NET ZERO CITIES

EU MISSION PLATFORM | CLIMATE NEUTRAL AND SMART CITIES

Climate City Contract

2030 Climate Neutrality Investment Plan

2030 Climate Neutrality Investment Plan of City of Trondheim

TRONDHEIM MUNICIPALITY

NetZeroCities has received funding from the H2020 Research and Innovation Programme under the grant agreement n°101036519.

Table of Contents

List of tables

Glossary of Terms

Acronym	Description
AP	Action Plan
CAPEX	Capital Expenditures
CCC AP	Climate City Contract Action Plan
CCS	Carbon capture and storage
CO2e	Carbon Dioxide Equivalent
IP	Investment Plan
KPI	Key Performance Indicator
MEL	Monitoring Evaluation & Learning
MEUR	Million Euro
MRV	Monitoring Reporting Verification
NPV	Net present value
OPEX	Operational Expenditure
PPP	Public-Private Partnership
SDG	Sustainable Development Goals
SME	Small and Medium-sized Enterprises
WP	Work Package

Part A – Current State of Climate Investment

Part A "Current State of Climate Investment" is the structural element of the climate neutrality investment plan, putting the basis for the development of the plan through a detailed-oriented evaluation and assessment of the city's existing financial policies and funding/financing activities.

Module IP-A1: Existing Climate Action Funding and Financing

A-1.1: Existing Climate Action Funding and Financing

In recent years, Trondheim has made significant strides in addressing the urgent challenges posed by climate change. The city's climate action journey gained momentum in November 2019 when the Trondheim City Council declared the climate crisis a priority, calling for extraordinary efforts to reduce the impact of global warming and biodiversity loss. This commitment has shaped a range of municipal initiatives across departments, with a clear focus on measurable goals, citizen engagement, and collaborative efforts with businesses. As part of the European Commission's Cities Mission, Trondheim is now one of the 112 selected cities across Europe working towards climate neutrality by 2030, an ambitious target that requires systematic planning, innovation, and substantial financial investment.

Climate budget

The City of Trondheim has a long history of integrating its climate ambitions into the local plans and governance system. The first climate budget was developed in 2018, a few years later the city took a leading role in developing and writing the national guidelines for how municipalities in Norway can get started with climate budgeting. The approach has since been adopted by many of the 357 municipalities in Norway. As for the climate budget in Trondheim it has been evolving over the last seven years and has now become a quite well developed concept and practical governance tool within the city organisation.

The climate budget currently contains three main elements. Firstly the budget includes an emissions inventory (currently for territorial emissions only, in line with national guidelines) together with prognoses for emissions towards the target year of 2030. These prognoses differentiate between a business-as-usual scenario, a scenario including estimates for emissions reductions from actions currently under implementation and a third prognosis based on an emissions trajectory that is in line with Trondheims goal of an 80 % reduction in emissions by 2030 compared with 2009. These prognoses provide useful information for the political leadership regarding the likely trajectory of emissions, and give the city council an opportunity to prioritise specific projects or funding streams. The climate budget also contains information on the main actions required to close the gap between the trajectory given current climate actions and the trajectory required in order to reach the city's emissions target for 2030.

Secondly, the climate budget also contains tables showing the main climate and energy actions being implemented in Trondheim, together with an allocation of responsibility within the city administration. This is an important aspect of the climate budget: the climate team in the administration's environmental department is not directly mandated to use the policy instruments needed to implement many if not most of the climate measures required to achieve Trondheims climate goals. Examples of this are planning regulations to reduce transport demand or procurement guidelines to stimulate use of electric machinery in construction projects. Important functions of the climate budget are therefore securing horizontal buy-in for climate actions across the city administration and presenting these measures to the political leadership in a holistic

manner, within the administration's most important planning document - ie. the municipal budget. This also provides the opportunity for the climate budget - and therefore the climate action plan - to be updated annually, with cross-sectoral input within the administration, and for status reports on climate measures to be included in quarterly financial reports.

The third element of the climate budget are the funding streams dedicated to climate action. This does not represent the totality of funding used to implement climate action, but rather dedicated funding streams that have been prioritised since the climate budget began to be implemented in its current form in 2021. The funding streams include for example operating costs for the climate team in the environmental department; for building climate capacity in other areas of the administration; and for funding local subsidies of climate actions. There are also several investment streams that are used to cover the additional costs for key capital-intensive measures, such as replacing the municipal vehicle fleet with emissions-free vehicles, and subsidising the transition to emissions-free constructions sites in municipal building and infrastructure projects.

Data on the municipal budget is given in table 1.

Trondheim's investments 2019-2022

Table 2 provides details on the spending from 2019 to 2022 for the climate budget, grants to the municipality and *Miljøpakken* funds (a joint initiative by the state, region, and municipality to promote eco-friendly personal transportation).

Overall explanation and trends:

- ***Miljøpakken's*** investments represent the investments in green personal transport, which is highly prioritised through multi-level government cooperation. There has been a strong focus on promoting sustainable transportation options - walking, biking and public transport.
- **Transport:** The Municipality's own vehicles and machinery and also transport services have a high priority and are rapidly getting emission free.
- **Built Environment:** Investments in this sector, particularly in emission-free construction sites but also reuse of material and other circular solutions has had a strong priority, especially through procurement. See also "Waste and circular economy". The Municipality, although local authority, is not allowed to require the use of emission free machinery in zoning plans.
- **Energy Systems:** From 2022, investments in solar energy and energy savings in the municipality's own buildings have gained momentum.
- **Waste and Circular Economy:** In line with the circular ambitions in "built environment", the Municipality puts efforts into making circular solutions and jobs. Food waste also has priority in this period and onwards.
- **Viable Nature:** Spendings for a viable nature needs to increase in the coming years. The municipalities, however, are only regulating nature-based solutions in zoning plans.

Data and reporting

As a part of the journey to become a climate neutral and smart city, Trondheim has also put big efforts into gathering, understanding and making use of data. One of the more prominent initiatives is the work to report and make use of the CDP framework, where Trondheim has been A-listed for the second consecutive year. In addition we have a lot of sector specific reporting demands and standards, which also give us useful data to navigate and measure progress. In a sustainability perspective Trondheim has been a frontrunner in measuring and localising the UN Sustainable Development Goals (SDGs). Having been labelled a UN Center of Excellence on SDG City Transition, Trondheim has extensive experience in working with KPIs as a foundation for sustainable value creation across different dimensions of sustainability. This is also proving useful in the mission on climate neutrality, since the interlinkages between environmental, economic and social sustainability across the city can be hard to understand without a broader approach to sustainability.

Public private partnerships

At any given time The City of Trondheim has a lot of ongoing public private partnerships related to reducing climate emissions. Of course, some are more prominent than others, but all are part of making Trondheim climate neutral. The bigger projects are often within the built environment and mobility. The city has also made some headlines the last couple of years with the Horizon 2020 funded smart city project +CityxChange. This is probably one of the projects that best showcases how the municipality can work together with companies to develop new and innovative solutions to tackle climate change, in this case focused on the energy domain. A big part of this project, and one of the key learnings, is how we need to navigate and change policies and regulations to be able to change the existing systems. This project has also created a lot of spin offs and new investments that will create impact, also in the years to come.

