utility transport more efficient. ● Use public procurements in a predictable and fair way, to promote greener and more efficient transport. ● Give practical and economic incentives in favour of zero emission transport. ● Support implementation of infrastructure for zero emission fuel. ● Use zero-emission zones, and similar regulations, in a predictable and fair way, to promote green and efficient transport, if the national authorities will allow it. ● Phase out all of the municipality's own light and heavy vehicles running on fossil fuels.
	2: Zero-emission zone ★ T3.1: Zero emission zone for passenger cars ★ T3.2 / 3.3 / 3.4: Zero emission zone for vans, heavy vehicles and buses	To speed up the energy transition in transport, we might need strong regulations like a city-wide zero-emission zone (ZEZ). Strong regulations like ZEZ must be announced a few years before implementation to promote behavioural change and investments in emission free vehicles. The four largest cities in Norway have requested national authorities for permission to implement ZEZ in order to limit GHG emissions.
	3: Sea transport ★ S2.2 / 2.3 / 3.1: Emission free public ferries and speed ferries ★ S3.2: Mandatory use of shore power and battery operation for all cruise ships, freighters and tankers	The county municipality aims for emission free public ferries and speed ferries. The harbour aims to provide shore power for full scale cruise ships by 2030, and promote, incentivise and eventually demand the use of shore power and ideally battery operation.
Built environment	1: Zero emission construction sites	● Emission-free building and construction sites in our own investment projects. ● Fossil fuel and emission-free construction sites in the Environment Package's projects ● Fossil fuel and emission-free construction sites for private actors.
	2: Climate footprint in land-use planning: ★ Limit climate footprint of buildings and constructions in zoning plans	The study "Trondheim's circular potential" contains a material flow analysis. The report concludes that the construction industry has the greatest potential to increase circularity and reduce indirect GHG emissions.
	Please note: - **Phasing out gas for heating in buildings and on construction sites** are addressed in the impact pathway "energy systems". - **Upgrades in building stock** are addressed under "energy systems". - **Emission free transport to and from construction sites** are addressed under "mobility and transport". - **Renovation of buildings and infrastructure, reuse of building materials and other circular solutions** are addressed under "waste and circular economy".	

	- **Trondheim Green Life** will include information campaigns and activities that address sustainable renovation and upgrading of homes and buildings, including smart energy use; and green transport. See “Cross-sectoral actions”.	
Waste & circular economy	0: Involve and engage	Information campaigns and cooperation with NGOs to engage citizens and businesses on reduced consumption and increased reuse, repair and sharing. See “Cross-sectoral actions”.
	1: Household waste ★ Increased reuse of household waste ★ New or improved systems for waste sorting and material recovery ★ E2.1: SESAM plant for post-sorting of residual waste	The portfolio is a part of the municipal's continual work with household waste management to comply with national legislations and local climate, environmental and societal goals. The portfolio contains actions to increase material recovery and reuse.
	2: “From Waste to Resources”. Examples: ★ Piloting on local recycling station ★ TRÅD: A new standard for design, production and downstream solutions for textiles. ★ Trøndelag resource bank for industrial materials	A project portfolio in close cooperation with TRV Gruppen (responsible for household waste management): Aims for increased circularity and to stimulate increased value creation, business development and green jobs. The portfolio contains different projects on for example: Textiles, plastic, waste reduction, industrial masses and increased reuse - for both public and private sectors. Research, innovation, contribution to technology development and cross-functional collaboration are important key words.
	3: Buildings and construction industry: ★ Renovation of buildings and infrastructure ★ Reuse centre ★ “Ready for Use” ★ See also “Trøndelag resource bank for industrial materials above”	The study “Trondheim's circular potential” contains a material flow analysis. The report concludes that the construction industry has the greatest potential to increase circularity and reduce indirect GHG emissions, which is why this industry is one of our focus areas. We will: ● encourage the building and construction sector city-wide to become more climate-conscious, circular and resource efficient. ● preserve, restore and upgrade the municipality’s buildings and constructions. ● develop digital and physical marketplaces to ease reuse of inventory, building elements and materials - also for commercial actors.
Viable nature	0: Involve and engage	Information campaigns and cooperation with NGOs to engage citizens and businesses in activities related to viable nature, agriculture and climate adaptation. See “Cross-sectoral actions”.
	1: Protect and restore nature and natural carbon sinks: ★ Assess and communicate the nature restoration potential ★ Map and communication on carbon-rich nature areas ★ Restore nature ★ Area neutral area planning	Identify areas with restoration potential, to increase biodiversity and natural carbon stores. Develop a database to map an overview of carbon-rich nature, with special focus on peatlands and forests.
	2: Agriculture: ★ Increase local food production	Portfolio of actions to increase local food production to obtain a higher degree of food security and better preparedness for the municipal population.

Tables B-2.2-X: Individual action outlines
one table for each action/intervention/project

Cross-sectoral actions: Involve and engage

B-2.2-CS1: Individual action outlines		
Action outline	Action name	**Trondheim Green Life**
	Action type	Social intervention
	Action description	Trondheim Municipality and several NGOs already have a lot of information, campaigns and activities to engage citizens in a green lifestyle - ranging from active transport, via protecting nature and circular solutions like repairing, to urban farming. Now, we will aim to cooperate and frame these activities under one label to build upon, and potentially include new topics like smart energy use and local climate adaptation measures.
Reference to impact pathway	Field of action	All
	Systemic lever	Social intervention / Democracy and participation / Learning and capabilities
	Outcome (according to module B-1.1)	Increased nature and climate awareness, engagement and activity among citizens and business and research actors. Increased knowledge on how we can accomplish a just climate transition fast. Increased green value creation.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	All of Trondheim
	Involved stakeholders	NGOs / Research actors
	Comments on implementation – consider mentioning resources, timelines, milestones	We aim to involve and engage NGOs in autumn 2024 and launch activities under a common label in 2025.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-CS2: Individual action outlines		
Action outline	Action name	**Trondheim Green Deal**
	Action type	Social intervention
	Action description	Create a network to - promote green jobs and value creation. - inform policy makers on how to promote the green transition in a just and fast manner.
Reference to impact pathway	Field of action	All
	Systemic lever	Social innovation / Democracy and participation / Learning and capabilities

	Outcome (according to module B-1.1)	Increased nature and climate awareness, engagement and activity among citizens and business and research actors. Increased knowledge on how we can accomplish a just climate transition fast. Increased green jobs and value creation.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality / Chamber of Commerce in the Trondheim Region (NiT)
	Action scale & addressed entities	Business and research institutions in Trondheim
	Involved stakeholders	Business / Research and innovation actors
	Comments on implementation – consider mentioning resources, timelines, milestones	Trondheim Green Deal will focus on actors signing the Climate City Contract. The network will focus on green jobs and value creation in a green transition focused on the commitments in the CCC.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-CS3: Individual action outlines		
Action outline	Action name	**National Cities Mission Platform**
	Action type	Governance intervention
	Action description	Create a platform to - Promote just transition in the cities participating in cities missions. - inform policy makers on how to promote the green transition in a just and fast manner.
Reference to impact pathway	Field of action	All
	Systemic lever	Governance and policy
	Outcome (according to module B-1.1)	An efficient framework for a just energy and climate transition across sectors.
Implementation	Responsible bodies/person for implementation	DOGA on behalf of the Ministry of Local Government and Regional Development
	Action scale & addressed entities	Norwegian cities connected to Cities Mission or relevant
	Involved stakeholders	National, regional and local authorities
	Comments on implementation – consider mentioning resources, timelines, milestones	The platform will focus on creating a framework to enable the cities to fulfil their missions.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A

	Total costs and costs by CO2e unit	Not yet estimated

Energy systems

Portfolio 1: Energy analysis

B-2.2-E1: Individual action outlines		
Action outline	Action name	**Energy analysis**
	Action type	Other intervention
	Action description	Combine energy data with current and planned land use and transport data, to make comprehensive, digital maps for knowledge-based urban planning of energy, land use and transport systems.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Technology and infrastructure / Governance and policy / Social innovation / Democracy and participation / Learning and capabilities
	Outcome (according to module B-1.1)	Implement energy solutions that save energy and strengthen the energy system. A test arena for energy has been established in Trondheim. The construction industry is enabled to make more climate-friendly decisions with help of the guidelines in the municipal master land use plan. Upscaled projects from pilot to mainstream. Smarter energy usage and reduced load demands on the grid, has created smaller peaks and more balanced usage of energy Urban development at various scales aim to implement energy solutions that save energy and strengthen the energy system. Coordinated development of the energy systems and local energy sources and storage.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	City-wide mapping of the electricity and district heating energy systems
	Involved stakeholders	Trondheim Municipality / Tensio AS (electric grid) / Statkraft Varme AS (district heating)
	Comments on implementation – consider mentioning resources, timelines, milestones	The three partners have committed to the subject, but have restricted capacity. The main obstacle is to satisfy GDPR and grid safety while useful data is made available. Due 2026.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	The energy analysis will be a tool to use our energy as smartly and efficiently as possible.
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

Portfolio 2: Carbon capture and storage (CCS) from waste incineration

B-2.2-E2: Individual action outlines		
Action outline	Action name	**Pilot City Programme on CCS: CCWaSte4NetZero**
	Action type	Social intervention
	Action description	Pilot cities programme on cities as a testbed for climate neutrality: Implementing CCS in waste-to-energy for a Net-Zero city. We will use CCS as a case to find meaningful ways to involve citizens in mini-democracies or citizen assemblies to co-create collective recommendations on CCS and other major policy questions. The interventions and learning points will be applied to overcome also other key barriers for climate neutrality.
Reference to impact pathway	Field of action	Energy systems CCS affects "waste and circular economy". Learning points will be applied in all fields of action.
	Systemic lever	Social innovation / Democracy and participation / Learning and capabilities
	Outcome (according to module B-1.1)	Develop methods to interact with and motivate behaviour change in target groups. Upscaled and increased participation for climate measures based on experiences and lessons learned from CCS. Accelerate our governmental capacity to overcome other key barriers to become a climate neutral city.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	Representative mini-democracy
	Involved stakeholders	Statkraft varme (facility owner) / SINTEF
	Comments on implementation – consider mentioning resources, timelines, milestones	Pilot 2024-2026. We will evaluate methods and learning points and apply these in the other impact pathways. More on the pilot project here: https://netzerocities.eu/trondheims-pilot-city-activity-cities-as-a-test-bed-for-climate-neutrality/.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	Pilot to make "E2.2: CCS from waste incineration" socially acceptable.
	GHG emissions compensated (natural or technological sinks)	Pilot to make "E2.2: CCS from waste incineration" socially acceptable.
	Total project costs	€ 600,000 project funding from NZC

B-2.2-E3: Individual action outlines		
Action outline	Action name	**E2.2: CCS from waste incineration**
	Action type	Technical intervention Physical/spatial intervention

	Action description	Implementation of CCS-technology at the waste incineration plant, which is also the backbone of Trondheim's district heating system. CCS will cut about 90 % of CO_2-emissions from waste of fossil and biological origin. When we succeed in cutting 80 % of GHG emissions, CCS of CO_2 from biological origin can compensate for all residual emissions in Trondheim.
Reference to impact pathway	Field of action	Energy systems Also relevant: "waste and circular economy"
	Systemic lever	Technology and infrastructure / Finance and funding
	Outcome (according to module B-1.1)	Plans for CCS on waste-to-energy plants are ready. Final investment decision for CCS at the waste incineration plant.
Implementation	Responsible bodies/person for implementation	Statkraft varme (facility owner)
	Action scale & addressed entities	Incineration plant. Harbour for shipping out captured CO_2.
	Involved stakeholders	Statkraft varme / Tensio / Trondheim havn
	Comments on implementation – consider mentioning resources, timelines, milestones	See also "Pilot City Programme on CCS" above Preliminary investment decision 2025 Final investment decision 2027 Implementation 2027-2030
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	90,500 tons CO2e
	GHG emissions compensated (natural or technological sinks)	130,000 tons CO2e of biological origin is captured and stored in bed rock.
	Total costs and costs by CO2e unit	Investment costs (NPV): Approx. € 260,869,565 Operational costs (NPV): Approx. € 26,086,957 annually. Expected life time: 60 years. Costs by CO_2 unit: App. € 339 /ton fossil CO2e App. € 139 /ton all CO2e Please note that this action: - Cuts most emissions from household waste treatment for Mid-Norway. - Cuts most emissions from district heating covering 30 percent of Trondheims heating needs. - Offsets all residual emissions in Trondheim.