Table 1: Historical Municipal Budget and Budget for Climate Actions

Budget Data	2019	2020	2021	2022
Municipal Budget (€)	*€1 304 782 609*	*€1 359 826 087*	*€1 443 304 348*	*€1 523 130 435*
Municipal Budget for Climate Actions & Projects (€)	*€4 450 722*	*€5 132 855*	*€7 864 164*	*€15 533 728*
% of Municipal Budget for Climate Actions & Projects (%)	*0,34%*	*0,38%*	*0,54%*	*1,02%*

Table 2: Finance Sources By Field of Actions (2019-2022)

	2019 (€)		2020 (€)		2021 (€)		2022 (€)	
Sector/action	**Municip.**	**Grants to municip.**	**Municip.**	**Grants to municip.**	**Municip.**	**Grants to municip.**	**Municip.**	**Grants to municip.**
Energy systems	***130 029***		***229 041***		***235 830***		***1 292 537***	
Map energy systems	*46 273*		80 874		82 665		78 754	
Solar PV							1 086 957	
Test thermal storage	*23 136*		51 306		36 362		39 377	
Prepare CCS	*60 620*		96 861		116 803		87 449	
Mobility & transport	***1 784 137***	***30 186 657***	***2 077 124***	***7 575 192***	***3 164 766***	***6 042 786***	***6 932 325***	***1 516 707***
Walking	*120 535*	4 422 089	237 108	3 167 093	260 191	3 315 420	334 207	1 251 129
Biking	*71 248*	2 613 895	76 017	783 079	116 516	1 126 871	359 141	302 780
Car								
Public transport	*623 570*	22 876 933	245 611	3 280 673	121 511	1 548 321	−9 938	−37 202
Infrastructure & shared mobility	*420 029*	86 957	715 367	30 435	639 578		370 798	
Transport & vehicles	*115 681*	186 783	585 749	156 522	1 404 363		5 594 276	
Facilitate green transport	*433 073*		217 271	157 391	622 607	52 174	283 841	
Built	***595 740***	***78 261***	***560 414***	***330 435***	***1 430 750***	***619 565***	***3 919 449***	***1 318 054***

environment								
Climate friendly city planning	*375 711*	78 261	375 621	69 565	593 398	117 391	515 508	
Public buildings	69 565		34 783		194 203		956 522	31 754
Emission free construction sites	115 681		147 836	260 870	643 149	502 174	2 447 419	1 286 300
Commercial buildings			2 174					
Residential buildings	34 783							
Waste & circular economy	***697 044***	***321 739***	***729 671***	***339 130***	***1 176 356***	***204 348***	***1 420 572***	***35 851***
Household waste		321 739				173 913		
Circular economy development	465 681		347 042	260 870	574 949	30 435	346 703	
Reuse of building materials	115 681		147 836	52 174	419 599		876 984	35 851
Urban food production and food waste reduction	115 681		234 793		181 809		196 885	
Other				26 087				
Viable nature	***1 243 771***	***0***	***1 482 712***	***39 130***	***1 852 175***	***0***	***1 968 846***	***0***
Nature-based solutions	318 319		300 021	39 130	381 009		393 769	
Parks & forests	347 044		443 509		545 426		590 654	
Restoration	231 363		295 673		363 618		393 769	
Agriculture	347 044		443 509		562 122		590 654	
SUM	**4 450 722**	**30 586 657**	**5 078 961**	**8 283 888**	**7 859 878**	**6 866 700**	**15 533 728**	**2 870 611**

Module IP-A2: Strategic Funding and Financing Evaluation

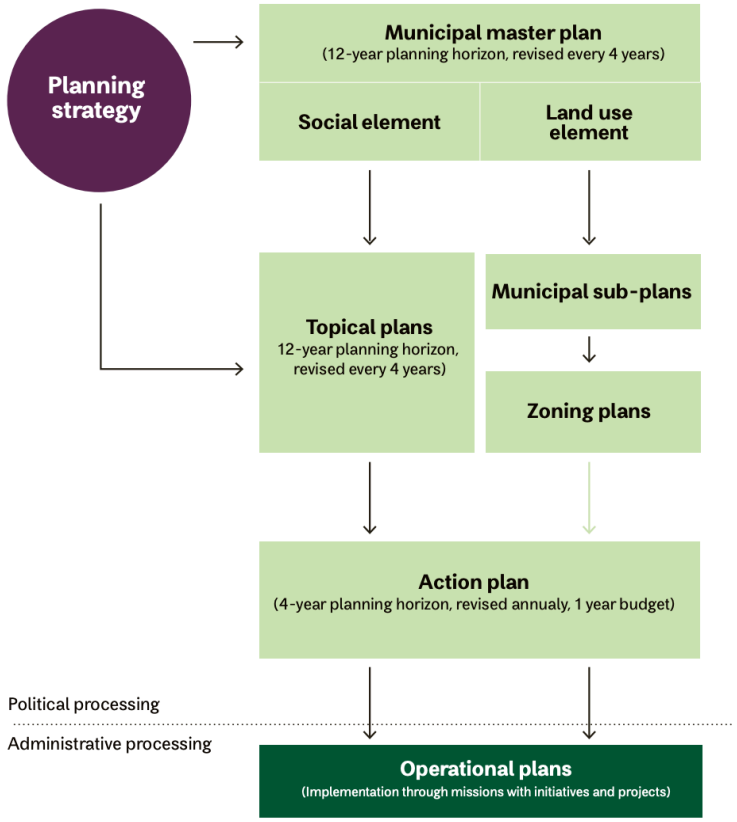
A-2.1: Strategic Funding and Financing Evaluation

The main focus when it comes to public finance in a municipality is to make sure that the municipality has a healthy and sustainable economy. This is to ensure high quality and predictable services to the citizens and good investments. And of course to use taxpayers money in the best way possible. This also means that capital sourcing for climate projects isn't always the highest priority for politicians and the finance department in the municipality. This of course is not ideal from a climate point of view, but it's also part of the reason why the mission and the investment plan is such an important tool in accelerating the work on climate.

As of today Trondheim has decent control over available financing sources and what kind of projects they can be used for. Still, the scale of available financing sources is not big enough to finance the level of ambition when it comes to reducing climate emissions. What this means is that the city administration in Trondheim, and local partners, need to develop the capacity to make use of more financial instruments as a part of their climate ambitions.

Plan and governance system

The municipal plans in Norway are all part of the municipal plan and governance system (see illustration below). This describes how municipal plans and ambitions, like the local climate action plan (topical plan), feed into a yearly discussion about resource allocation (action plan). If the city wants to spend public sector money on climate action projects, this needs to be a part of the yearly budget discussion, and agreed upon by the politicians.



Financial regulations

The most important guidelines and rules for how Trondheim manages its financial assets are described in the city's financial regulations (Finansreglementet). The document describes the overall guidelines for how the city administration are allowed to manage investments, debt, risk, etc. Some key points are especially relevant for climate investments. For example no single loan can be bigger than 1 billion NOK, the loans can only be Norwegian currency and the due dates on loans need to be spread out over time to avoid liquidity challenges in the future. The financial regulations also regulate how the city can invest its own funds in terms of stocks, bonds and different asset classes. The finance department reports to the city council on the financial status according to Finansreglementet once a year.

In addition to local regulations, Norwegian municipalities are also bound by national regulations such as Kommuneloven which on a more general level outlines how the municipalities can act regarding finance. These regulations can of course be changed and developed, but in what way also depends on things like how the NetZero Platform and the Capital Hub is set up and developed.

Table 3 and 4 lists the income and capital sources for Trondheim municipality.

Green loans

Green loans have been a part of Trondheims loan portfolio since 2018. Even though the banking sector has been developing the concept of green loans since then, it's not always obvious what kind of loans will have the best impact on climate action. As of 2024 the city has a total debt of 20,3 billions, with 3,7 billions in green loans. In other words, about 18 % of the city depts are from green loans. The ambition is to increase the share of green loans to 25 % by 2025, which seems to be on track.

Approaching new financial mechanisms

Even though the current regulations are very much focused around providing services to citizens and building schools and health care centres, we're starting to see a shift towards having a broader perspective on finance. This is especially the case when it comes to climate action initiatives. In Trondheim part of this is driven by the business development department. Historically a lot of the collaborative projects with local businesses and research partners have been isolated and not part of a portfolio thinking. Since joining the Net Zero Cities program there's a lot more focus on creating meaningful portfolios, and also planning for different kinds of assets. This means a more strategic use of existing finance schemes as well as to a greater degree aiming for bigger innovation projects, together with local businesses.

Table 3: List of Income Sources for the City

Income Category	City income 2023	% of city budget
Tax	788	47%
Operational income	409	24%
Financial income	71	4%
Government transfers to the municipality	425	25%
Total in million €	**1 693**	**100%**

Table 4: List of Capital Sources for the City

Type	Size Range	Level	Description
Bonds	682	Private	Bonds and certificates
Loans from the finance sector	683	Private	Kommunalbanken and KLP
Other loans	289	Public	Husbanken
Green loans	281	Private	Kommunalbanken
Total in million €	**1 936**		

Module IP-A3: Barriers to Climate Investment

A-3.1: Barriers to Climate Investment
Achieving climate neutrality by 2030 presents not only opportunities but also significant challenges for Trondheim. While the city has made progress in climate action, a variety of structural, policy,

economic, and financial barriers continue to impede the effective deployment of capital for climate-related projects.