Portfolio 3: Phase out fossil fuels in industry and at construction sites

B-2.2-E4: Individual action outlines		
Action outline	Action name	**I2.1: Phase out fossil fuel from the Rockwool facility**
	Action type	Technical intervention

	Action description	Rockwool produces stone wool for insulation purposes, and uses fossil fuels in the process. There is a need to make a plan and budget to phase out fossil fuels.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Technology and infrastructure / Finance and funding
	Outcome (according to module B-1.1)	Plans on how to phase out fossil fuel at small and medium sized industry facilities. Financial solution to phase out fossil fuel at Rockwool facility.
Implementation	Responsible bodies/person for implementation	Rockwool facility
	Action scale & addressed entities	Rockwool facility
	Involved stakeholders	Trondheim Municipality (dialog and facilitation) / banking/Investment funds
	Comments on implementation – consider mentioning resources, timelines, milestones	This measure is completely dependent on increased electric transmission capacity that is not due before 2030. Planning should start to secure financing.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	Numbers from 2020: Coke: 5,098 tons / Propane: 1,246 tons Expected increase in electricity demand: 31 GWh/year
	GHG emissions reduction estimate (total) per emission source sector	15,500 tons CO2e
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-E5: Individual action outlines		
Action outline	Action name	**I3.1: Energy transition in industry**
	Action type	Governance intervention Technical intervention
	Action description	All use of fossil fuels in industry must be replaced by renewable energy.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Technology & infrastructure / Social innovation / Democracy and participation / Finance & funding
	Outcome (according to module B-1.1)	Plans on how to phase out fossil fuel at small and medium sized industry facilities. Smaller industries and enterprises corporate in " Trondheim Trondheim Deal" to phase out fossil fuel. Upscaled and increased participation for climate measures based on experiences and lessons learned from CCS. New business models are developed that promote local energy production, flexibility, and efficiency. "Green loans" become more available as banks and finance institutions integrate the taxonomy in their business.
Implementation	Responsible bodies/person for implementation	Local industry
	Action scale & addressed entities	City-wide

	Involved stakeholders	National authorities (*Enova* for financial support) Trondheim Municipality / local industry / *Tensio* (grid owner)
	Comments on implementation – consider mentioning resources, timelines, milestones	The municipality and the local coalition of enterprises invite small and medium sized industry into a network starting in 2024. National authorities should also (continue and strengthen) support the energy transition in the industry sector to cut all emissions by 2030.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	Increase in electricity use: 43 GWh
	GHG emissions reduction estimate (total) per emission source sector	13,400 tons CO2e
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-E6: Individual action outlines		
Action outline	Action name	**O2.1 / 2.2: Phase out gas for heating construction sites and buildings**
	Action type	Governance intervention Technical intervention
	Action description	Fossil fuel must be replaced by either electricity or district heating.
Reference to impact pathway	Field of action	Energy
	Systemic lever	Technology & infrastructure / Governance and policy / Social innovation / Finance & funding
	Outcome (according to module B-1.1)	Construction sites and buildings phase out fossil fuel. Implement energy solutions that save energy and strengthen the energy system. Increased national CO2-fee for sectors that are not in ETS The construction industry is enabled to make more climate-friendly decisions with help of the guidelines in the municipal master land use plan. Smaller industries and enterprises corporate in " Trondheims grønne giv" to phase out fossil fuel. New business models are developed that promote local energy production, flexibility, and efficiency. "Green loans" become more available as banks and finance institutions integrate the taxonomy in their business
Implementation	Responsible bodies/person for implementation	Owners of buildings
	Action scale & addressed entities	City-wide
	Involved stakeholders	National authorities (*Enova* for financial support) Trondheim Municipality / local industry / Tensio (grid owner) / Statkraft - district heating company
	Comments on implementation – consider mentioning resources, timelines, milestones	The municipality and the local coalition of enterprises invite small and medium sized industry into a network starting in 2024. National authorities should also (continue and strengthen) support the energy transition in the building sector to cut all emissions by 2030.

Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	6,000 tons CO2e
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

Portfolio 4: Upgrades of hydropower plants and the electricity grid

B-2.2-E7: Individual action outlines		
Action outline	Action name	**Upgrades of hydropower plants**
	Action type	Technical intervention Physical/spatial intervention
	Action description	Actions to increase electric (energy and) power production towards 2030. New dam at Hyttfossen, construction of a new Svean power plant, upgrade of Fjæremsfossen power plant and rehabilitation of the dams at Øvre and Nedre Leirfoss.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Technology and infrastructure / Finance and funding
	Outcome (according to module B-1.1)	Upgrades of hydropower plants are in progress. Citizens, neighbourhoods and businesses invest more in local energy production and smart energy use.
Implementation	Responsible bodies/person for implementation	Statkraft (plant owner)
	Action scale & addressed entities	Hydropower plants as mentioned in the action description above.
	Involved stakeholders	National, regional and local authorities
	Comments on implementation – consider mentioning resources, timelines, milestones	All projects are scheduled to be implemented by 2030.
Impact & cost	Generated renewable energy (if applicable)	These hydropower plants deliver approximately 2.7 TWh annually. The planned upgrades will only increase this capacity slightly, but more importantly the (simultaneous) power production will increase.
	Removed/substituted energy, volume, or fuel type	Phasing out fossil fuels requires electric energy and power.
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	€ 100,347,826

B-2.2-E8: Individual action outlines		
Action outline	Action name	**Upgrades in the electricity grid**
	Action type	Technical intervention Physical/spatial intervention

	Action description	Establish a new 420 kV transformer in the transmission grid, and a new 132 kV transmission line from Strinda to Brattøra.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Technology and infrastructure / Finance and funding
	Outcome (according to module B-1.1)	Licence is granted for upgrading power lines and grid stations. Citizens, neighbourhoods and businesses invest more in local energy production and smart energy use.
Implementation	Responsible bodies/person for implementation	Grid owners *Statnett* and *Tensio*
	Action scale & addressed entities	Transmission grid
	Involved stakeholders	National, regional and local authorities / neighbours
	Comments on implementation – consider mentioning resources, timelines, milestones	The licence application is to be delivered in 2024, physical work 2027-2030
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	Higher electric transmission capacity will enable phasing out fossil fuel in transport and industry.
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	€ 156,521,739

Mobility and transport

Portfolio 1: Tool kit for green goods- and utility transport

B-2.2-M1: Individual action outlines		
Action outline	Action name	**T2.1 / 2.2: Improved logistics for goods transport**
	Action type	Physical/spatial intervention Social innovation Procurement
	Action description	Develop an action plan on city logistics in close cooperation with transport and logistics actors, to find actions to improve logistics and streamline delivery of goods.
Reference to impact pathway	Field of action	Mobility and transport
	Systemic lever	Technology and infrastructure / Governance and policy / Social Innovation / Democracy and participation / Learning and capabilities
	Outcome (according to module B-1.1)	City logistics hub pilot. Restrictive policies on fossil fuel vehicles. Goods and utility transport are reduced in the city centre. Test new market models where city logistics with collaboration and sharing via hubs etc. become cost effective.

		Implemented systems for ongoing public feedback on transport initiatives, including zero emission zones. Engaged local businesses in initiatives to reduce transport emissions. See also “Cross-sectoral actions”. Used knowledge from the research and development community regarding the mobility and transport sector. Implemented learning from other cities.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality / transport sector
	Action scale & addressed entities	City centre
	Involved stakeholders	Transport and logistics actors / customers The municipality as a facilitator for hub and/or new market models Research and innovation actors
	Comments on implementation – consider mentioning resources, timelines, milestones	An action plan to streamline city logistics will be developed by 2026, in cooperation with the business actors. A city logistics hub and other appropriate measures will be piloted, and if effective, implemented.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	Decrease in electricity use: 2 GWh. Decrease in diesel use: 20 GWh. Decrease in biodiesel use: 3 GWh.
	GHG emissions reduction estimate (total) per emission source sector	5,500 tons CO2e
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-M2: Individual action outlines		
Action outline	Action name	**T2.3 / 2.4: Zero emission vans (procurement and infrastructure)**
	Action type	Governance intervention Technical intervention
	Action description	Establish infrastructure and ensure only emission free new light duty vans from 2025 and new heavy duty vans from 2030.
Reference to impact pathway	Field of action	Mobility and transport
	Systemic lever	Technology and infrastructure / Governance and policy / Democracy and participation / Finance and funding / Learning and capabilities
	Outcome (according to module B-1.1)	Practically all vehicles are emission free. Support establishment of charging and fueling infrastructure for emission-free energy carriers for both land and sea transport. Replaced infrastructure for fossil fuel with infrastructure for renewable fuels. Improved infrastructure and flexible use of the grid.

		Practically all new vans, buses and trucks are emission free. Benefits for emission free transport are maintained nationally, regionally and locally. Restrictive policies on fossil fuel vehicles. All municipal vehicles that can be emission-free are emission-free. Public procurement must only utilise emission free transport. Engaged local businesses in initiatives to reduce transport emissions. See also “Cross-sectoral actions”. Local and national financial support for emission-free transport are maintained and strengthened. Used knowledge from the research and development community regarding the mobility and transport sector.
Implementation	Responsible bodies/person for implementation	National and local authorities / transport sector
	Action scale & addressed entities	All new vans in the municipality.
	Involved stakeholders	National and local authorities / transport sector / energy sector
	Comments on implementation – consider mentioning resources, timelines, milestones	Local authorities must address the need for a quick shift towards emission free vans. National authorities must set up an efficient framework for transport actors (support and regulations).
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	Increase in electricity use: 6 GWh. Decrease in diesel use: 13 GWh. Decrease in biodiesel use: 2 GWh. Decrease in gasoline and ethanol: 0.4 GWh.
	GHG emissions reduction estimate (total) per emission source sector	3,000 tons CO2e
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Budgeted costs for preparing a site offered to a charging or refuelling operator to establish infrastructure: €2,800,000.

Portfolio 2: Zero emission zone (ZEZ)

B-2.2-M3: Individual action outlines		
Action outline	Action name	**T3.1: Zero emission zone for cars**
	Action type	Governance intervention
	Action description	Trondheim has about 35 percent electric cars, and close to 90 percent of all new car sales are electric by 2024. Zero emission zones are here used as an example of a strong intervention that - if announced a few years in advance - can speed up this energy transition and remove practically all GHG emissions from cars.
Reference to impact pathway	Field of action	Mobility and transport
	Systemic lever	Technology and infrastructure / Governance and policy / Democracy and participation / Learning and capabilities

	Outcome (according to module B-1.1)	Practically all vehicles are emission free. Improved infrastructure and flexible use of the grid. Benefits for emission free transport are maintained nationally, regionally and locally. Restrictive policies on fossil fuel vehicles. We are allowed and ready to implement zero mission zones. A citizen assembly on climate and environmental issues are established, for citizens to come up with action points and tasks. Implemented systems for ongoing public feedback on transport initiatives, including zero emission zones. Evaluate and apply new knowledge from the R&D to promote zero emission transport.
Implementation	Responsible bodies/person for implementation	National and local authorities
	Action scale & addressed entities	All public roads in the municipality, except thoroughfares.
	Involved stakeholders	National and local authorities / car owners / Tensio (grid owner)
	Comments on implementation – consider mentioning resources, timelines, milestones	This intervention is on hold in lack of permission from national authorities. For car transport, there seems to be a general perception that all other means must be tried before ZEZ, since it represents a strong personal intervention. Still, electric cars entered the market properly from about 2011: There is a considerable network of charging infrastructure, and a large market for used electric cars. Thus, democratic and participatory actions building on our Pilot City programme on CCS (see “Energy systems”, portfolio 2) will be taken to explore how the energy transition of cars can gain even more traction, while still reducing overall car traffic.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	See “T3.2 / 3.3 / 3.4: Zero emission zone for vans, heavy vehicles and buses” below.
	GHG emissions reduction estimate (total) per emission source sector	See “T3.2 / 3.3 / 3.4: Zero emission zone for vans, heavy vehicles and buses” below.
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-M4: Individual action outlines		
Action outline	Action name	**T3.2 / 3.3 / 3.4: Zero emission zone for vans, heavy vehicles and buses**
	Action type	Governance intervention
	Action description	Trondheim has close to 15 percent electric vans and 10 percent fossil-free trucks, and the turn-over of such vehicles is higher than for cars. A city-wide zero emission zone with bans or very strong interventions can reduce the use of

		fossil-fuel vehicles in Trondheim to practically zero, if announced a few years in advance and supported by strong infrastructure development and continued support on emission free vehicles.
Reference to impact pathway	Field of action	Mobility and transport
	Systemic lever	Technology and infrastructure / Governance and policy / Social innovation / Democracy and participation / Learning and capabilities
	Outcome (according to module B-1.1)	Practically all vehicles are emission free. Benefits for emission free transport are maintained nationally, regionally and locally. Restrictive policies on fossil fuel vehicles. We are allowed and ready to implement zero mission zones. All municipal vehicles that can be emission-free are emission-free. Public procurement must only utilise emission free transport. Goods and utility transport are reduced in the city centre. Have established a citizen assembly on climate and environmental issues, where the citizens come up with action points and tasks. Implemented systems for ongoing public feedback on transport initiatives, including zero emission zones. Engaged local businesses in initiatives to reduce transport emissions. See also “Cross-sectoral actions”. Local and national financial support for emission-free transport are maintained and strengthened. Evaluate and apply new knowledge from the R&D to promote zero emission transport.
Implementation	Responsible bodies/person for implementation	National and local authorities
	Action scale & addressed entities	All public roads in the municipality, except thoroughfares.
	Involved stakeholders	National and local authorities / vehicle owners / Tensio (grid owner)
	Comments on implementation – consider mentioning resources, timelines, milestones	This intervention is on hold in lack of permission from national authorities. Grid capacity is an issue that is linked to governance regulation about grid security (n-1). Stronger energy infrastructure will be needed - and there is work in progress from both national and local authorities. The signal from several local transport actors is that they will make this transition, if: it is enforced by equal regulation for all actors; announced a few years in advance; there is sufficient energy infrastructure; and available emission free vehicles in the market. Local and national benefits must also be maintained.
Impact & cost	Generated renewable energy (if applicable)	N/A

	Removed/substituted energy, volume, or fuel type	Increase in electricity use: 138 GWh Decrease in diesel use: 246 GWh Decrease in gasoline use: 37 GWh Decrease in biodiesel use: 30 GWh Decrease in ethanol use: 3 GWh Action “T3.1: Zero emission zone for cars” included.
	GHG emissions reduction estimate (total) per emission source sector	79,300 tons CO2e Action “T3.1: Zero emission zone for cars” included.
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

Portfolio 3: Sea transport

B-2.2-M5: Individual action outlines		
Action outline	Action name	**S2.2 / 2.3 / 3.1: Emission free public ferries and speed ferries**
	Action type	Governance intervention Procurement Technical intervention
	Action description	National regulations demand that new public ferries and speed ferries must be emission free. This is an existing policy, but requires considerable efforts, and the expected emission cuts are *not* included under existing/other plans.
Reference to impact pathway	Field of action	Mobility and transport
	Systemic lever	Governance and policy / Learning and capabilities
	Outcome (according to module B-1.1)	Emission free ferries are on track for 2029. Used knowledge from the research and development community regarding the mobility and transport sector. Implemented learning from other cities.
Implementation	Responsible bodies/person for implementation	Trøndelag County Authority
	Action scale & addressed entities	All ferries and speed ferries in the municipality.
	Involved stakeholders	Trøndelag County Authority (regional authority) / AtB (operator) / Tensio (regional electric grid owner)
	Comments on implementation – consider mentioning resources, timelines, milestones	Electric and hybrid-electric speed ferries from 2024. The hybrid-electric ferries from 2019 must be replaced by emission free ferries in 2029.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	Increase in electricity use: 5 GWh. Decrease in diesel use: 12 GWh. Decrease in biodiesel use: 3 GWh.
	GHG emissions reduction estimate (total) per emission source sector	3,200 tons CO2e
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-M6: Individual action outlines		
Action outline	Action name	**S3.2: Mandatory use of shore power and battery operation for all cruise ships, freighters and tankers**
	Action type	Governance intervention Technical intervention
	Action description	Establish shore power for cruise ships and make incentives for shore power in cruise ships, freighters and tankers. To maximise the emission cuts, a regulation should be implemented to make it obligatory to use shore power - and when available - battery operation.
Reference to impact pathway	Field of action	Mobility and transport
	Systemic lever	Technology and infrastructure / Governance and policy
	Outcome (according to module B-1.1)	Shore power for cruise ships is on schedule for 2030. Mandatory use of available shore power for compatible ships. Local and national financial support for emission-free transport are maintained and strengthened.
Implementation	Responsible bodies/person for implementation	National and local authorities
	Action scale & addressed entities	All compatible ships visiting harbours within the municipality's borders.
	Involved stakeholders	International, national and local authorities / ship owners / energy grid operators.
	Comments on implementation – consider mentioning resources, timelines, milestones	In order to make it mandatory, the infrastructure needs to be at place.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	Increase in electricity use: 12 GWh Decrease in natural gas use: 6 GWh Decrease in diesel use: 20 GWh Decrease in biodiesel use: 3 GWh
	GHG emissions reduction estimate (total) per emission source sector	6,800 tons CO2e
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Budgeted investment in shore power for cruise ships: € 7,565,217 Operational costs: not estimated Life expectancy: 60 years Cost by CO2e unit: €19 + operational costs

Built environment

Portfolio 1: Zero emission construction sites

B-2.2-B1: Individual action outlines		
Action outline	Action name	**AT1.2 / 2.2 / 3.1: Emission free off-road mobile machinery**
	Action type	Governance intervention

		Procurement Technical intervention
	Action description	Make all construction sites emission free by 2030.
Reference to impact pathway	Field of action	Built environment
	Systemic lever	Technology and infrastructure / Governance and policy / Funding and finance / Learning and capabilities
	Outcome (according to module B-1.1)	Heading towards emission-free construction sites city-wide by 2030. Better technology and lower cost on emission-free machinery. National authorities have developed frameworks and regulations that promote climate and energy transition. Local authorities are allowed to demand emission-free private construction sites. Knowledge arenas for the construction industry are established to streamline emission free construction sites (and circular solutions, see “waste and circular economy”) All public procurements require emission free construction sites. Emission free and circular construction sites are streamlined and cost effective. Arenas for sharing experiences and knowledge in the industry.
Implementation	Responsible bodies/person for implementation	National and local authorities / actors responsible for public procurement of buildings and constructions
	Action scale & addressed entities	All construction sites city-wide
	Involved stakeholders	The Norwegian Public Roads Administration / Trøndelag County Authority / Trondheim Municipality / private actors
	Comments on implementation – consider mentioning resources, timelines, milestones	Emission free machinery is a demand in the municipality’s procurement of buildings and infrastructure projects, since 2021. The goal is 100 % emission free machinery by 2025. *Miljøpakken* has also started using emission free machinery. To make all construction sites city-wide emission free by 2030, national authorities need to provide a framework to enable the private construction actors to make this shift swiftly. Local authorities must be allowed to demand emission-free construction sites.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	Increase in electricity use: 77 GWh Decrease in diesel use: 217 GWh Decrease in biodiesel use: 18 GWh
	GHG emissions reduction estimate (total) per emission source sector	53.500 tons CO2e
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

Portfolio 2: Limit climate footprint in land-use planning

B-2.2-B2: Individual action outlines		
Action outline	Action name	**Limit climate footprint of buildings and constructions in zoning plans**
	Action type	Governance intervention Physical/spatial intervention
	Action description	Set a limit for climate footprint of new buildings and constructions in zoning plans by active use of climate budgets for expected lifespan compared to reference buildings and constructions.
Reference to impact pathway	Field of action	Built environment Complementary actions under “waste and circular economy”
	Systemic lever	Governance and policy
	Outcome (according to module B-1.1)	Limit climate footprint for expected lifespan in land-use planning
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	New land-use plans
	Involved stakeholders	Land owners and developers / construction actors
	Comments on implementation – consider mentioning resources, timelines, milestones	The municipal master plan is expected to demand the use of climate budgets for expected lifespan from 2024. Experience from the municipality’s own projects show that we routinely cut 40 % of the climate footprint in our building projects. Next, we need to establish mechanisms to ensure similar effects in all building and construction projects by 2030.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	To be quantified in each project
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	To be quantified in each project

Waste and circular economy

Portfolio 1: Household waste

B-2.2-W1: Individual action outlines		
Action outline	Action name	**Increased reuse of household waste**
	Action type	Technical intervention Governance intervention Physical/spatial intervention
	Action description	The municipality is constantly working on finding solutions for increased reuse and trade of household waste.
Reference to impact pathway	Field of action	Waste and circular economy

	Systemic lever	Technology and infrastructure / Democracy and participation / Learning and capabilities
	Outcome (according to module B-1.1)	More waste from households is reused. Implementation of new or improved systems for waste sorting, material recovery and increased circular economy. Established arenas where citizens and/orlocal businesses can interact on sustainability. Develop, evaluate, learn and upscale new ideas. Initiated or joined new collaborations and further developed existing ones.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	City-wide
	Involved stakeholders	Trondheim Municipality / Trondheim Renholdsverk (waste management) / recycling/reuse operator and organisations / Inhabitants
	Comments on implementation – consider mentioning resources, timelines, milestones	This action is a melting pot of piloting ideas and finding new markets for reuse of household waste - often in cooperation with private recycling/reuse operators and organisations to increase the sale of reusable household waste. End date 2030
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-W2: Individual action outlines		
Action outline	Action name	**New or improved systems for waste sorting and material recovery**
	Action type	Technical intervention Governance intervention Physical/spatial intervention
	Action description	The municipality is constantly working to find better solutions for waste sorting and material recovery of household waste. This is done both to comply with upcoming laws and regulations, and to ensure that more waste is recycled.
Reference to impact pathway	Field of action	Waste and circular economy
	Systemic lever	Technology and infrastructure / Governance and policy / Social innovation / Learning and capabilities
	Outcome (according to module B-1.1)	Increased collection of food waste, plastic packaging, glass and metals. Implementation of new or improved systems for waste sorting, material recovery and increased circular economy.

		Household waste: Improve systems for source sorting and material recovery to increase collection of food waste, plastic packaging, glass and metals. Less food waste. Develop, evaluate, learn and upscale new ideas.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	Households in Trondheim
	Involved stakeholders	Trondheim Municipality / Trondheim Renholdsverk (waste management) / inhabitants
	Comments on implementation – consider mentioning resources, timelines, milestones	Implement at-home collection of food waste, textiles, glass, and metal. This includes to project and rebuild buried waste solutions for at-home sorting and collection of food waste, glass and metals, and to develop new solutions for collecting textiles in 2025. The collection system in Midtbyen will also be upgraded. End date 2030
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-W3: Individual action outlines		
Action outline	Action name	**E2.1: SESAM plant for post-sorting of residual waste**
	Action type	Technical intervention
	Action description	Establish a mixed waste sorting plant for residual waste from households. Intention: To sort out materials from the residual waste to increase material recovery - especially plastic packaging. SESAM will also act as a competence centre to educate and increase awareness on circular waste and resource management.
Reference to impact pathway	Field of action	Waste and circular economy
	Systemic lever	Technology and infrastructure / Governance and policy / Social innovation / Finance and funding / Learning and capabilities
	Outcome (according to module B-1.1)	Started construction of the SESAM mixed waste sorting plant. Increased collection of food waste, plastic packaging, glass and metals. More waste from households is reused. Implementation of new or improved systems for waste sorting, material recovery and increased circular economy. SESAM: Secured land areas regulated to industrial development and investments.

		Household waste: Improve systems for source sorting and material recovery to increase collection of food waste, plastic packaging, glass and metals. Continued educating children in school on topics related to the waste hierarchy and circular economy. Finalise plans for SESAMs as a competence centre for citizens. Finalised the plans for SESAMs contribution to residents as a competence centre. SESAM: Construction phase financed by all involved municipalities. SESAM: Engineering and construction phase adapted for future development.
Implementation	Responsible bodies/person for implementation	SESAM Ressurs AS
	Action scale & addressed entities	Mid-Norway (53 municipalities)
	Involved stakeholders	Seven waste management companies
	Comments on implementation – consider mentioning resources, timelines, milestones	1) Location 2) Finance and investment plan, 3) support and agreement with cooperating municipalities in the region.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	Plastic waste will be sorted out for material recovery before incineration.
	GHG emissions reduction estimate (total) per emission source sector	7,300 tons CO2e
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Estimated investment cost: € 87 million. Estimated operational cost: Not quantified. Life expectancy: 60 years. Cost by CO2e unit: €199 + operational costs. Please note that SESAM also will perform post-sorting of e.g. metals, and will increase the general material recovery.

Portfolio 2: From waste to resources

Please note: These are a few *examples* of the actions that are and will be developed in this portfolio.

B-2.2-W4: Individual action outlines		
Action outline	Action name	**Pilot on local recycling station**
	Action type	Physical/spatial intervention Social intervention
	Action description	A pilot for a local recycling station will be established. The goal of this project is to reduce local waste, but the station should also offer a social aspect; as a meeting place, a space for local initiatives (repair-events, clothes exchange events etc.). The local recycling station will also have a reuse section, where residents can get free things other residents don't need anymore.

Reference to impact pathway	Field of action	Waste and circular economy
	Systemic lever	Technical intervention / Governance and policy / Social innovation / Learning and capabilities
	Outcome (according to module B-1.1)	More waste from households is reused. Implementation of new or improved systems for waste sorting, material recovery and increased circular economy. Increased reuse from the recycling centre and local recycling stations. More local businesses offer - and more residents use - repair services and other circular solutions. End pilot on local recycling station: Evaluate, improve and/or upscale to new/more locations. Develop, evaluate, learn and upscale new ideas.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	Lademoen: a neighbourhood in Trondheim.
	Involved stakeholders	Trondheim Renholdsverk (waste management) / local inhabitants
	Comments on implementation – consider mentioning resources, timelines, milestones	Phase one (dec. 2023-Apr 2024) culminated in a report based on a survey given to inhabitants at Lademoen. The survey addressed the current issues of stray waste/littering in the area, as well as the lack of social meeting spaces. Phase two (May 2024- Sept. 2024). The main goal is to localise a suitable lot for the waste station. If a suitable lot is found, a pilot will be established in the area for 1 year. The outcome of the pilot (cost, usage, citizen feedback) will be analysed before a potential permanent waste station is established. The project will run until 2027, with a total budget for the project (Næringsfondet) of 3.3 MNOK.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Total budget (Næringsfondet) € 286,957

B-2.2-W5: Individual action outlines		
Action outline	Action name	**TRÅD: A new standard for design, production and downstream solutions for textiles**
	Action type	Governance intervention
	Action description	Interregional project (Norway-Sweden) that aims to develop a new standard for design, production, procurement and administration of used and virgin textile products.
Reference to impact pathway	Field of action	Waste and circular economy
	Systemic lever	Governance and policy / Social innovation /

		Learning and capabilities
	Outcome (according to module B-1.1)	Regulatory changes: EPR (Extended Producer Responsibility) for clothes/textiles. More local businesses offer - and more residents use - repair services and other circular solutions. Develop, evaluate, learn and upscale new ideas.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	Preparation for a more stream-lined implementation of the EU strategy for textiles
	Involved stakeholders	Swedish and Norwegian municipalities / textile producers / NGOs / fabric producers / consumers
	Comments on implementation – consider mentioning resources, timelines, milestones	Milestones: - Map existing textile waste streams - Facilitate workshops for national textile industries and textile waste handlers - Outreach on social platforms to increase public awareness on textile waste impact End date 2027
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Total budget € 622,000

B-2.2-W6: Individual action outlines		
Action outline	Action name	**Trøndelag resource bank for industrial materials**
	Action type	Governance intervention Physical/spatial intervention Technical intervention Social intervention
	Action description	From landfills and the extraction of new industrial materials to sustainable material handling through increased reuse and material recycling.
Reference to impact pathway	Field of action	Waste and circular economy / Built environment
	Systemic lever	Technology and infrastructure / Governance and policy / Democracy and participation / Learning and capabilities
	Outcome (according to module B-1.1)	More reuse of materials from buildings and constructions. Implementation of new or improved systems for waste sorting, material recovery and circular economy. Market stimulation to develop a circular market for building materials and furniture. Established arenas where citizens and/or local businesses can interact on sustainability. Develop, evaluate, learn and upscale new ideas.