Structural

A major structural barrier to climate investment in Trondheim lies within the city's internal capacity. While there is strong political commitment to climate action, the technical and administrative capacity across municipal departments is sometimes insufficient to manage and implement large-scale climate projects. This includes a lack of dedicated staff with expertise in climate finance and project development, which can delay the approval and execution of projects. Furthermore, the siloed nature of municipal departments often leads to poor coordination and limited integration of climate goals into financial planning.

The internal capacity on climate investment is still considered a barrier the municipality needs to overcome. While the more traditional investment domains for a Norwegian municipality (build environment, road infrastructure, etc) have the needed capacity, the capacity for a city wide mission arguably looks a bit different. To succeed with the mission of becoming a climate neutral city a more strategic cross sector and impact oriented approach is needed. This is something that Trondheim is working on, but it will require some time still. It's also a question which of the existing municipal departments the capacity building needs to develop from; finance department, climate department, business development department or a combination of those. The development of a transition team and a local green deal will be instrumental in that regard.

Traditionally the finance and investing skillset in a municipality is not set up for working with missions. To make the transition to develop the understanding of what it takes to orient the finance department more towards a mission economy is something a Mission Platform could be able to support.

The city could prioritise cross-departmental coordination and create dedicated teams that focus specifically on integrating climate considerations into budgetary processes and project management.

Policy

Policy misalignment and regulatory hurdles represent another significant barrier to climate investment. Local policies are often not fully aligned with national regulations or EU directives, creating uncertainty and disincentivizing private sector engagement in climate initiatives. For example, regulations surrounding land use, construction permits, and energy efficiency standards may not sufficiently promote low-carbon technologies or sustainable urban development. Additionally, the lack of long-term policy frameworks that offer clear and predictable incentives for green investments can lead to investor hesitation.

To address these policy barriers, Trondheim needs enhanced collaboration between municipal, regional, and national governments. Aligning policies at all levels to support climate action will require Trondheim to advocate for legislative reforms that encourage climate investment. The Norwegian Nation platform for Cities Mission is an important tool in that regard. Focusing on multi-level governance across Norwegian municipalities is crucial to overcome policy barriers.

Economic

One of the core economic barriers to climate investment is the perception of high financial risk associated with many climate projects. Sustainable infrastructure, renewable energy systems, and energy efficiency programs often require substantial upfront capital and have long payback periods. These factors can make it difficult to attract traditional investors, who may prioritise short-term returns over long-term sustainability outcomes. Moreover, some climate projects, particularly those

related to new technologies or nature-based solutions, may lack a proven track record, increasing the perceived risk for potential investors.

A way to mitigate these risks is to explore blended financing models that combine public and private capital, leveraging public funds to de-risk investments and attract private sector participation. The city could also work with the Mission platform to develop innovative financing instruments, such as green bonds or impact investment funds, that specifically target climate action and reduce investor concerns about long-term viability.

Financial

In addition to structural and policy challenges, Trondheim faces financial constraints that limit the city's ability to fund large-scale climate projects. Municipal budgets are often stretched thin, with competing priorities for public spending. This can result in insufficient financial resources allocated for climate action, especially for projects that require significant capital investment, such as renewable energy infrastructure or sustainable transport systems. Furthermore, while the city has made strides in climate budgeting, there are still gaps in how climate risks and opportunities are factored into long-term financial planning.

To overcome these financial barriers, an option is to consider forming public-private partnerships (PPPs) to unlock private sector funding for climate projects. PPPs can allow the city to share the financial burden while tapping into the expertise and resources of the private sector. Trondheim could also work to improve its climate budgeting processes, ensuring that climate action is fully integrated into financial decision-making. Support from external stakeholders, such as the EU Cities Mission and private investment networks, will be essential in identifying innovative financing solutions and attracting international capital to Trondheim's climate projects.

Stakeholder engagement

A final barrier is the limited engagement of external stakeholders, including private companies, investors, and citizens. While Trondheim has strong political will and some collaboration with the business community, there is still room for greater involvement from private sector partners. Private sector engagement is crucial for driving innovation and scaling up climate investments, yet many companies remain hesitant due to regulatory uncertainty or a lack of clear incentives. Similarly, citizen participation in climate projects, while improving, needs to be strengthened to ensure widespread public support for ambitious climate actions.

To enhance stakeholder engagement, Trondheim could develop targeted outreach programs aimed at building partnerships with local businesses, research institutions, and international investors. The city should also continue to promote citizen engagement through initiatives that involve the public in climate decision-making, co-creation, and implementation of projects. By fostering a strong climate investment ecosystem that includes both private sector and civil society actors, Trondheim can create an enabling environment for sustained investment in climate action.

In conclusion, while Trondheim has made considerable progress in addressing climate change, various barriers continue to hinder the deployment of capital for climate action. Overcoming these structural, policy, economic, and financial challenges will require coordinated efforts across multiple levels of government, as well as strong partnerships with external stakeholders. By addressing these barriers, Trondheim can unlock the potential for increased climate investment, ultimately accelerating its journey toward climate neutrality by 2030.

Table 5 lists these and more barriers to climate investment.

Table 5: Barriers to Climate Investment

Financial Barriers to achieving Climate Neutrality	Typology of Barrier	Description	Sector and stakeholders involved
Insufficient Municipal Budget	Financial	Municipal budgets are stretched thin, limiting resources for large-scale climate projects such as renewable energy infrastructure or transport systems. Potential solution: Actively pursue grants and subsidies from national and international sources dedicated to climate action. Explore alternative financing mechanisms like green bonds, crowdfunding, or public-private partnerships to supplement municipal funds.	Municipal finance departments, energy sector, transport sector, national government
High Initial Capital Costs	Economic	Climate projects require substantial upfront capital with long payback periods, deterring traditional investors focused on short-term financial returns.	Private investors, financial institutions, municipal government, energy and construction sectors
Lack of Climate Investment Expertise	Structural	Municipal finance departments lack expertise in climate finance, mission-oriented investments, and complex cross-sectoral climate project management. Potential solution: Hire or train staff. Seek external expertise.	Municipal finance department, climate/environment departments, private sector, EU Cities Mission platform
Unclear or Misaligned Policies	Policy	Misalignment between local, national, and EU policies creates uncertainty, delaying or deterring investment in climate-related initiatives and technologies.	Municipal planning departments, national government, EU regulatory bodies, private construction sector
Limited Private Sector Engagement	Stakeholder Engagement	Private sector investors are hesitant to engage due to perceived high risks and unclear incentives for investing in climate-related projects or technologies. Potential solution: Create attractive conditions for private sector involvement through clear regulations, streamlined permitting processes, and financial incentives. Explore Public-Private Partnerships (PPPs) to leverage private sector expertise and capital for large-scale climate projects.	Private investors, municipal government, business sector, national government, financial institutions

Limited Public-Private Partnership (PPP) Models	Structural	Underdeveloped PPP models limit the municipality's ability to collaborate with the private sector to share risks and finance large-scale climate projects. Potential solution: Develop clear guidelines and standardised procedures for PPPs, and provide training and support to both public and private sector partners to build trust and facilitate successful collaborations.	Municipal government, private sector, national government, EU Cities Mission, financial institutions
Uncertainty Around Innovative Financial Instruments	Financial	There is limited use of green bonds or impact investment funds due to lack of knowledge and awareness about these financial tools. Potential solution: Raise awareness on these tools by integrating climate risks and opportunities into all aspects of financial planning and decision-making.	Municipal government, financial institutions, private investors, EU Cities Mission platform
Competing Municipal Financial Priorities	Policy	Competing public spending priorities hinder the allocation of sufficient financial resources towards long-term climate neutrality investments. Potential solution: Demonstrate political will and leadership in prioritising climate action, fostering a sense of urgency and commitment across all departments.	Municipal finance departments, political leadership, regional and municipal stakeholders
Weak Integration of Climate in Financial Planning	Structural	Climate goals are not fully integrated into municipal financial planning, leading to inadequate funding and poor alignment between budgets and climate needs.	Municipal government, finance departments, climate and environment departments
Limited Citizen and Business Engagement	Stakeholder Engagement	Insufficient outreach to engage local businesses, investors, and citizens in climate projects, reducing broad-based support and investment momentum. Potential solution: Proactively communicate climate plans and progress to the public, fostering trust and understanding. Involve citizens and stakeholders in decision-making processes related to climate investments, ensuring their voices are heard and concerns are addressed	Private investors, local businesses, citizens, municipal government, research institutions

Part B – Investment Pathways towards Climate Neutrality by 2030

Part B "Investment Pathways towards Climate Neutrality by 2030" is in place to capture the actions and needs for mobilising and delivering the funding and financing needed for climate neutrality. This Part of the Investment Plan will be aligned with and built upon the Action Plan. In addition, each of these Plans are likely to entail multiple iterations over the course of the path to climate neutrality. Cities are encouraged to fill this section out with the help of their municipal Finance or Treasury teams - the data provided should be as complete and as robust as possible. In the instances where macroeconomic data or forecasting has been completed, a breakdown of the assumptions that the city has used should be provided as an annex and – if possible – the model or worksheet that was used to obtain the data should be presented for validation.

Module IP-B1: Cost Scenarios for Climate Neutrality

B-1.1: Cost Scenarios for Climate Neutrality

To create a solid foundation for the investment plan, Trondheim used the NZC economic model as a foundation. The Net Zero Cities Economic model employs a comprehensive, multi-faceted approach to evaluate the economic implications of transitioning to a climate-neutral city. Key aspects of its methodology include:

- Sectoral Analysis: The model meticulously examines multiple sectors crucial to urban functionality, including:
  - Passenger and Freight Transport
  - Buildings and Heating
  - Electricity Generation and Distribution
  - Waste Management
- Lever-Based Approach: Within each sector, the model identifies specific "levers" or actions that can be implemented to reduce greenhouse gas emissions. It then quantifies the impact of these levers on emissions and the associated costs and benefits.
- Co-Benefits Assessment: The model goes beyond just emission reductions to assess the wider societal and economic benefits of climate action, such as improved air quality, reduced healthcare costs, and increased job creation.
- Financial Modelling: It incorporates financial modelling to project the investment needs and potential funding sources for implementing the identified climate actions.
- Sensitivity Analysis: The model utilises sensitivity analysis to test the robustness of its findings against various assumptions and uncertainties.

In essence, the NetZeroCities Economic model offers a powerful tool for cities to:

- Gain a deeper understanding of the economic ramifications of their climate policies.
- Make informed decisions regarding the most effective and cost-efficient pathways to net zero.
- Communicate the economic case for climate action to stakeholders and secure necessary funding.

A lot of cities have used the NZC economic model, so the methodology is well known. More details can be found here.

In addition to the NZC economic model, more detailed calculations were made where numbers were available and the projects were more developed.

Engagement in Costing Activities

The City of Trondheim has already taken significant steps in estimating the costs related to its climate action efforts. Much of the initial costing work has been carried out internally by municipal teams, with input from key partners such as stakeholders responsible for specific actions or research actors like NTNU and SINTEF.

Costing of Actions in the 2030 Climate Neutrality Plan

The NZC economic model is a tool designed to help cities understand and communicate the economic case for decarbonization. It evaluates the potential for reducing CO2 emissions, air pollution (NOx and PM), investment needs, cost savings, and other societal co-benefits across key sectors such as transport, heating, and electricity. The model is scenario-based and utilises both top-down and bottom-up approaches to provide city-specific insights.

Table 6 outlines the results from the NZC economic model, split in sectors and typical actions. These actions have been tagged with their associated costs (both capital expenditure and operational expenditure), GHG reduction potential, and co-benefits. Below, we describe how we use the NZC economic model. For actions with estimated costs from the action plan, we detail the financial assumptions and the methodology used for cost estimates.

How it works and how we have validated the model:

Baseline emissions: Quantifies current GHG emissions from transport, buildings and heating, electricity and waste sectors. We have validated the baseline GHG emission inventory from the economic model with our existing city-wide scope 1 inventory for Trondheim 2022 made by the National Environment Agency for all municipalities (methodology described in detail here).

Scenario analysis: Tests different decarbonization measures against the baseline scenario. The 2030 GHG emission scenario is validated with a model specifically made for Trondheim by CICERO (Centre for International Climate Research) and TØI (Norwegian Centre for Transport Research). This model is based on the city-wide scope 1 inventory from 2015-2022 and very detailed assumptions on demography, economic development, energy, transport, buildings, energy, waste and more. This model includes scope 2 and 3 emissions from electricity. The model does however not address economic cost scenarios or co-benefits. A comprehensive roadmap for a climate neutral Trondheim - based on results from this model but with 2019 input data - can be found here (in Norwegian).

Economic evaluation: Estimates the socioeconomic case for 15 decarbonization measures by analysing their impact on emissions, costs, and co-benefits. For buildings and heating, electricity and waste the results are “validated” by collecting preliminary cost estimates on the proposed actions in the AP from the relevant stakeholders. We argue that these estimates have less uncertainties than the economic model: All actors are public and are expected to provide data to the best of their knowledge. However, these estimates do not provide information on the value of co-benefits created, such as economic and societal benefits of these measures, including health improvements, reduced pollution, and operational cost savings. For co-benefits, we refer to the economic model results.

Stakeholder impact: Distributes costs and benefits across different stakeholders, including municipalities, citizens, property owners, and healthcare providers. We have not evaluated these numbers, except for specific actions found in table 7. Please note that the state is not among the stakeholders: I

By assessing the costs and the cost allocation among stakeholders, as well as co-benefits, the economic model and additional mapping of the investment needs support policy-making by identifying the most impactful and cost-effective actions for reducing GHG emissions.

For Trondheim, the economic model is used to:

- Primarily assess the costs for the transport sector - as these are shared between a lot of actors and citizens and thus must be estimated.

Why do we not use the results for other sectors from the economic model?

- Buildings and heating: Practically all electric energy in Norway is made from renewable hydropower. Thus, most emissions in this sector comes from the waste-to-energy plant, which is the backbone of the district heating system covering 30 percent of Trondheim's heating needs. We aim to make the waste-to-energy plant carbon positive by CCS of CO2 from incineration of waste from fossil and biogenic sources: CO2 from biogenic sources is not included in the emission inventory and will eventually return to the atmosphere through decomposition or incineration, CCS of this CO2 represents actual removal of CO2 from the atmosphere. The captured CO2 will be stored in geological stable structures in sub-sea bedrock. The estimated cost of this action is provided in table 7, and the action is described in more detail in the action plan. The building stock will still be subject to upgrades, but existing national policies are considered to be satisfactory.
- Electricity: Preliminary cost predictions to upgrade hydropower plants and electrical grid is provided in table 7 and are thus more reliable than the results from the economic model. See also "buildings and heating" above.
- Waste: Actions to increase material recovery are covered under "waste" in table 7.

Costing Methodology and Assumptions

The cost estimates provided below are derived from both municipal and external expert assessments. For example, in "energy systems" the costs of carbon capture and storage (CCS; table 7) for the district heating system are based on feasibility studies conducted in collaboration with SINTEF, where CCS technology will be used to significantly reduce the carbon footprint of the waste-to-energy plant, which currently covers 30% of the city's heating needs. Incremental costs to upgrade hydropower plants and electricity grid in order to meet increasing demand are estimated by the responsible public energy actors, based on preliminary cost estimates and a cost allocation between periodic maintenance (excluded) and costs related to increasing electricity demand (included).

In "Mobility and transport", the existing action program "Miljøpakken" has existing targets, like cutting 20 percent of personal car traffic, and financial plans and are as such an "existing policy". However, the particular action plan to ensure this cut in car traffic is not yet adopted (expected 2024/2025). Thus, Miljøpakken is listed in the action plan as a portfolio without actions, but with indicators. The expected emission cuts are in "other plans", not in the "CCC AP". In this investment plan, "Miljøpakken's" investments in public transport, walking and cycling infrastructure are still given from an adopted cost framework and cost allocation between stakeholders.This reflects that we will need to pay special attention to the coming action plan and its results on green personal transport. The other investments listed in table 7 for "Mobility and transport" are preliminary estimates made by the municipality for proposed actions in electrification of public and private transport systems (e.g., charging stations, biogas stations, shore power). These actions are necessary to phase out fossil fuels and will significantly contribute to GHG reductions.