		Initiated or joined new collaborations and further developed existing ones.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality (project owner)
	Action scale & addressed entities	Regional (Trøndelag County)
	Involved stakeholders	The Trondheim Region / Trøndelag County Authority / construction actors
	Comments on implementation – consider mentioning resources, timelines, milestones	The initiative is in the early stages of development. Goals and action points have been established, with a focus on addressing lightly contaminated masses, data collection, and the need for temporary storage. Additionally, the development of a digital marketplace is being explored. New milestones and work packages will be defined. End date 2030
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs	€ 91,304

Portfolio 3: Buildings and construction industry

B-2.2-W7: Individual action outlines		
Action outline	Action name	**Renovation of buildings and infrastructure**
	Action type	Governance intervention Physical/spatial intervention Social intervention
	Action description	Make policies that promote renovation of buildings and infrastructure, to limit demolition.
Reference to impact pathway	Field of action	Waste and circular economy / Built environment
	Systemic lever	Technology and infrastructure / Governance and policy / Social innovation / Finance and funding
	Outcome (according to module B-1.1)	Less waste produced. Policies on conservation and renovation of buildings and constructions, to avoid demolition. More reuse of buildings and materials from buildings and constructions. Market stimulation to develop a circular market for building materials and furniture.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	Trondheim - starting with public buildings and infrastructure
	Involved stakeholders	Trøndelag County Authority / construction actors

	Comments on implementation – consider mentioning resources, timelines, milestones	Newly adopted policy in Trondheim municipality - need adoption in the county municipality. May inspire private actors. End date 2030
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-W8: Individual action outlines		
Action outline	Action name	**Reuse Centre (Gjenbrukslageret)**
	Action type	Governance intervention Physical/spatial intervention Social intervention
	Action description	A (reused) storage for reusable building materials and furniture. The storage also has a system for marketing of the materials.
Reference to impact pathway	Field of action	Waste and circular economy / Built environment
	Systemic lever	Technology and infrastructure / Governance and policy / Social innovation / Finance and funding
	Outcome (according to module B-1.1)	Less waste produced. More waste from households is reused. More reuse of buildings and materials from buildings and constructions. Market stimulation to develop a circular market for building materials and furnitures. Increased reuse from the recycling centre. More local businesses offer - and more residents use - repair services and other circular solutions. Reuse centre: Self-financing through sale of reused building materials and furniture.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	Trøndelag County Authority
	Involved stakeholders	Loopfront / Sirken / building companies and building owners
	Comments on implementation – consider mentioning resources, timelines, milestones	Planning to be self-financed through sale of reused materials in 3-4 years. End date 2030
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A

	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs	Annual operational cost: € 434,783

B-2.2-W9: Individual action outlines		
Action outline	Action name	**"Ready for Use"**
	Action type	Technical intervention
	Action description	The idea, which is under development, is a digital tool that can be used on building sites to identify the properties that must be documented for a building material to be reused. This helps to ensure that the properties are known when considering the reuse of a material. It will be linked to existing documentation of building materials, and can work as a "recertification"-tool. The solution may ease the documentation and reuse of building materials.
Reference to impact pathway	Field of action	Waste and circular economy / Built environment
	Systemic lever	Technology and infrastructure / Governance and policy / Social innovation / Learning and capabilities
	Outcome (according to module B-1.1)	More reuse of buildings and materials from buildings and constructions. Implementation of new or improved systems for waste sorting, material recovery and increased circular economy. Less waste produced. Market stimulation to develop a circular market for building materials and furnitures. More local businesses offer - and more residents use - repair services and other circular solutions. Develop, evaluate, learn and upscale new ideas.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	Development and testing in Trondheim. If efficient, the tool will become commercially available.
	Involved stakeholders	COWI / Loopfront
	Comments on implementation – consider mentioning resources, timelines, milestones	MVP has been developed, the goal is to extend the amount of materials in the digital tool. In the future, an AI tool will help make the work more flexible and less resource-intensive. End date 2030
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs	€ 56 522

Viable nature

Portfolio 1: Protect and restore nature and natural carbon sinks

B-2.2-N1: Individual action outlines		
Action outline	Action name	**Assess and communicate the nature restoration potential**
	Action type	Governance intervention
	Action description	To be able to meet the goal of restoring more nature, it is necessary to get an overview of which areas have potential for nature restoration.This will be done by GIS-analyses and establishing criteria for prioritising the different areas and identifying the restoration measures that can be applied.
Reference to impact pathway	Field of action	Viable nature
	Systemic lever	Technology and infrastructure / Governance and policy / Learning and capabilities
	Outcome (according to module B-1.1)	Nature is a key priority in land use management. Nature restoration plan. More people appreciate the value of arable land, common and vulnerable nature. Funds are allocated for nature restoration, both from the public and business sector. Incentives have been implemented to restore more private land. The real cost of reducing nature and agricultural land is made visible in the early planning, and throughout, all projects. Trondheim is a resource in the region for practical nature restoration.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	City-wide
	Involved stakeholders	Environmental consultants and Trondheim Municipality
	Comments on implementation – consider mentioning resources, timelines, milestones	- Data acquisition from national and local databases - Categorise which ecosystems to include - Classification of grade of deterioration - GIS-analyses resulting in a map that shows potential restoration areas - Present a set of data to use to identify changes in ecological state - Propose criteria to prioritise between potential restoration objects We aim to assess the nature restoration potential by 2025.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-N2: Individual action outlines		
Action outline	Action name	**Map and communication on carbon rich nature areas**
	Action type	Technical intervention
	Action description	Provide a useful overview of the carbon stocks in different nature types. The database will include: - Mapping of peat depths in peatlands in the municipality. This will give an indication of the carbon stores we have and the benefit it will be to restore more peatlands. In addition, it will also supply information to assess the restoration potential for bogs. - Data from the new forest tax will be used to get an overview of carbon-rich forest areas.
Reference to impact pathway	Field of action	Viable nature
	Systemic lever	Technology and infrastructure / Finance and funding / Learning and capabilities
	Outcome (according to module B-1.1)	Natural carbon stocks are mapped and estimated. Nature is a key priority in land use management. Nature restoration plan. More people appreciate the value of arable land, common and vulnerable nature. Funds are allocated for nature restoration, both from the public and business sector. Incentives have been implemented to restore more private land. The real cost of reducing nature and agricultural land is made visible in the early planning, and throughout, all projects. Trondheim is a resource in the region for practical nature restoration.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	City-wide
	Involved stakeholders	Land owners / NTNU University Museum / The County Governor in Trøndelag / Trøndelag County Authority
	Comments on implementation – consider mentioning resources, timelines, milestones	Peatlands: - Method development: Selection of peatlands. - Mapping of where measurements will be conducted. - Further development of the database's structure. - Perform calculations of carbon storage. - Perform calculations that show the benefits of peatland restoration and how much more carbon can be sequestered. Forests: - Forest taxation is a well developed method. We aim to map carbon rich areas by 2027.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A

	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-N3: Individual action outlines		
Action outline	Action name	**Restore nature**
	Action type	Governance intervention Physical/spatial intervention Nature-based solution
	Action description	Restore common and vulnerable nature in line with the UN's Global Biodiversity Framework. Using the assessment and mapping of nature restoration potential and carbon rich areas, we can strengthen biodiversity, carbon sinks and nature's resilience to climate change.
Reference to impact pathway	Field of action	Viable nature
	Systemic lever	Technology and infrastructure / Finance and funding / Learning and capabilities
	Outcome (according to module B-1.1)	Nature restoration plan. Efforts to restore nature are strengthened. Funds are allocated for nature restoration, both from the public and business sector. Incentives have been implemented to restore more private land. Trondheim is a resource in the region for practical nature restoration.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	City-wide
	Involved stakeholders	Land owners / NTNU University Museum / The County Governor in Trøndelag / Trøndelag County Authority
	Comments on implementation – consider mentioning resources, timelines, milestones	Nature restoration is ongoing work, but must be upscaled in coherence with the UN framework. Assessment and mapping of restoration potential and carbon-rich areas provide knowledge to increase the awareness and raise funding for many projects by 2030.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	Efforts to restore nature will not compensate for residual emissions by 2030, since natural carbon capture takes time. However, our efforts now will make valuable contributions in a few decades.
	Total costs and costs by CO2e unit	Not yet estimated

B-2.2-N4: Individual action outlines		
Action outline	Action name	**Area neutral area planning**
	Action type	Governance intervention Physical/spatial intervention

		Nature-based solution
	Action description	The governance of land use must reach for area neutrality and in time positivity, to gain any real effect from nature restoration on carbon sinks and climate resilience.
Reference to impact pathway	Field of action	Viable nature
	Systemic lever	Governance and policy
	Outcome (according to module B-1.1)	National authorities provide clear guidelines on the municipalities role in spatial planning, to help achieve national climate and nature goals. The “objection mechanism” is strengthened, and land use management is governed more by regional authorities, according to the Climate Committee's proposal. Inhabitants have gained more knowledge about the value of nature and use it to get involved in taking care of nature. The real cost of reducing nature and agricultural land is made visible in the early planning, and throughout, all projects.
Implementation	Responsible bodies/person for implementation	National, regional and local authorities
	Action scale & addressed entities	City-wide
	Involved stakeholders	National, regional and local authorities and politicians / land owners / citizens
	Comments on implementation – consider mentioning resources, timelines, milestones	The local area plan is revised - aiming for area neutrality. Regardless of the final outcome, the actual land use needs to become area neutral in the coming years, to meet our obligations on nature and biodiversity, climate mitigation and adaptation.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	Area neutrality - and eventually positivity - is key for future carbon sinks, which will become vital.
	Total costs and costs by CO2e unit	Not yet estimated

Portfolio 2: Agriculture

B-2.2-N5: Individual action outlines		
Action outline	Action name	**Increase local food production**
	Action type	Governance intervention. Physical/spatial intervention. Nature-based solution Procurement
	Action description	Carry out several measures to increase local food production in order to obtain a higher degree of food security and better preparedness for the municipal population.
Reference to impact pathway	Field of action	Viable nature
	Systemic lever	Technology and infrastructure / Social innovation /

		Democracy and participation / Finance and funding
	Outcome (according to module B-1.1)	Agriculture: Increasing self-sufficiency in both the municipality and the region through sustainable food production. More people appreciate the value of arable land, common and vulnerable nature. The population takes greater responsibility for their own food security and production. Arena for cooperation between professional agriculture and urban farming. Inhabitants have gained more knowledge about their own food production and urban agriculture. The real cost of reducing nature and agricultural land is made visible in the early planning, and throughout, all projects.
Implementation	Responsible bodies/person for implementation	Trondheim Municipality
	Action scale & addressed entities	The municipality and the region
	Involved stakeholders	Farmers and landowners / national, regional and local authorities / public procurers / agricultural organisations / inhabitants
	Comments on implementation – consider mentioning resources, timelines, milestones	Multiple steps towards 2030 - Agricultural land is used only for food production - Decide the extent of the cultivation obligation on the municipality's own agricultural land. - Support drainage projects, erosion control of streams and waterways, as well as ploughing in spring. - Produce food on agricultural land and keep grazing resources in outerlands. - Greater knowledge of local raw materials and seasonal variations for increased utilisation of local raw materials. - Use the municipality's public procurement power to promote local food production. - Active use of communication and participation projects to create awareness and make the population take more responsibility for their own food security. E.g. Joint information campaigns with agricultural organisations.
Impact & cost	Generated renewable energy (if applicable)	N/A
	Removed/substituted energy, volume, or fuel type	N/A
	GHG emissions reduction estimate (total) per emission source sector	N/A
	GHG emissions compensated (natural or technological sinks)	N/A
	Total costs and costs by CO2e unit	Not yet estimated

Strategy for residual emissions

Strategy for residual emissions

Where does the residual emissions stem from?

The residual emissions are hard to abate emissions from (Fig. B8, Tables A-2.3a and A-2.3b):

- **Buildings:**
  - District heating: Residual emissions after implementing CCS. The expected efficiency to remove CO2 is close to 90 percent.
  - Local heating: The residual emissions here are primarily methane and nitrous oxide from the burning of wood. Wood stoves are a small but traditional part of the energy system in Trondheim, and removal of this part of the energy system would be extremely unpopular and therefore difficult to achieve, while achieving marginal emissions reduction and most likely placing more strain on the electricity sector.
  - Electricity: Due to the very low emission factor from renewable wind and hydropower, building renovations are not particularly cost effective and are also quite resource intensive. Thus, it is not in focus in this CCC AP, but there are some national efforts in existing plans/ongoing work.
- **Transport:** There will be some residual emissions from thoroughfare road transport. In addition, the action plan envisages the widespread implementation of shore power for passenger and commercial shipping: This will allow significant reductions in direct emissions from ships both in port and on their approach to and from the harbour, given the availability of batteries onboard. However, it is considered unlikely that all shipping will be able to use this technology by 2030, hence the residual emissions for sea transport.
- **Waste and sewage:** Wastewater from Trondheim is currently emitted to the Trondheim fjord after treatment. Given the size of this body of water these emissions are considered to have minimal impact on the fjord ecosystem. Currently, a fair amount of biological material is converted into methane in the fjord. Upgrading to a more advanced treatment method, which would reduce biological material in the wastewater, is not possible without substantial investment that is not currently under consideration.
- **Industry / IPPU:** The action plan is based on an aggressive scenario for reducing emissions from *energy use* within the industrial section. Much of the residual emissions in 2030 will be from hard-to-abate *industrial processes*.
- **Agriculture / AFOLU:** The emissions from agriculture in the residuals inventory are from three main sources: methane emissions from livestock, emissions from fertiliser stocks, and the emissions from the spread of manure and other farming practices in agricultural fields. A comprehensive analysis carried out by Norwegian Institute for Bioeconomy Research in 2020 concluded that significant reductions from this sector would be extremely difficult to achieve without a radical restructuring of the farming sector within Trondheim.