Actions on waste and circular economy in table 7 is similarly based on early investment estimates on proposed actions.

Direct and Indirect Benefits of Actions

All climate actions included in the Action Plan not only reduce GHG emissions but also generate co-benefits that enhance the overall quality of life in Trondheim. For instance, building energy efficiency measures reduce energy costs for households and businesses, while investments in renewable energy systems enhance the city's resilience and energy independence. These actions also support the city's overarching goals of creating jobs and fostering economic growth through green investments.

Next Steps

To continuously update and refine the cost scenarios, the city will collaborate with the relevant stakeholders and financial experts to ensure that future iterations of the plan incorporate the latest data. This iterative process is essential for attracting external funding, ensuring cost-effectiveness, and remaining aligned with the overarching goal of achieving climate neutrality by 2030.

Here is the overview of all (portfolios of) actions taken from the CCC Action Plan, which this IP builds upon.

Fields of action	List of portfolios and actions
Cross-sectoral actions	0: Involve and engage ★ Trondheim Green Life ★ Trondheim Green Deal ★ National Cities Mission Platform
Energy systems	1: Energy analysis ★ Energy analysis
	2: Carbon capture and storage (CCS) from waste- incineration ★ Pilot City programme on CCS ★ CCS from waste incineration
	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
	4: Upgrades of hydropower plants and in the electricity grid ★ Upgrades of hydropower plants ★ Upgrades in the electricity grid
Mobility & transport	*(Miljøpakken)*
	1: Tool kit for green goods and utility transport ★ Improved logistics for goods transport ★ Zero emission vans (procurement and infrastructure)
	2: Zero-emission zone ★ Zero emission zone for passenger cars ★ Zero emission zone for vans, heavy vehicles and buses
	3: Sea transport ★ Emission free public ferries and speed ferries ★ Mandatory use of shore power and battery operation for all cruise ships, freighters and tankers
Built environment	1: Zero emission construction sites
	2: Climate footprint in land-use planning: ★ Limit climate footprint of buildings and constructions in zoning plans
Waste & circular economy	1: Household waste ★ Increased reuse of household waste

	★ New or improved systems for waste sorting and material recovery ★ SESAM plant for post-sorting of residual waste
	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
	3: Buildings and construction industry: ★ Renovation of buildings and infrastructure ★ Reuse centre ★ “Ready for Use” ★ See also “Trøndelag resource bank for industrial materials above”
Viable nature	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
	2: Agriculture: ★ Increase local food production

Table 6: Sectoral Costing

Net Present Value (NPV) - incremental to existing costs.

Sector	**Subsector**	**NPV Investment Expense - CAPEX** (MEUR 2020-2030)	**NPV Operational Savings - OPEX** (MEUR 2020-2040)	**Year 2030 kton CO2e Reduction**	**NPV MEUR Investment Expense** Year 2030 kton CO2e Reduction	**NPV Co-benefits** (MEUR 2020-2040)*
Transport	Reduced motorised passenger transportation need**	*€ -*	*€212*	*9*	€ -	*€43*
	Shift to public & non-motorized transport**	*−€32*	*€57*	*13*	−€2	*€106*
	Increased car pooling**	*€ -*	*€137*	*9*	€ -	*€42*
	Electrification of cars + motorcycles	*−€249*	*€106*	*25*	−€10	*€24*
	Electrification of buses**	−€20	€63	25	−€1	€29
	Optimised logistics	*€ -*	*€9*	*38*	€ -	*€53*
	Electrification of trucks	*−€176*	*€124*	*34*	−€5	*€23*
Buildings & Heating* **	Building renovations (envelope)	*−€247*	*€134*	*9*	−€26	*€14*
	New energy-efficient buildings	*−€62*	*€24*	*2*	−€39	*€2*

	Efficient lighting & appliances	−€130	€100	3	−€51	€2
	Decarbonizing heating generation	*−€15*	*€25*	*32*	€0	*€2*
Electricity**	Decarbonizing electricity generation	€0	€180	0	€0	€ -
Waste***	Increased waste recycling	*−€2*	*€1*	*6*	−€0,4	*€0*
Total		**−€935**	**€ 1 174**	**203**	**€5**	**€340**

**Indicative indicators*
*** Portfolio (Miljøpakken) in other plans/existing policies has allocated app. €1270 mill. in CAPEX and €60 mill. OPEX for green personal transport in the period 2024-2029, see table 7 below.*
**** CCS on waste-to-energy district heating system will cut 90.5 ktons CO2e from this sector - see "E2.2: CCS from waste incineration" in table 7 (app €260 mill CAPEX, €26 annual OPEX).*
***** Norway and Trondheim is self-reliant on renewable energy from wind and hydropower. Costs to upgrade this infrastructure are given in "Upgrades of hydropower plants" and "Upgrades in the electricity grid" in table 7 below (sums to app €250 mill. CAPEX).*
****** See "E2.1: SESAM plant for post-sorting of residual waste" in table 7 below (€87 mill. CAPEX).*

Table 7: Capital Intensive Projects

Incremental to existing costs. Selected projects where we have estimates.

Fields of Action	Action / Indicator	Capex (€)	Opex (€)	Cost Effectiveness (EUR/tCO2e)	Investment (Split by Stakeholders)
Energy systems	Pilot City programme on CCS: CCWaSte4NetZero	***Project Description:** 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.*			
		€500 000	-	-	Net zero cities
	E2.2: CCS from waste incineration	***Project Description:** Capture and storage of CO2 from incineration of waste of both fossil and biogenic origin, represents both an emission cut (90,5 ktons/yr), and a carbon sink (130 ktons/yr). Cost/effect is calculated for 60 years.*			
		€260 869 565	€26 086 957	€139	Plant owner. Support from state necessary.
	Upgrades of hydropower plants	*Project Description: Actions to increase electric (energy and) power production towards 2030. The costs displayed are the incremental costs related to increased production, not the total cost of upgrades.*			
		€100 347 826	-	-	Plant owner.
	Upgrades in the electricity grid	*Project Description: Actions to increase electric (energy and) power production towards 2030. The costs displayed are the incremental costs related to increased capacity, not the total cost of upgrades.*			
		€156 521 739	-	-	Statnett and Tensio (respective grid).

Mobility and transport	(Miljøpakken)	***Project Description:*** *(Existing portfolio for green mobility. Here: Planned investments (2024-2029) to reduce car transport by 20 % by 2030)*			
		€1 269 565 217	€60 869 565	-	Miljøpakken: State (65%) Region (3,5%) Municipality (1,5%) Toll fees (30%).
	T2.3 / 2.4: Zero emission vans (procurement and infrastructure)	***Project Description:*** *Prepare a site for an energy actor to establish a renewable energy station for heavy vehicles. The energy actor must expect additional costs to establish infrastructure on the site.*			
		€2 782 609	-	-	Trondheim municipality
	Shore power for cruise ships	***Project Description:*** *Provide shore power for cruise ships is an important step for action "S3.2: Mandatory use of shore power and battery operation for all cruise ships, freighters and tankers" (expected GHG cut 6800 tons/yr for 60 yrs).*			
		€7 565 217	Currently not estimated.	€19 + operational costs	Inter-municipal harbour. Support from Enova: € 1 739 130
Waste and circular economy	E2.1: SESAM plant for post-sorting of residual waste	***Project Description:*** *Establish a mixed waste sorting plant for residual waste from households, to sort out e.g. plastic packaging and metals to increase material recovery. Cost/effect based on 7300 tons/yr GHG emission cuts for 60 years.*			
		€86 956 522	Currently not estimated.	€199 + operational costs	Plant owners - 7 municipalities. Split not ready.
	Reuse-centre (Gjenbrukslageret)	***Project Description:*** *A (reused) storage for reusable building materials and furniture. The storage also has a system for marketing of the materials.*			
		-	€434 783	-	Trondheim municipality
	Pilot on local recycling station	***Project Description:*** *A pilot for a local recycling station to reduce local waste, promote reuse, offer a social aspect as a meeting place and a space for local initiatives (repair-events, clothes exchange events etc.).*			
		€286 957	-	-	Trondheim municipality
	TRÅD	***Project Description:*** *Interregional project (Norway-Sweden) that aims to develop a new standard for design, production, procurement and administration of used and virgin textile products.*			
		€622 000	-	-	Interreg project

Module IP-B2: Capital Planning for Climate Neutrality

B-2.1: Capital Planning for Climate Neutrality

Existing Resources and Available Capital, including examples
The City of Trondheim has several existing resources and funding streams already in place, including:

1. **Public Contributions.** Examples:

   a. The municipality's climate budget includes allocations for electric vehicles and machinery, emission free construction sites, renewable energy investments and energy efficiency improvements across public buildings among other actions.
   b. "Miljøpakken" - an action plan for green personal transport - where the state covers most of the costs for sustainable mobility including public transport and infrastructure for walking and cycling, provided that the region and city overholds the City Growth Agreement aiming for densification of the city and region and zero growth in car traffic despite population growth (see table 7).

2. **Taxes and fees:** Due to the strong welfare system and public sector in Norway, there are numerous taxes and fees. These can be used to encourage investments and behavioural change. Examples:
   a. Toll roads: The income goes into "Miljøpakken", which invests in green personal transport.
   b. There are substantial fees on cars and vehicles in Norway. Emission free cars and vehicles are exempt from these - both fees on the investment and partly the fees on the use of emission free cars and vehicles.
3. **National and EU Grants.** Examples:
   a. Trondheim has secured funding through national programs like Klimasats (Norwegian Environment Agency), the Norwegian Research Council and Enova which provides financial support for municipalities to implement climate measures.
   b. As a participant in the EU Cities Mission and the finished Positive City Exchange program, Trondheim has access to European Union funding streams, which supports innovation projects including those related to climate neutrality.
4. **Private Investments:** Public-private partnerships are already in place for certain projects, such as:
   a. Renewable energy initiatives in collaboration with TrønderEnergi and Aneo.
   b. Private companies involved in infrastructure development for electric vehicle charging stations and battery containers for emission free construction sites in cooperation with Enova. This indicates strong interest from the private sector to contribute to the city's climate goals.
5. **Existing Investments Secured.** Examples:
   a. The investments in upgrading hydropower plants and electric grid are secured from the public owners and this infrastructure.
   b. Infrastructure projects like district heating systems, which currently supply 30 percent of Trondheim's heating needs, have already been initiated with substantial funding from both public and private entities. Efforts to integrate carbon capture and storage (CCS) technology into this system are underway, backed by feasibility studies and initial capital.

Budget Availability and Financial Gaps

While Trondheim has made strides in securing funding for key climate projects, there remains a significant financing gap to fully implement all the actions necessary to achieve climate neutrality by 2030. The city's annual climate budget provides a structured framework for tracking climate-related expenditures, but the scope of necessary investments—particularly for large-scale infrastructure like CCS and renewable energy systems—means that additional funding sources will be required.

As of the latest financial reports, Trondheim is operating under budget constraints, with limited flexibility for large, unplanned capital expenditures. While certain sectors, such as transport and waste management, are well-funded through existing programs, others - like energy systems and carbon sequestration - face funding shortages. An overview of the current capital planning (September 2024) is given in table 9.

The main Investment Gap: Electrification of Vehicles and Machinery

A significant investment gap exists in the transition towards electrifying all vehicles, as estimated in table 8 (electrification of cars and trucks). Existing national government incentives provide a solid foundation, by making emission free vehicles exempt from fees both at purchase and in use for all citizens and professional actors. This - and other contributions from the state in transport and other sectors - is not acknowledged in table 8.

To ensure sustained momentum, it's crucial to secure these existing initiatives at least until 2030. Ideally, they should be strengthened to increase the momentum in the transition towards emission free vehicles.

Decarbonising off-road machinery e.g. for construction sites is a transition that poses unique challenges across the systemic levers technology & infrastructure, governance & policy, finance & funding and learning & capabilities. This transition requires increased targeted support and progressive governance through both public procurement and strong, but fair regulations. Addressing this investment gap will be pivotal in achieving a greener and more sustainable transportation and construction sector.

Optimising Public and Private Investment Capital

To address these funding challenges, Trondheim aims to optimise the use of both public funding and private investment. The strategy involves a mixed approach, leveraging public funds to de-risk early-stage projects and attract private capital for larger infrastructure investments. For example:

- Public-Private Partnerships (PPP): Trondheim has already shown success in developing partnerships with private sector entities for energy and transport projects. Expanding these PPPs is a priority to ensure that projects like renewable energy installations, building retrofits, and mobility infrastructure can move forward without placing undue strain on the municipal budget.
- Green Bonds: The city is exploring the potential to issue green bonds as a way to raise capital specifically for climate projects. These bonds could fund large-scale investments such as renewable energy systems, energy efficiency upgrades in public buildings, the scaling of zero-emission transport options, optimisation of freight and utility transport and off-road machinery in the construction sector.
- External Grants and EU Programs: Trondheim's experience from participating in the EU's Horizon Europe and now the NetZero Cities Mission will continue to be key in securing external funding. Additionally, further engagement with EU green funding mechanisms can provide capital for scaling renewable energy, emission free transport and improving the city's resilience.
- Crowdfunding and Citizen Participation: Exploring new models of funding, including citizen-led investment schemes, could engage the public directly in financing smaller, community-based projects such as local renewable energy initiatives, urban greening projects and restoration of nature.

Creating a Project Pipeline with Private Sector Involvement

Trondheim has a growing body of experience in building a project pipeline that involves the private sector. For example:

1. Positive City Exchange: This EU-funded project provided a model for public-private collaboration, focusing on positive energy districts where companies, research institutions, and the municipality worked together to develop sustainable energy solutions. The legacy from this project will be used to develop future projects.
2. Renewable energy projects: The ongoing collaboration with TrønderEnergi for large-scale renewable energy generation (including wind and solar) is a demonstration of how private companies are already investing in Trondheim's green transition. Expanding this collaboration will create a more robust pipeline of climate-related projects.

3. Circular and zero-emission construction projects: Trondheim has been pioneering circular and zero-emission construction through active procurement of circular solutions for increased resource efficiency; and innovations such as battery-powered construction machinery and large scale power banks to provide fast charging of heavy duty machinery at construction sites with limited access to electrical power. These initiatives have relied on both municipal funding and private sector innovation, showcasing the potential for future collaborations in the building and construction sector.

Targeting Financing Solutions

Moving forward, Trondheim's capital planning will target solutions to fill the identified funding gaps:

- Freight and utility transport: Address the need to strengthen national incentives and support mechanisms for freight and utility transport optimization to accelerate their transition to electric or other low-emission technologies. Explore innovative financing models and public-private partnerships to fund infrastructure development, such as charging and filling stations for renewable energy.
- Off-road machinery: Address the need for dedicated funding for research, development, and deployment of emission free technologies for off-road machinery. Incentivise the adoption of cleaner machinery through public procurement policies and grants. Encourage collaboration between industry, academia, and government to accelerate technological advancements and reduce the cost of adoption.
- Mobility: Secure additional external funds for complementary projects in sectors with existing significant investments like transport, such as developing bike and pedestrian infrastructure.
- Energy Sector: Attract private sector financing for large-scale renewable energy projects and CCS technology by making these projects more attractive through innovative financing mechanisms like carbon offsets or public co-financing.
- Circular Economy: Prioritise public funding for projects fostering a circular economy, like advanced waste management and resource efficiency initiatives, while involving private stakeholders through sustainable business models.
- Nature Restoration: Secure funding for nature restoration projects, such as reforestation, wetland restoration, and habitat creation. Explore innovative financing mechanisms, such as biodiversity offsets and payments for ecosystem services, to leverage private sector investment.