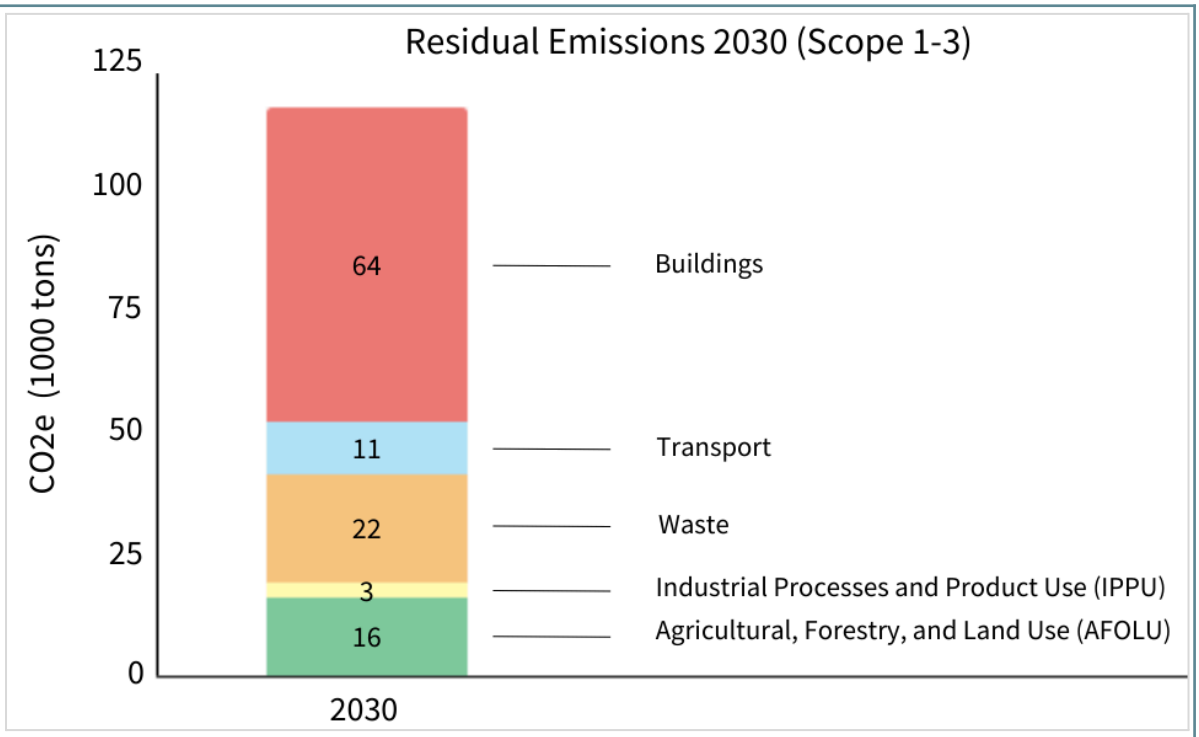


Fig. B8: Residual emissions 2030 in scope 1-3, Trondheim model
After successful implementation of CCC AP (2022-2030, Table A-2.3a)

Compensation by CCS from incineration of waste from biological origin

Trondheim plans to compensate for these emissions - in the short term - by CCS from waste incineration of household waste from all of Mid-Norway. Carbon capture and storage (CCS) makes it possible to capture the carbon from flue gas and store it for the foreseeable future in geologically stable formations several kilometres below the seabed. For our part, it is a goal to capture CO2 from the waste-to-energy plant in Trondheim. This will give us emission-free incineration of the residual waste we cannot recycle, and the surplus heat from this will provide the city with virtually emission-free district heating that covers 30 percent of the city's heating needs. The technology has been tested and similar plans are made in Oslo. There is ongoing work on national level to establish the offshore facilities for the actual CO2-storage by 2025 - the "Longship" project (see the government's information on this here).

Emission figures show that CCS at the incineration plant can contribute to:

- An emission reduction of 90 500 tons CO2e
- 130 000 tons CO2e of negative emissions, which we use to compensate for residual emissions

The emission reductions stem from the incineration of waste with fossil origins, such as plastic and other oil products. These are emissions that human activity adds to the natural carbon cycle, and which contribute to climate change.

What is negative emissions and how can it compensate for other emissions?

Negative emissions occur through the capture and storage of CO2 from the incineration of biogenic waste, such as wood. Biogenic waste makes up about 60 percent of the waste that is incinerated. CO2 from biogenic sources is part of the natural carbon cycle and therefore does not contribute to climate change in the same way as emissions from fossil sources. The emissions are therefore not counted in the emissions accounts - until we capture and remove them from the natural cycle. Then we get negative emissions, which can thus compensate for residual emissions from other sources.

It is still most important to cut emissions: According to the UN, we must cut almost all emissions by 2050 and capture biogenic CO2 on a large scale to avoid the worst effects of climate change.

How about natural absorption of greenhouse gases?

Forests and other vegetation bind and store CO2 from the air through photosynthesis. Photosynthesis is a prerequisite for life on Earth, and a key part of the carbon cycle.

Over time, a lot of carbon is deposited in the soil. However, by 2030 we will not have time to strengthen the natural carbon stores significantly. We can therefore not rely on natural carbon uptake to compensate for residual emissions by 2030, but it is of course important to plan and implement measures that will strengthen the natural carbon stores in the longer term. In the action plan, we describe that we will start with assessing the nature restoration potential and aim for area-neutral government of land use combined with projects to restore nature in line with the UN's biodiversity framework. The work starts now, but the results in form of increasing carbon sinks will not come this decade, but later.

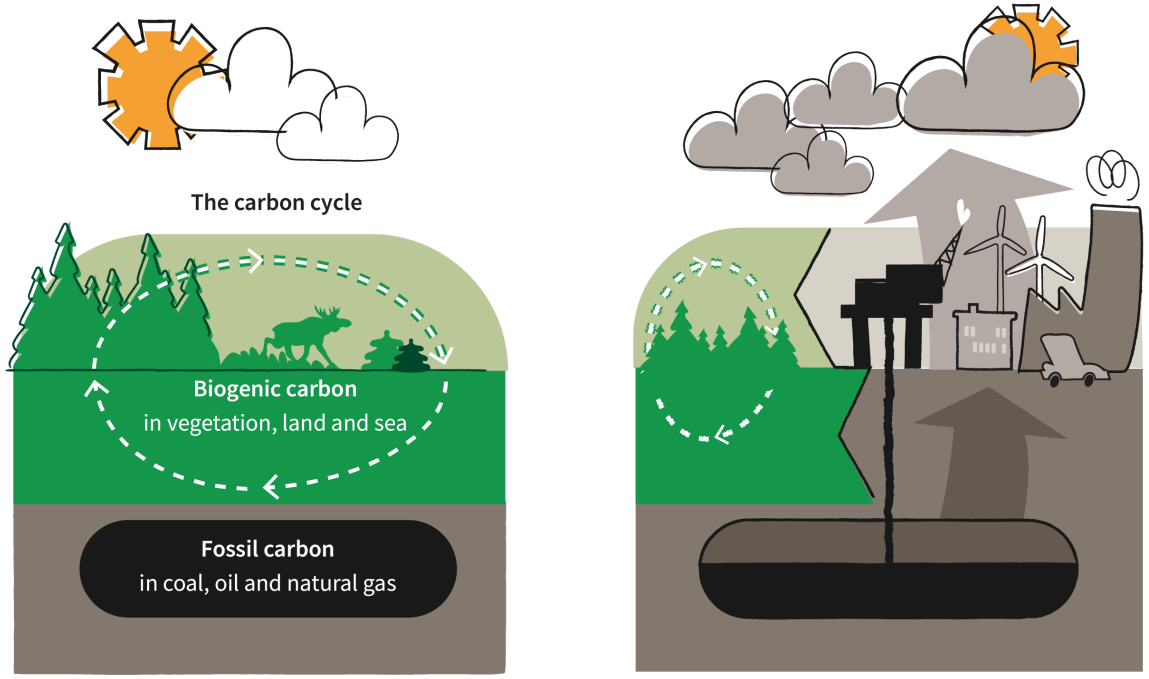


Fig. B9: The carbon cycles
The climate crisis arises when we remove nature and add fossil carbon to the carbon cycle.

Why are natural carbon stores so important?

The climate and nature crises must be solved together: Globally, there is three times more greenhouse gas in the soil than in the atmosphere. To slow down climate change, we must therefore stop the degradation and destruction of nature: Not only does the forest and the possibility of binding and storing CO2 disappear, but when the forest and vegetation die, the carbon stores in the soil are also gradually released into the atmosphere (Fig. B9). Natural habitats such as forests and bogs have larger carbon stores than other natural habitats, and are therefore particularly important to take care of.

Nature is also very well adapted to the stable climate we have had since the last ice age. When we add fossil greenhouse gases, we change the climate faster than nature can adapt. This makes nature's carbon stores more vulnerable and can lead to them not storing, but releasing, CO2. We

must therefore take care of and strengthen nature and agricultural areas. This prevents emissions now and promotes natural uptake of greenhouse gases in the future. At the same time, we become more robust against climate change by maintaining biodiversity, food production and other natural resources.

To conclude, CCS will compensate for residual emissions in the short term. However, at some point, there will be physical limits to how much carbon we can store in the ground. Thus, in the long term we need to cut practically all emissions, and compensate for the residual emission by strengthening the natural carbon sinks over decades, starting now.

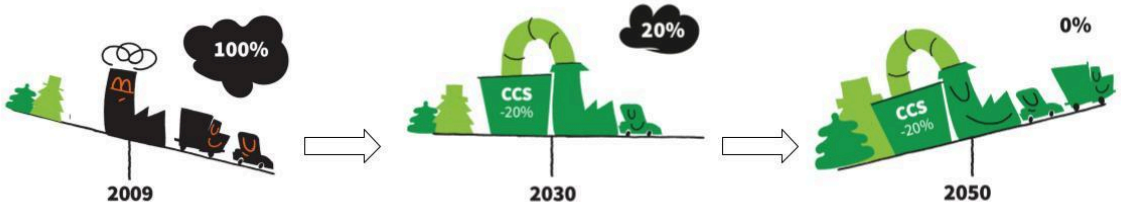


Fig. B10: Short-term (2030) and long-term (2050) compensation strategy

The illustrations above are designed for Klimaløftene, by Klipp og lim AS.

Module B-3 Indicators for Monitoring, Evaluation and Learning

Module B-3 contains a selection of indicators to monitor and evaluate progress along the selected impact pathways and fields of action described in Module B-1, as well as a monitoring and evaluation plan, i.e. metadata on each indicator selected, in addition to milestones and timeline. More specifically:

- *Table B-3.1 is an overview table listing the indicators selected per outcome and impact including targets and evaluation points*
- *Table B-3.2-X are metadata tables for each indicator selected*

Monitoring, Evaluation and Learning (MEL)
Trondheim Municipality has a strong basis for reporting the climate transition. The municipality has been an active participant in lobbying for and establishing the system for municipal GHG inventories managed by the Norwegian Environment Agency. In addition, the integration of the climate action plans/climate budget into the municipal budget plan provides a solid framework for reporting on both progress in the implementation of climate actions and progress towards GHG emissions and other targets. In the climate budget there is a strong focus on the “emissions gap” in the short term, in order to focus on the need for urgent climate action now, precisely in order to achieve longer term goals. Trondheim also reports annually to the CDP/ICLEI track platform. Building on the existing reporting platform will be required in order to follow-up. Our selection of indicators for the CCC AP is supposed to be measurable and relevant for our targets and/or actions. We have chosen indicators based on data availability. We expect to collect data at least annually for most or all indicators and will primarily compare data to a 2022 baseline in our international CDP reporting and the CCC. Where available, for example for the city-wide vehicle fleet, data will be collected more often for the reporting on climate budget twice a year. This reporting is part of the municipal economy reporting and informs the City Council on the status of the climate transition, so they can make possible adjustments to budget allocations. Trondheim has worked in various contexts within the field of data-based learning at the city-level, for example through the projects like United for Sustainable Smart Cities. To mobilise citizens and other stakeholders, we will also consider establishing an on-line “climate barometer”, similar to that published by the City of Oslo. Here, we can provide status and open data on key indicators for Trondheim’s climate transition for others to be informed and engaged. This may also include indicators on environmental, social and economic co-benefits connecting to the developmental goals in Trondheimsløftet (the municipal master plan), which are not included in this CCC AP. Trondheim's CCC shall be implemented, reported and updated in close connection with the existing management routines. In addition to the existing reporting schemes managed by the municipality, the scope of the CCC will also require that we involve other key stakeholders, both public and private, to provide status on their responsible actions. With all data available, we may perform analysis to identify internal and external gaps and challenges. Based on this analysis, Trondheim’s CCC is to be updated and improved.