Next Steps for Capital Planning

The next step for Trondheim is to finalise its capital planning framework, focusing on:

1. Identifying Additional Funding Sources: Leveraging existing relationships with national government and EU institutions to secure further grants and low-interest loans.
2. Attracting Private Sector Involvement: Engaging with private investors and businesses to create investment opportunities within the green economy.
3. Identify local industrial and commercial businesses that rely on fossil fuels and help them explore financing options to switch to renewable energy sources.
4. Expanding the Project Pipeline: Ensuring that projects across sectors are developed and structured in a way that makes them attractive to both public and private capital sources.

In addition, Trondheim's climate finance must ensure that decarbonization benefits are shared equitably. This requires:

- Prioritising investments that favour vulnerable groups, to redistribute resources and benefits.
- Engaging all stakeholders in decision-making and funding allocation.
- Supporting green job creation in sustainable sectors.
- Ensuring access to affordable clean energy for all.

- Maintaining transparent and accountable financial governance.

This capital planning process will be iterative, continuously evolving to reflect the city's financial position, funding opportunities, and the strategic needs of its just transition towards climate neutrality goals. A current overview of capital planning by stakeholder (table 8) and capital planning including selected actions (table 9) are provided.

Table 8: Capital Planning by Stakeholder, included *selected actions in cursive*

Total Investment-CAPEX (Cash Basis MEUR 2020-2030). Incremental to existing costs.
Please also note that the state's contributions to both citizens and professional actors are not reflected in this table.

Field of Action	Action / Indicator	Citizens (€)	Private Sector (€)	Municipality (€)	Transport Operators (€)	Utility Providers (€)	Total (€)
Transport	*Reduced motorised passenger transportation need**	€ -	€ -	€ -	€ -	€ -	€ -
	Shift to public & non-motorized transport*	−€6	€ -	−€2	−€31	€ -	−€40
	Increased car pooling*	€ -	€ -	€ -	€ -	€ -	€ -
	Electrification of cars + motorcycles	−€240	−€18	−€2	€ -	€ -	−€260
	Electrification of buses*	€ -	€ -	€ -	−€22	€ -	−€22
	Optimised logistics	€ -	€ -	€ -	€ -	€ -	€ -
	Electrification of trucks	€ -	−€22	−€3	−€170	€ -	−€196
	(Miljøpakken)		−€362	*−€17*	*(See private sector)*	*STATE & REGION: -€864*	*-€1270*
	T2.3 / 2.4: Zero emission vans (procurement and infrastructure)	-	-	*−€2,8*	-	*Unknown*	*-€2,8 for preparing a site offered to a charging or refueling operator*
	Shore power for cruise ships	-	-	*Municipalities: -€5,9*	*Unknown*	*Enova: -€1,7*	*-€7,6*

Buildings & Heating**	Building renovations (envelope)	−€204	−€73	−€15	€ -	€ -	−€291
	New energy-efficient buildings	−€22	−€45	−€7	€ -	€ -	−€74
	Efficient lighting & appliances	−€108	−€39	−€8	€ -	€ -	−€155
	Decarbonizing heating generation	€5	€2	−€5	€ -	−€20	−€18
	Pilot City programme on CCS: CCWaSte4NetZero	-	-	-	-	NZC: -€0,5	*-€0,5*
	E2.2: CCS from waste incineration	-	-€261	-	-	-	*-€261*
Electricity***	Decarbonizing electricity generation	€0	€0	€0	€ -	€ -	€0
	Upgrades of hydropower plants	-	-	-	-	*Statkraft: -€100*	*-€100*
	Upgrades in the electricity grid	-	-	-	-	*Statnett and Tensio: -€157*	*-€157*
Waste****	Increased waste recycling	€ -	€ -	−€3	€ -	€ -	−€3
	E2.1: SESAM plant for post-sorting of residual waste	-	-	*Municipalities: -€87*	-	-	*-€87*
	Pilot on local recycling centre	-	-	*-€0,3*	-	-	*-€0,3*
	TRÅD	-	-	-	-	*Interreg: -€0,6*	*-€0,6*
Total unknown split			**−€362**				
Total		**−€246**	**−€301**	**−€119**	**−€223**	**−€1 124**	**−€2 375**
% of Total		10%	13%	5%	9%	47%	100%

Euros Per Capita (2030 population)		−€1 070	−€1 309	−€517	−€970	−€4 886	−€10 326

** See (Miljøpakken)*
*** See: "Pilot City programme on CCS: CCWaSte4NetZero" and "E2.2: CCS from waste incineration".*
**** See "Upgrades of hydropower plants" and "Upgrades in the electricity grid"*
***** See "E2.1: SESAM plant for post-sorting of residual waste", "Pilot…" and "TRÅD".*
****** Sums in grey not included.*

Table 9: Capital Planning

including *selected actions in cursive* (Cash Basis MEUR 2020-2030 - incremental to existing costs)

Field of Action	Action / Indicator	Cost to Municipality	Cost to Other	% of Costs Covered
Transport	Reduced motorised passenger transportation need*	€ -	€ -	-
	Shift to public & non-motorized transport*	−€2	−€38	See (Miljøpakken) below
	Increased car pooling*	€ -	€ -	See (Miljøpakken) below
	Electrification of cars + motorcycles	−€2	−€258	Cost to Municipality covered. Remaining costs not assessed
	Electrification of buses*	€ -	−€22	See (Miljøpakken) below
	Optimised logistics	€ -	€ -	-
	Electrification of trucks	−€3	−€192	Cost to Municipality covered. Remaining costs not assessed
	(Miljøpakken)	*−€17*	*−€1 252*	*100*
	T2.3 / 2.4: Zero emission vans (procurement and infrastructure)	*−€2,8*	*Unknown*	*Municipal cost: 100*
	Shore power for cruise ships		*−€7,6*	*100. Enova covers €1,7. The intermunicipal split is not known.*
Buildings &	Building renovations (envelope)	−€15	−€276	Not assessed
	New energy-efficient buildings	−€7	−€67	Not assessed
	Efficient lighting & appliances	−€8	−€147	Not assessed

Heating**	Decarbonizing heating generation	−€5	−€13	Not assessed
	Pilot City programme on CCS: CCWaSte4NetZero	*€ -*	*−€0,5*	*100*
	E2.2: CCS from waste incineration	*€ -*	*−€261*	*Statkraft: No investment decision yet: signals need for support from state*
Electricity***	Decarbonizing electricity generation	€0	€0	-
	Upgrades of hydropower plants	*€ -*	*−€100*	*100*
	Upgrades in the electricity grid	*€ -*	*−€157*	*100*
Waste****	Increased waste recycling	−€3	€ -	-
	E2.1: SESAM plant for post-sorting of residual waste		*−€87*	*No investment decision or split between* municipalities *yet.*
	Pilot on local recyling centre	*−€0,3*	*€ -*	*100*
	TRÅD	*€ -*	*−€0,6*	*100*
Total unknown split			**−€95**	
Total*****		**−€27**	**−€2 221**	

** See (Miljøpakken)*
*** See: "Pilot City programme on CCS: CCWaSte4NetZero" and "E2.2: CCS from waste incineration".*
**** See "Upgrades of hydropower plants" and "Upgrades in the electricity grid"*
***** See "E2.1: SESAM plant for post-sorting of residual waste", "Pilot…" and "TRÅD".*
****** Sums in grey not included.*

Module IP-B3: Economic and Financial Indicators for Monitoring, Evaluation and Learning

B-3.1: Economic and Financial Indicators for Monitoring, Evaluation and Learning

A robust framework for monitoring, evaluation, and learning (MEL) is part of what Trondheim needs to develop to meet its 2030 climate neutrality targets. This framework will provide the necessary oversight of capital investments, enabling the city to measure financial performance, assess the effectiveness of climate actions, and adjust its strategies as needed. Furthermore, having a reliable monitoring system is crucial for securing external funding, as private investors require clear and consistent reporting on project implementation, financial performance, and progress toward climate goals.

Existing Monitoring Systems and Tools

The City of Trondheim already has several monitoring and evaluation tools in place, particularly through its annual climate budget process, which tracks the allocation of funds toward climate-related projects. Additionally, Trondheim has developed GHG emissions tracking systems in collaboration with national agencies, such as the Norwegian Environment Agency, which publishes annual emission statistics for the city. These tools provide a foundation for monitoring the impact of green investments, but additional refinements are needed to align fully with the city's climate neutrality goals.