Table B-3.1: Overview of indicators						
Outcomes/ impacts addressed *List early changes/ late outcomes and impacts to be evaluated by indicator*	**Action/ project** *List action/ pilot project if applicable*	**Indicator ID** *Indicate unique identifier*	**Indicator name**	**Target values** *List one value per indicator*		
				2025	**2027**	**2030**
Cross-sectoral indicators (CS)						
All outcomes that directly affect scope 1 GHG emissions.	Many - see indicator metadata.	CS1	**GHG emission inventory for Norwegian municipalities**	40 % GHG emission cuts since 2009	50 % GHG emission cuts since 2009	80 % GHG emission cuts since 2009 *See also table A-2.3*
Increased nature and climate awareness, engagement and activity among citizens and business and research actors.	Trondheim Green Life	CS2	**Climate engagement**	80 %	80 %	80 %
Indicators on energy systems (E)						
Smarter use of energy avoids a rise in peak demand of power through the day and year.	Engage civil society to scale up local renewable energy production, energy efficiency and consumer flexibility	E1	**Peak power electricity and district heating demand, controlled for outdoor temperature**	600 MW_el 260 MW_DH	600 MW_el 260 MW_DH	600 MW_el 260 MW_DH
Urban development at various scales aim to implement energy solutions that save energy and strengthen the energy system.	Energy analysis	E2	**No. of local energy analyses developed, in relation to area zoning plans**	5	25	50
Investment decision on CCS at the waste incinerator	E2.2: CCS from waste incineration	E3	**Investment decision CCS**	Preliminary	Final	…
Plans on how to phase out fossil fuel at small and medium sized industry facilities. Financial solution to phase out fossil fuel et Rockwool	I2.1: Phase out fossil fuel from Rockwool facility	E4	**Phase out fossil fuel at Rockwool facility**		Plan and financial solution ready	Done

Upgrades of hydropower plants are in progress.	Upgrades of hydropower plants	E5	**Progress to upgrade hydropower plants**	Good progress	Good progress	Upgrades complete
Licence is granted for upgrading power lines and grid stations.	Upgrades in the electricity grid	E6	**Progress upgrading the electricity grid**		Good progress	Upgrades complete
Plans on how to phase out fossil fuel at small and medium sized industry facilities.	I3.1: Energy transition in industry	CS1	GHG emission inventory for Norwegian municipalities	2000	8000	13400
Construction sites and buildings phase out fossil fuel for heating/drying purposes	O2.1 / 2.2: Phase out gas for heating from construction sites and buildings	CS1	GHG emission inventory for Norwegian municipalities	500	3000	6000
Indicators on mobility and transport (MT)						
See also CS1 - GHG emission inventory for Norwegian municipalities						
Good progress reducing car traffic 20 % by 2030.* Increased amount of people commute by walking, bike, other emission free micro-mobility or use public transport.* Increased amount of children walk or bike or use public transport to school.*	(*Miljøpakken*)	MT1	**Green personal transport**	50 %	55 %	60 %
Good progress reducing car traffic 20 % by 2030.*	*(Miljøpakken)*	MT2	**Car traffic reduction**	5 %	10%	20%
Zero-emission city buses are getting implemented for 2029.* Emission free ferries are on track for 2029.	(*Miljøpakken*) S2.2 / 2.3 / 3.1: Emission free public ferries and speed ferries.	MT3	**Emission free public transport on sea and at land**	Speed ferries, some city-buses	Investment decisions all buses and ferries	Buses and ferries implemented
Practically all vehicles are emission free.	T2.3 / 2.4: Zero emission vans (procurement and infrastructure) T3.1: Zero emission zone for passenger cars.	MT4	**Emission free vehicles**	Cars: 45 % Vans: 30 % Heavy vehicles: 20 %	Cars: 75 % Vans: 60 % Heavy vehicles: 50 %	90-100 %

	T3.2 / 3.3 / 3.4: Zero emission zone for vans, heavy vehicles and buses.					
Restrictive policies on fossil fuel vehicles. We are allowed and ready to implement zero mission zones.	T3.1: Zero emission zone for passenger cars. T3.2 / 3.3 / 3.4: Zero emission zone for vans, heavy vehicles and buses.	MT5	**Zero emission zone**	Local authority to implement	Announced for 2030	Implemented
Indicators on built environment						
See CS1 - GHG emission inventory for Norwegian municipalities. *See also "energy systems" and "waste and the circular economy"*						
Indicators on waste and circular economy (CE)						
Increased collection of food waste, plastic packaging, glass and metals.	New or improved systems for waste sorting and material recovery	CE1	**Amount of sorted plastic packaging by source**		50 % in 2028	60 %
Increased collection of food waste, plastic packaging, glass and metals.	New or improved systems for waste sorting and material recovery	CE2	**Amount of sorted food waste by source**	55 %		60 %
Increased collection of food waste, plastic packaging, glass and metals.	New or improved systems for waste sorting and material recovery	CE3	**Amount of sorted glass and metal packaging by source**		85% in 2028	90 % from 2035
Less waste produced	Citizen-directed activities for reduced consumption and increased reuse, repair and sharing.	CE4	**Amount of collected household waste**			
More waste from households is reused.	Increased reuse of household waste.	CE5	**Amount of household waste for reuse**			3 %

Increased reuse from the recycling centre and local recycling stations.	Reuse centre (gjenbrukslageret)	CE6	**Reuse at reuse centre (tons)**	400	800	1200
Increased reuse from the recycling centre and local recycling stations.	Reuse centre (gjenbrukslageret)	CE7	**Emission cut at reuse centre (tons CO2e scope 1-3)**	300	750	1100
Less food waste.	New or improved systems for waste sorting and material recovery	CE8	**Food waste reduction**			50 % reduction
More waste from households is reused.	E2.1: SESAM plant…	CE9	**SESAM: Reduced CO2 emissions**			Ongoing calculations
More waste from households is reused.	E2.1: SESAM plant…	CE10	**SESAM: Increased sorting of plastic from waste**			70 %
More waste from households is reused.	E2.1: SESAM plant…	CE11	**SESAM: Increased sorting of metals from waste**			90 %
Indicators on viable nature (VN)						
Map areas in Trondheim with restoration potential	Assess and communicate the nature restoration potential	VN1	**Nature restoration potential**	To be defined.		
Natural carbon stocks are mapped and estimated.	Map and communication on carbon rich nature areas	VN2	**Natural carbon stocks**	To be defined.		

Tables B-3.2-X: Metadata tables for each indicator selected

Cross-sectoral indicators

B-3.2-CS1: Indicator Metadata	
Indicator Name	**GHG emission inventory for Norwegian municipalities**
Indicator Unit	Tons CO2e
Definition	Inventory on scope 1 GHG emissions for each municipality.
Calculation	Complex - see references under. Based on bottom-up activity data.
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	Yes
If yes, which emission source sectors does it measure?	Energy systems, including local and district heating of buildings and construction sites. Mobility and transport, including aviation and sea transport. The built environment, including machinery on construction sites. Waste and circular economy: Please note that GHG emissions from waste incineration are reported under district heating in energy systems.
Does the indicator measure indirect impacts (i.e., co- benefits)?	No
If yes, which co-benefit does it measure?	N/A
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Energy systems: - E2.2: CCS from waste incineration, when implemented. - I2.1: Phase out fossil fuel from Rockwool - I3.1: Energy transition in industry - O2.1 / 2.2: Phase out gas for heating construction sites and buildings Mobility and transport: - T2.1 / 2.2: Improved logistics for goods transport - T2.3 / 2.4: Zero emission vans - T3.1: Zero emission zone (ZEZ; for passenger cars) - T3.2 / 3.3 / 3.4: Zero emission zones (ZEZs; for vans, heavy vehicles and buses) - S2.2 / 2.3 / 3.1: Emission free public ferries and speed ferries. - S3.2: Mandatory use of shore power and battery operation for all cruise ships, freighters and tankers The built environment: - AT1.2 / 2.2 / 3.1: Emission free off-road mobile machinery Waste and circular economy: - E2.1: SESAM plant for post-sorting of residual waste - See also E2.2 under energy systems.
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	CDP C.03
Data requirements	
Expected data source	Norwegian environment agency
Is the data source local or regional/national?	Local
Expected availability	Annually, with one year lag.
Suggested collection interval	Annually.
References	
Deliverables describing the indicator	www.miljodirektoratet.no/contentassets/e4256c220b7a49e99cb5ae89f5c99813/qaqc-documentation_regionalgreeenhousegasemissioninventory_norway_201906252.pdf
Other indicator systems using this indicator	

B-3.2-CS2: Indicator Metadata	
Indicator Name	**Climate engagement**
Indicator Unit	Percentage
Definition	Amount of citizens supporting that “it is important that Trondheim cuts 80 % of our direct emissions by 2030”.
Calculation	Survey among citizens
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Citizen engagement
Is the indicator useful for monitoring the output/impact of action(s)?	This indicator is useful to assess the overall support to the local climate transition.
If yes, which action and impact pathway is it relevant for?	Impact Pathways according to Module B-1 This indicator is particularly relevant to actions related to communication and citizen participation, such as: - Energy systems: Engage civil society to scale up local renewable energy production, energy efficiency and consumer flexibility. - Mobility and transport: T3.1: Zero emission zone (ZEZ; for passenger cars) - or other strong regulations affecting mobility. - Waste and circular economy: Citizen-directed activities for reduced consumption and increased reuse, repair and sharing.
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	Local climate survey
Is the data source local or regional/national?	Local
Expected availability	Annually
Suggested collection interval	Annually
References	
Deliverables describing the indicator	N/A
Other indicator systems using this indicator	MT7

Energy systems

B-3.2-E1: Indicator Metadata	
Indicator Name	**Peak power electricity and district heating demand, controlled for outdoor temperature**
Indicator Unit	MW
Definition	Measured for electricity and district heating
Calculation	Controlled for outdoor temperature
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Avoid increased transmission costs, if we avoid increased grid capacity. Lower energy costs if we share and utilise surplus energy, and increase local production.

	Increased energy efficiency and utilisation of local energy sources according to local possibilities and constraints. Avoid inefficient investments in energy systems.
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Energy systems: - (Engage citizens and NGOs) - Upgrades of hydropower plants. - Upgrades in the electricity grid.
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	CDP 4.1.3 relevant
Data requirements	
Expected data source	Data from the distribution system operator for electricity (DSO, Tensio). Data from the district heating company (Statkraft)
Is the data source local or regional/national?	Local
Expected availability	Good
Suggested collection interval	Annually
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	-

B-3.2-E2: Indicator Metadata	
Indicator Name	**Number of local energy analyses developed, in relation to area zoning plans**
Indicator Unit	
Definition	
Calculation	Counted by the municipality, as the results are reported through the processing of applications
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Lower energy costs if we share and utilise surplus energy, and increase local production.
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	- Governance and policy - Learning and capabilities
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	Data from the municipal processing of private land use plans
Is the data source local or regional/national?	Local
Expected availability	Good
Suggested collection interval	Annually
References	
Deliverables describing the indicator	N/A
Other indicator systems using this indicator	N/A

B-3.2-E3: Indicator Metadata	
Indicator Name	**Investment decision CCS**
Indicator Unit	**Yes/no**
Definition	It is under planning a preliminary investment decision in 2025 and a final investment decision in 2027: Are they positive?
Calculation	N/A
Indicator Context	

Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	No
If yes, which co-benefit does it measure?	N/A
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Energy systems: - E2.2: CCS from waste incineration
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	CDP 9.3
Data requirements	
Expected data source	Collaboration between the district heating company and the municipality
Is the data source local or regional/national?	Local
Expected availability	Good
Suggested collection interval	2025, 2027
References	
Deliverables describing the indicator	N/A
Other indicator systems using this indicator	N/A

B-3.2-E4: Indicator Metadata	
Indicator Name	**Phase out fossil fuel at Rockwool facility**
Indicator Unit	Progress on track to 2030?
Definition	Plan and financial solution should be in place by 2027 to cut emissions by 2030.
Calculation	Information from Rockwool facility
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	No
If yes, which co-benefit does it measure?	N/A
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Energy systems: - I2.1: Phase out fossil fuel from Rockwool facility
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	The Rockwool facility in Trondheim
Is the data source local or regional/national?	Local
Expected availability	Good
Suggested collection interval	Annually
References	
Deliverables describing the indicator	N/A
Other indicator systems using this indicator	N/A

B-3.2-E5: Indicator Metadata	
Indicator Name	**Progress to upgrade hydropower plants**
Indicator Unit	Progress on track to 2030?
Definition	Defined by operator
Calculation	Information from operator Statkraft
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No

If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	No
If yes, which co-benefit does it measure?	N/A
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Energy systems: - Upgrades hydropower plants
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	Statkraft
Is the data source local or regional/national?	Local
Expected availability	Good
Suggested collection interval	Annually
References	
Deliverables describing the indicator	N/A
Other indicator systems using this indicator	N/A

B-3.2-E6: Indicator Metadata	
Indicator Name	**Progress upgrading the electricity grid**
Indicator Unit	Progress on track to 2030?
Definition	Defined by operators
Calculation	Information from Statnett and Tensio
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	No
If yes, which co-benefit does it measure?	N/A
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Energy systems: - Upgrades in the electricity grid
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	Statnett and Tensio
Is the data source local or regional/national?	Local
Expected availability	Good
Suggested collection interval	Annually
References	
Deliverables describing the indicator	N/A
Other indicator systems using this indicator	N/A

Mobility and transport

B-3.2-MT1: Indicator Metadata	
Indicator Name	**Green personal transport**
Indicator Unit	Share of trips
Definition	Amount of travels that are not done by car
Calculation	Survey
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No

If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Active and healthy transport
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Mobility and transport: - (*Miljøpakken*)
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	CDP 4.5
Data requirements	
Expected data source	Travel habit survey
Is the data source local or regional/national?	National, with additional local data
Expected availability	Good
Suggested collection interval	Annual
References	
Deliverables describing the indicator	https://miljopakken.no/wp-content/uploads/2023/08/rvu-trondheimsregionen-2022.pdf
Other indicator systems using this indicator	-

B-3.2-MT2: Indicator Metadata	
Indicator Name	**Car traffic reduction**
Indicator Unit	Percent
Definition	Compared to baseline year (2019)
Calculation	Based on traffic data
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Reduced car traffic makes the city healthier, safer and more accessible.
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Mobility and transport: - (*Miljøpakken*)
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	CDP 4.5
Data requirements	
Expected data source	Local traffic data
Is the data source local or regional/national?	Local
Expected availability	Good
Suggested collection interval	Annual
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	-

B-3.2-MT3: Indicator Metadata	
Indicator Name	**Emission free public transport on sea and at land**
Indicator Unit	Description of status
Definition	Progress on plans to make the public transport emission free in 2029
Calculation	N/A
Indicator Context	

Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	No
If yes, which co-benefit does it measure?	N/A
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Mobility and transport: - (*Miljøpakken* - emission free buses) - S2.2 / 2.3 / 3.1: Emission free public ferries and speed ferries
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	*Miljøpakken* / Trøndelag County Authority / AtB
Is the data source local or regional/national?	Regional
Expected availability	Good
Suggested collection interval	Annual
References	
Deliverables describing the indicator	N/A
Other indicator systems using this indicator	-

B-3.2-MT4: Indicator Metadata	
Indicator Name	**Emission free vehicles**
Indicator Unit	Percent
Definition	Amount of emission free cars, vans and heavy vehicles
Calculation	Data from register
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	Yes
If yes, which emission source sectors does it measure?	Transport
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	The amount of emission free vehicles are closely linked to the air pollutant NO_2 (annual average)
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Mobility and transport: - T2.3 / 2.4: Zero emission vans (procurement and infrastructure). - T3.1: Zero emission zone for passenger cars. - T3.2 / 3.3 / 3.4: Zero emission zone for vans, heavy vehicles and buses.
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	National register on vehicles (*OFV Statistikk*)
Is the data source local or regional/national?	National
Expected availability	Good, monthly
Suggested collection interval	Annual
References	
Deliverables describing the indicator	General info in Norwegian: https://ofv.no/produktinfo/ofv-statistikk-norges-beste-verktoy-for-kjoretoystatistikk
Other indicator systems using this indicator	-

B-3.2-MT5: Indicator Metadata	
Indicator Name	**Zero emission zone (ZEZ)**
Indicator Unit	Description of status
Definition	Progress on the need and access to implement ZEZ
Calculation	N/A
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	No
If yes, which co-benefit does it measure?	N/A
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Mobility and transport: - T3.1: Zero emission zone for passenger cars. - T3.2 / 3.3 / 3.4: Zero emission zone for vans, heavy vehicles and buses.
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	National authorities
Is the data source local or regional/national?	National
Expected availability	Good
Suggested collection interval	Annual
References	
Deliverables describing the indicator	N/A
Other indicator systems using this indicator	-

Waste and the circular economy

B-3.2-CE2: Indicator Metadata	
Indicator Name	**Amount of sorted plastic packaging by source**
Indicator Unit	Ton or percentage
Definition	Amount collected and percentage of total amount
Calculation	Weight of collected plastic packaging. Weight of collected plastic packaging/total amount of waste collected.
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Less residual waste. Increased circularity/resource efficiency.
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Waste and circular economy: - New or improved systems for waste sorting and material recovery
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	Data on collected household waste

Is the data source local or regional/national?	Local - Trondheim
Expected availability	Good
Suggested collection interval	Annual
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	The Norwegian fulfilment of EU regulations. KOSTRA/SSB: amount of food collected

B-3.2-CE2: Indicator Metadata	
Indicator Name	**Amount of sorted food waste by source**
Indicator Unit	Ton or percentage
Definition	Amount collected and percentage of total amount
Calculation	Weight of collected food waste. Weight of collected food waste/total amount of waste collected.
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Less residual waste. Increased circularity/resource efficiency via production of biogas and biofertilizer from the food waste.
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Waste and circular economy: - New or improved systems for waste sorting and material recovery
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	Data on collected household waste
Is the data source local or regional/national?	Local - Trondheim
Expected availability	Good
Suggested collection interval	Annual
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	The Norwegian fulfilment of EU regulations. KOSTRA/SSB: amount of food collected

B-3.2-CE3: Indicator Metadata	
Indicator Name	**Amount of sorted glass and metal packaging by source**
Indicator Unit	Ton og percentage
Definition	Increased collection of glass and metal packaging from household waste
Calculation	Collected volume (tons) of glass and metal packaging from household waste. Collected volume (tons) of glass and metal packaging from household waste/ Total volume (tons) of household waste
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Less residual waste. Increased circularity/material recovery.

Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Waste and circular economy: - New or improved systems for waste sorting and material recovery
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	Data on collected household waste
Is the data source local or regional/national?	Local, for Trondheim
Expected availability	Good
Suggested collection interval	Annual
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	The Norwegian fulfilment of EU regulations. KOSTRA/SSB: amount of food collected

B-3.2-CE4: Indicator Metadata	
Indicator Name	**Amount of collected household waste**
Indicator Unit	Ton
Definition	Total amount of collected household waste
Calculation	Measured
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Reduced consumption Less waste
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Waste and circular economy - Citizen-directed activities for reduced consumption and increased reuse, repair and sharing. - Increased reuse of household waste
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	Data of collected household waste
Is the data source local or regional/national?	Local - Trondheim
Expected availability	Good
Suggested collection interval	Annual
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	The Norwegian fulfilment of EU regulations. KOSTRA/SSB: amount of food collected

B-3.2-CE5: Indicator Metadata	
Indicator Name	**Amount of household waste for reuse**
Indicator Unit	Ton og percentage
Definition	Amount of reused household waste
Calculation	Total amount of reused household waste Total amount of reused household waste / Total amount of household waste collected
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No

If yes, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Reduced waste production. Reduced consumption. Increased circularity.
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Waste and circular economy: -
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	CDP 4.7
Data requirements	
Expected data source	Data of collected and reused household waste
Is the data source local or regional/national?	Local, for Trondheim
Expected availability	Good
Suggested collection interval	Annual
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	The Norwegian fulfilment of EU regulations. KOSTRA/SSB: amount of food collected

B-3.2-CE6: Indicator Metadata	
Indicator Name	**Reuse at reuse centre**
Indicator Unit	Tons
Definition	Waste savings
Calculation	Weight of reused materials
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	NA
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Waste reduction Reuse of materials
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Waste and circular economy: - Reuse centre (portfolio 3)
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	Loopfront database.
Is the data source local or regional/national?	Local/regional
Expected availability	High/good
Suggested collection interval	Annual
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	-

B-3.2-CE7: Indicator Metadata	
Indicator Name	**Emission cut at reuse centre**
Indicator Unit	Tons CO2e
Definition	Avoided emissions from comparable new materials.
Calculation	Based on A1 - A4 GWP from EPD.
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	Yes

If yes, which emission source sectors does it measure?	Reduced emissions from extraction of raw materials, production and transport of the final material or product.
Does the indicator measure indirect impacts (i.e., co- benefits)?	No
If yes, which co-benefit does it measure?	N/A
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Waste and circular economy: - Reuse centre (portfolio 3)
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	EPD-Norge, One-click LCA, Loopfront
Is the data source local or regional/national?	National
Expected availability	Good, but limited coverage of materials in present time
Suggested collection interval	Annual
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	-

B-3.2-CE8: Indicator Metadata	
Indicator Name	**Food waste reduction**
Indicator Unit	Ton or percentage
Definition	Reduced amounts of food loss
Calculation	Waste analysis
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Reduced consumption and food waste.
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Waste and circular economy - Citizen-directed activities for reduced consumption and increased reuse, repair and sharing.
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	CDP 4.7 relevant
Data requirements	
Expected data source	Data from waste analyses of a limited amount of waste from different parts of the city
Is the data source local or regional/national?	Local
Expected availability	Good, with some uncertainties in such analyses
Suggested collection interval	Every two years
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	-

B-3.2-CE9: Indicator Metadata	
Indicator Name	**SESAM: Reduced CO2 emissions**
Indicator Unit	Tons CO2e
Definition	The reduced amount of CO2 emissions from waste-to-energy plant compared with the full life cycle analysis of ‘cradle to grave’ for materials sorted out in a mixed waste sorting facility.
Calculation	Calculation of estimates ongoing. Full life cycle analysis planned when location and plant design is completed.

Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	Yes
If yes, which emission source sectors does it measure?	I.4 Energy industries
Does the indicator measure indirect impacts (i.e., co- benefits)?	No
If yes, which co-benefit does it measure?	No
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Waste and circular economy: - E2.1: SESAM plant…
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	Life cycle analysis of SESAM sorting facility and its output, compared with incineration of waste.
Is the data source local or regional/national?	Local or regional, depending on the final location.
Expected availability	A third party analysis will be publicly available.
Suggested collection interval	Full analysis when location is determined and plant design decided.
References	
Deliverables describing the indicator	Will follow the analysis
Other indicator systems using this indicator	Unknown at this point

B-3.2-CE10: Indicator Metadata	
Indicator Name	**SESAM: Increased sorting of plastic from waste**
Indicator Unit	Percentage (%)
Definition	Percent of plastic sorted out from residual waste and sent to material recovery.
Calculation	Tonnes of sorted plastic / tonnes of plastic in residual waste * 100%
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Less residual waste. Increased amount of plastics recovered. Reduced usage of virgin, fossil plastics. Less plastic lowers the fossil share of CO2-emissions from incineration of waste.
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Waste and circular economy: - E2.1: SESAM plant…
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	The SESAM post-sorting waste facility
Is the data source local or regional/national?	Local or regional, depending on the final location
Expected availability	Real-time availability of data in the sorting facility
Suggested collection interval	Monthly
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	The Norwegian fulfilment of EU regulations. KOSTRA/SSB

B-3.2-CE11: Indicator Metadata	
Indicator Name	**SESAM: Increased sorting of metals from waste**
Indicator Unit	Percentage (%)
Definition	Percent of metals sorted out from residual waste and sent to material recovery
Calculation	Tonnes of sorted metals / tonnes of metals in residual waste * 100%. (Tonnes of sorted metals will be a sum of metals sorted through source separation and SESAM sorting).
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Less residual waste. Increased amount of metals recovered. Reduced extraction of virgin metals.
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Waste and circular economy: - E2.1: SESAM plant…
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	The SESAM post-sorting waste facility
Is the data source local or regional/national?	Local or regional, depending on the final location
Expected availability	Real-time availability of data in the sorting facility
Suggested collection interval	Monthly
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	The Norwegian fulfilment of EU regulations. KOSTRA/SSB

Viable nature

B-3.2-VN1: Indicator Metadata	
Indicator Name	**Nature restoration potential**
Indicator Unit	Classification to be set
Definition	Identify areas and degree of potential for restoration.
Calculation	Areas with potential for nature restoration will be identified via geo-information systems.
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	No
If yes, which co-benefit does it measure?	N/A
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	- Assess and communicate the nature restoration potential
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	CDP - relevant in climate adaptation
Data requirements	
Expected data source	Database
Is the data source local or regional/national?	Local

Expected availability	Not yet known
Suggested collection interval	Annual or less
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	-

B-3.2-VN2: Indicator Metadata	
Indicator Name	**Natural carbon stocks**
Indicator Unit	Tons of carbon
Definition	Develop a database over carbon rich areas with special focus on peatlands and forests and their carbon contents.
Calculation	Data on forests are available through the forest taxation system. Data on peatlands must be acquired by field work, LIDAR or other methodology for quantification of peatland volumes.
Indicator Context	
Does the indicator measure direct impacts (reduction in GHG emissions?)	No
If yes, which emission source sectors does it measure?	N/A
Does the indicator measure indirect impacts (i.e., co- benefits)?	Yes
If yes, which co-benefit does it measure?	Natural carbon stocks
Is the indicator useful for monitoring the output/impact of action(s)?	Yes
If yes, which action and impact pathway is it relevant for?	Viable nature: - Map and communication on carbon rich nature areas - Over time: Restore nature
Is the indicator captured by the existing CDP/ SCIS/ CoM platforms?	No
Data requirements	
Expected data source	Database
Is the data source local or regional/national?	Local
Expected availability	Not yet known
Suggested collection interval	Annual or less
References	
Deliverables describing the indicator	-
Other indicator systems using this indicator	-

Part C – Enabling Climate Neutrality by 2030

Part C "Enabling Climate Neutrality by 2030" aims to outline any enabling interventions, i.e., regarding organisational setting or collaborative governance models or related to social innovations – designed to support the climate action portfolios (Module B-2) as well as aiming to achieve co-benefits outlined in the impact pathway (Module B-1). These interventions also address the identified opportunities, gaps and barriers identified Module A-2 and A-3.

Module C-1 Governance Innovation Interventions

Module C-1 details the city´s governance innovations for achieving climate neutrality by 2030, describing innovations in institutional design, in leadership, and in collaborative and outreach processes, whether they are internal or inter-organisational.

Description of the participatory governance innovations

Participatory and collaborative governance is vital for success in Trondheim's climate transition. The municipality should start from mechanisms that mobilise its own organisation for continuous improvements. Module A-3 presents a stakeholder mapping in the quadruple-helix manner. We describe governance innovation in the same structure here.

Climate governance within Trondheim Municipality

June 2024 was a historic moment in Trondheim's political landscape: The municipality turned into the parliamentary governance model after 187 years of chairmanship model. The municipal administration is being restructured, and it takes time for the organisation to adjust to new routines.

The Department of Climate and Environment has had the coordinating responsibility for planning and reporting of the municipal energy and climate plan. During the implementation phase of the previous plan adopted in 2017, one of the focuses was to increase the working capacity in other departments. This resulted in an enlarged climate team in the municipal organisation. Colleagues in other departments used to be referred to as "satellites". Later we renamed it ***Team Climate***. Now when Klimaløftene was adopted and the new parliamentary governance model introduced, we should also strengthen Team Climate and connect it closer to the parliamentary leadership, so that it enables climate actions to take place where the responsibilities sit.

Climate budgeting has been recognised as an important governance innovation by the ZERO Foundation as Local Climate Measure of the Year in 2021. Trondheim was one of the pioneers in this. ***Climate budget*** has been annually revised as part of the municipal budget since 2018. It is to be revised according to Klimaløftene, the new energy and climate plan.

Climate governance that strengthens partnership and collaboration

★ **Government**

Multi-level governance refers to the system that supports policy and decision-making among national, regional, and local governments. When these levels of government work well together, policies are more likely to succeed, fostering development in all places, according to OECD.

The Norwegian Environmental Agency (NEA) has the main responsibility to coordinate climate transition at the national level. They publish GHG emissions inventory for all municipalities, manage the funding scheme Klimasats and offer various types of support for climate and nature efforts at local level. Here is an overview. Trondheim is an active user of the supporting programmes. We shall also enhance multi-level governance together with other major cities in Norway.

- ***Miljøpakken*** is a multi-level partnership for sustainable mobility in the Trondheim Region, established in 2008. In cooperation, municipalities, county and state invest in new infrastructure to facilitate increased biking, walking and use of public transport.
- ***Urban Growth Agreements*** between the state, counties and municipalities have been established to enhance the integration of land use and transport policy in order to achieve a national goal of zero growth in personal car transport. They include considerable state financing of transport projects in order to promote public transport, biking and pedestrians. The latest version for the Trondheim region covers 2023-2029.
- ***Collaboration between major cities.*** The four largest Norwegian cities, Oslo, Bergen, Trondheim and Stavanger, meet regularly on climate issues for information exchange and joint actions. In recent years, they have made joint statements annually, advocating central issues in urban climate transition.
- ***Norwegian Cities Mission Forum*** was initiated in light of the EU Cities Mission, with the Norwegian Ministry of Local Government and Regional Development as the national contact and DOGA as the coordinator. Other than the three Norwegian mission cities, some other major cities with mission-oriented focus were also invited to join. The goal is to strengthen multi-level governance and to bring in systemic levers needed.

★ **Business**

- ***Renergy Cluster.*** Trondheim Municipality is one of the partners that initiated Renergy, the Renewable Energy Cluster, in 2017. This innovation cluster works for sustainable value creation and the transition to a renewable society by promoting innovation, increased production and efficient use of renewable energy and related technologies. 100 companies and organisations participate, covering the whole value chain.
- ***Klimapartnere Trøndelag.*** Klimapartnere is a national partnership operating in all regions, currently with more than 400 partners in both public and private sectors. Trondheim Municipality has been a partner since 2018. The climate partners participate actively, set clear goals, share knowledge - and work on climate transition in their own organisation. The efforts are anchored at top-level leadership. The partners submit yearly climate accounting.
- ***Sustainability Networks.*** The UN Sustainable Development Goals (SGDs) have gained momentum in the private sector through focus on ESG (environmental, social and governance). In Trondheim and Mid-Norway, surveys such as Bærekraftsbarometer (Sparebank 1 SMN) and Løypemeldingen (PwC) were made to track the development. The Chamber of Commerce in the Trondheim Region (NiT) also recently launched a network for those who are in charge of sustainability issues in their member companies.
- ***Trondheim Green Deal.*** This is a proposed action in Trondheim's first CCC, in order to mobilise and seek synergies while focusing more strategically on the five focus areas for Trondheim's climate transition. Another key strategic priority is to attract climate finance and investment, with closer connection to the European Green Deal.

★ **Research and innovation**

- ***University City TRD3.0.*** In 2018 as a national pilot, the Norwegian University of Science and Technology (NTNU) and Trondheim Municipality entered into a partnership agreement to jointly develop a University City. With a duration of eight years, it aims to develop a model for innovation and restructure the public sector through research, innovation, education.
- A ***cooperation agreement*** was signed ***between Trondheim Municipality and SINTEF***, first for 2020-2022 and later revised for 2023-2027, with the goal to strengthen systematic and long-term collaboration. "Climate, environment and circular economy" is one of the two focus areas.
- ***Gemini-Centre "Towards 100 climate-neutral and socially innovative cities"*** is a collaboration between NTNU and SINTEF during 2021-2025, following up opportunities in the EU Cities Mission and Horizon Europe. An agreement on climate-neutral Trondheim was signed in 2022 between Trondheim Municipality, NTNU and SINTEF to highlight

research and innovation as enabler in Trondheim's climate transition, while the municipal energy and climate plan was about to be revised.

★ Civic society

Engaged citizens can play a critical role in making cities more transparent, accountable, and effective, and contributing innovative solutions to development challenges such as the climate transition. The participation ladder from Distriktsenteret (Fig. C1) is a well-illustrated tool for the municipalities when planning and implementing citizen involvement. The municipalities shall make an active choice about the level (five steps in the staircase: information, dialogue, collaboration, co-determination and decision) on the basis of the desired degree of participation in the various phases of the development work.

Fig. C1: The participatory ladder for citizen engagement

In 2019, the Trondheim City Council adopted "Trondheim - the co-created municipality", with the aim to put more focus on participatory mechanisms. This is also to be applied for the climate transition.

- ***Annual climate survey***. Since 2017, Trondheim Municipality has conducted an annual climate survey to get an update about the public opinions on the climate transition. The questionnaire covers the respondents' attitudes about climate change, their support for Trondheim's climate measures and the individual behaviours within certain focus area(s). The results over years are comparable and provide important insights.
- ***Participatory citizen consultation*** (when making municipal plans). The revision of Klimaløftene, the municipal energy and climate plan, included many rounds of consultations with the citizens and citizen groups. The activities are still in the lower steps of the participatory ladder: information and dialogues.
- ***Citizen panel.*** This mechanism will be (re)designed and tested in the Pilot Cities project connected to CCS at the waste-to-energy plant, a key action for our climate neutrality.
- ***Trondheim Green Life.*** This is a proposed action in Trondheim's first CCC, in order to engage the citizens in making Trondheim a greener and more circular city. As a start, Trondheim Municipality shall publish the climate and environment status in a more citizen-friendly way. We shall then invite citizens to co-create green solutions that have an impact on their everyday life. Environmental NGOs can be good partners for this.

Module C-2 Social Innovation Interventions

Module C-2 presents examples of actions to support and foster social innovation initiatives or non-technological innovation more broadly (e.g., in entrepreneurship, social economy, social awareness & mobilisation, social cohesion and solidarity, etc).

Description of social innovation interventions

In Trondheim's climate transition, citizens have to play an active role as change makers. Following the description about participatory governance for civic society in module C-1, we take a closer look at how the municipality may empower and enable the Trondhjemmers through various types of social innovation.

Who are the "citizens", really?

The citizens are people of all kinds, in all stages of life, with different economic status and value systems. They are students, families with small childrens, elderly pensionists. They are environmental activists or can be skeptical about whether climate change is man-made. In our climate communication strategy, we start from making assessments of various target groups so that we can address the messages and communicate more effectively, especially if we are expecting to stimulate behaviour changes. Below is an example of such an assessment.

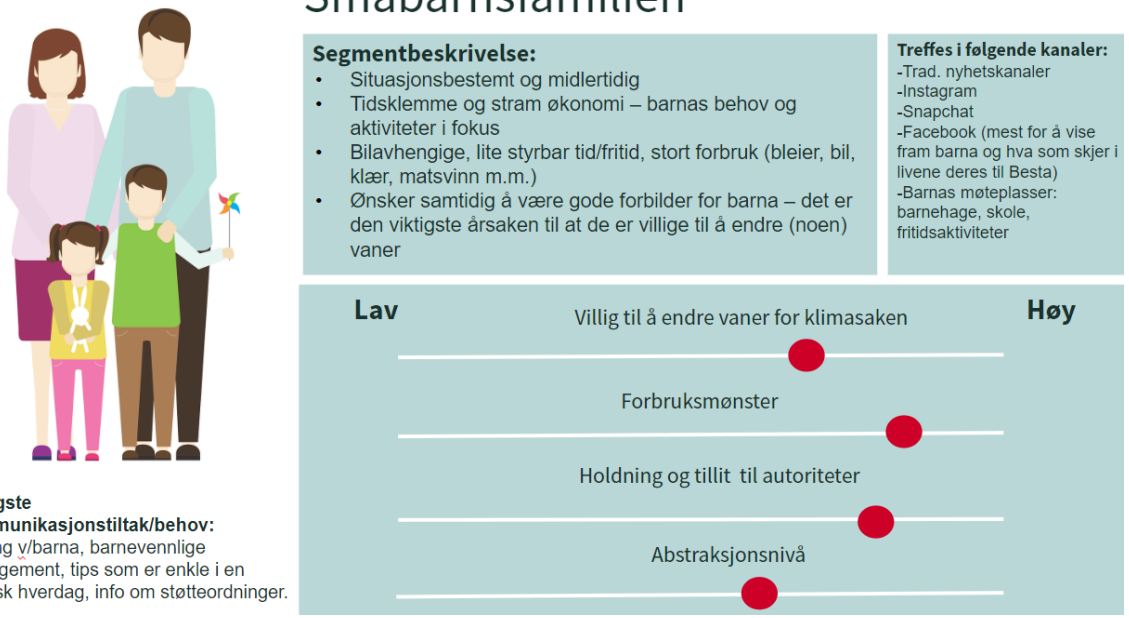


Fig. C2: Example of target group assessment - family with small children

Some examples of social innovation interventions

Trondheim Municipality has several good practices that drive social innovation already. Going forward, we shall seek more collaborations for outreach and synergies.

★ Transition at neighbourhood level

Neighbourhoods are often addressed as change units in urban transitions. Several projects such as +CityxChange and FME ZEN already put focus on neighbourhoods. *Områdesatsing* is a program in Trondheim that aims to give less well-off neighbourhoods a strategic lift. The processes are carried

out intensively in co-creation format, both to improve physical infrastructure and to enhance place identity.

★ **Entrepreneurship**

Trondheim has a high percentage of student population. The high intensity of research and development often results in start-ups and commercialisation. Trondheim's climate transition should make room for testing and upscaling of innovative solutions. *Climathon* and *Ungt entrepreneurskap* are some programs we are active in.

★ **Funding schemes for citizen actions**

Trondheim Municipality provides various funding schemes for citizens and housing associations to apply, such as urban farming and vehicle charging infrastructure. We have also tried *Klimamillion* and *Climathon for citizens* to give financial support for the citizens' own green initiatives. In addition to municipal funding, we may also look into banks and other private funding opportunities.

★ **Just transition**

Trondheim Municipality was a partner in the *COJUST* research project, which aimed to co-produce energy and climate policies with and for low-income groups in Norway. During the revision of Klimaløftene, we have also had dialogues with those who provide welfare and social support. This gave us important insight to develop effective and fair measures that have support in the population.

★ **Knowledge that mobilises**

Grønn barneby is a municipal program for schools and kindergartens in Trondheim, addressing sustainability, climate and public health. All municipal entities and 80 % of the private entities are certified with Green flag (eco-schools). *UngKlima*, inspired by and in collaboration with *UngEnergi*, is a project which aims to enhance the understanding of climate issues among the young generation. From youth to youth, the messages are made and spread through articles, school visits, school assignments, films and other media. With NTNU at the forefront, the tech capital of Trondheim has several venues and events that promote climate and nature through research and innovation, such as *Vitenskapsmuseet*, *Forskningsdagene* and *Trondheim Skaperfest*. These are all mobilising platforms for green transition.

★ **Public libraries as centres for sustainable lifestyle**

Libraries are already in the reuse business. In addition to books and media, libraries in Trondheim have extended their services to lending out pro tools and e-bikes for transport and organising repair workshops and toy exchanges. They have become a platform to promote sustainable lifestyle.

Trondheim Green Life

To a larger extent, the planning and implementation of Trondheim's climate transition has to relate to our citizens' everyday life. This is how they can be empowered and enabled as change makers. In this CCC AP, we propose to launch Trondheim Green Life as the new, coordinated platform for various citizen initiatives. And below are two relevant projects this platform can built upon:

★ *CrAFT* (Creating Actionable Futures) is an EU-funded project for cities to become climate-neutral, beautiful and inclusive, connected to the New European Bauhaus initiative. Trondheim is a CrAFt city, and there are many good examples we can learn from our city colleagues across Europe.

★ *NIYF* (Nature in Your Face) is a Norwegian research project Trondheim participates in. The project aims to develop and test a methodology to stimulate transformative societal change in a co-constructive way together with citizens and stakeholders from the civil, public, and private sectors.

Outlook and next steps

This section should draw any necessary conclusions on the CCC AP above and highlight next steps and plans for refining the CCC AP as part of the Climate City Contract in future iterations.

Plans for next CCC and CCC AP iteration

The Climate City Contract (CCC) is both an ongoing process and a "living" document. The CCC process aims to co-create new ways of working together with local, regional, and national stakeholders to reach climate neutrality in the city by 2030. A CCC contains three elements: Commitments, Action Plan (AP) and Investment Plan (IP). AP and IP have a common structure. It describes the current status, draws pathways towards climate neutrality in detail and presents enabling interventions in governance and societal innovation. The documents are extensive, but the process has helped to strengthen the anchorage and share ownership. The figure below shows a selection of milestones from this CCC Action Plan.

Fig. O1: Selected milestones 2022-2030

The CCC is neither legally binding nor a politically adopted action plan. It is a tool for Trondheim to realise the political ambitions adopted by the City Council, in mainly the following ways:

- CCC strengthens climate governance. Trondheim's CCC shall be implemented, reported and updated in close connection with the existing management routines such as the annual climate budget and CDP reporting.
- CCC activates strategic partnerships. Trondheim's climate transition requires much more than what the municipality alone can manage. We are dependent on strategic partnerships that bring in each their resources and expertise. The municipality shall create enabling conditions for all stakeholders to participate and contribute.
- CCC makes our portfolios of actions more investment-ready. So far, our annual climate budget only details allocations of the municipal budget. Moving forward, we shall make our climate actions more bankable, as they will be carried out by both the public and private sectors. This is to be detailed in CCC IP.

As for further iterations, we plan to update our CCC every two years, at least partially, if not completely, to highlight both breakthroughs and improvements.