1. Climate Budget Monitoring: The climate budget process ensures that the city's financial commitments align with its emission reduction targets. This system will be further integrated into the overall capital investment planning process, helping to identify deviations between planned investments and actual financial performance.
2. GHG Emission Monitoring: Trondheim's GHG inventory follows national methodologies and tracks emissions reductions from key sectors such as transport, energy, and waste. However, this system is being continuously improved to provide more granular data and to better capture co-benefits, such as improved air quality and public health.
3. CDP reporting: Since 2015, Trondheim Municipality has reported annually to the CDP platform, now also known as the CDP-ICLEI track. The reporting goes through five management phases: governance, assessment, targets, planning and actions. Trondheim came to Cites A List in 2022 and 2023.

Key Economic and Financial Indicators

A set of financial and economic indicators will be developed and implemented to monitor the progress of capital investments and their impact on Trondheim's climate goals, see table 10 and 11. These indicators aim to align both the financial policies laid out in the city's Climate Neutrality Action Plan and the specific actions selected for implementation. The following are key indicators that will likely be used for monitoring and evaluation:

1. Capital Expenditure (CapEx) and Operational Expenditure (OpEx)**: These indicators will track the total investment allocated to each climate action (CapEx) as well as the ongoing operational costs (OpEx) associated with maintaining and managing those actions. This will ensure that the city's capital allocation aligns with its climate goals and provides insights into cost-effectiveness over time.
2. Greenhouse Gas (GHG) Emission Reductions: Using recognised methodologies, this indicator will estimate the emission reductions achieved through specific projects, such as renewable energy installations or transport electrification. This will be closely linked to the climate budget and will serve as a key performance measure for climate action success.
3. Return on Investment (ROI) for Climate Projects: This indicator will assess the financial performance of projects in relation to their environmental and social impact. It will provide insights into how efficiently public and private capital is being used to achieve the desired outcomes and help to optimise future capital allocations.
4. Cost per Ton of CO2 Reduced: This metric will allow Trondheim to evaluate the cost-effectiveness of different climate actions, helping to prioritise the most impactful and cost-efficient measures. It will be particularly important when deciding between different infrastructure investments and scaling renewable energy systems.
5. Co-Benefits Measurement: This indicator will track the indirect benefits of climate actions, such as improvements in air quality, public health, and local job creation. Measuring these co-benefits is essential for demonstrating the broader societal impact of Trondheim's climate neutrality efforts, especially when seeking external funding.
6. Deviations in Capital Investment Planning: This indicator will monitor any deviations between planned capital investments and actual expenditures. Tracking these deviations will ensure that corrective actions can be taken early to keep projects on budget and on track towards climate neutrality by 2030.

Data Availability and Stakeholder Involvement

While much of the data required to monitor these indicators is already available through Trondheim's existing climate and financial tracking systems, some additional data sources and stakeholders will need to be engaged to ensure full coverage. For example:

- Emission Reduction Data: While GHG emission data is already available, more detailed data will be needed for specific sectors, such as construction and energy production, to accurately estimate reductions at the project level. Partnerships with institutions like NTNU and SINTEF, which already provide technical expertise, will be expanded to support this data collection.
- Financial Data for Private Investments: The involvement of private sector partners will require transparent financial reporting mechanisms that align with investor expectations. The city plans to work closely with private investors and financial institutions to standardise data collection and reporting, particularly for public-private partnership (PPP) projects.
- Co-Benefit Data: Additional collaboration with public health authorities and local businesses will be needed to measure the co-benefits of climate actions, such as improved air quality and economic development. These benefits are critical for showcasing the full value of Trondheim's climate investments.

Enhancing Monitoring and Learning Systems

To strengthen the city's capacity for monitoring, evaluation, and learning, the following steps will be taken:

1. Integrating Financial and Emission Data Systems: A key priority is to ensure that financial data (e.g., CapEx, OpEx, ROI) is fully integrated with GHG emission reduction data. This will enable the city to track how effectively financial resources are being used to achieve climate outcomes.
2. Developing a Comprehensive Reporting Framework: A comprehensive reporting framework will be created to align with both internal monitoring needs and the requirements of external stakeholders, such as private investors and funding institutions. This framework will provide clear insights into financial performance, project progress, and emission reductions.
3. Building Capacity for Real-Time Data Tracking: To ensure continuous learning and adjustment, the city will invest in real-time tracking tools that allow for ongoing monitoring of both financial performance and climate outcomes. This will be particularly important for large infrastructure projects, where delays or budget overruns could significantly impact overall climate targets.

Conclusion: Aligning Indicators with Long-Term Goals

By developing a robust monitoring, evaluation, and learning framework, Trondheim will be well-positioned to track its progress toward climate neutrality by 2030. The use of key financial and economic indicators - such as capital expenditure, ROI, and GHG reductions - will allow the city to make data-driven decisions, optimise the use of public and private capital, and ensure that it meets its climate targets efficiently. Additionally, these systems will help build the trust and confidence required to secure ongoing external funding and investment.

Through continuous evaluation and learning, Trondheim will not only meet its climate goals but also become a leader in sustainable city finance and capital planning.

Table 10: Economic Indicators by Sector

Fields of Action	Indicator	Indicator Unit	Indicator Baseline*	Indicator Target 2030*
Transport	Reduced motorised passenger transportation need	% reduction by 2030	2022	10%
	Reduced passenger kilometres by car through shift to public & non-motorized transportation	% reduction in car passenger kilometres by 2030	2022	30%
	Car pooling	average passengers per car	1,2	1,5
	Electrification of cars + motorcycles by 2030	% of fleet electrified	28%	100%
	Electrification of buses	% of fleet electrified	11%	100%
	Optimization of trucking logistics - light duty trucks (< 3.5 t)	average utilisation of maximum load weight for light duty trucks (< 3.5t)	23%	45%
	Optimization of trucking logistics - heavy duty trucks (> 3.5 t)	average utilisation of maximum load weight for heavy duty trucks (< 3.5t)	45%	60%
	Electrification of light duty trucks <3.5t by 2030	% of fleet electrified	0%	100%
	Electrification of heavy duty trucks <3.5t by 2030	% of fleet electrified	0%	100%
Buildings & Heating	Building renovation (envelope)	% annual renovation rate	1,50%	2,50%
	New buildings built to top performing standard	% of buildings built to the top standard	10%	30%
	Efficient lighting and appliances	% annual renovation rate	1,50%	2,50%
	Heating technologies	share of heating as district heating	29%	30%
	Decarbonizing district heating	share of district heating produced using fossil fuels	5%	0%
	Decarbonizing district heating	share of district heating produced using electric heat pumps	15%	17%
	Decarbonizing district heating	share of district heating produced using bio fuels	4%	6%
	Heating technologies	share of heating as local heating	71%	70%
	Decarbonizing local heating	share of local heating produced using fossil fuels	3%	3%

	Decarbonizing local heating	share of local heating produced using electric heat pumps	93%	93%
	Decarbonizing local heating	share of local heating produced using bio fuels	4%	4%
Electricity	Renewable / fossil fuel electricity production	share of electricity produced using fossil fuels	1%	1%
Waste	Paper recycling	% recycling rate	86%	90%
	Metal recycling	% recycling rate	76%	85%
	Plastic recycling	% recycling rate	42%	90%
	Glass recycling	% recycling rate	89%	90%
	Organic recycling	% recycling rate	27%	70%

**Indicative indicators*

Table 11: Financial Indicators by Sector

All costs are incremental. Please note that table 11 relies solely on the NZC economic model. We are currently not able to make project specific indicators apart from CAPEX and OPEX given in table 7.

Fields of Action	Indicator	NPV Investment Expense - CAPEX (MEUR 2020-2030)	NPV Operational Savings - OPEX (MEUR 2020-2040)	NPV Co-benefits (MEUR 2020-2040)	NPV Return on Investment (ROI) (MEUR 2020-2040)	% Return on Investment (ROI)	Year 2030 kton CO2e Reduction	NPV MEUR Investment Expense / Year 2030 kton CO2e Reduction
Transport	*Reduced motorised passenger transportation need*	€ -	€212	€43	€255	0%	9	€ -
	Shift to public & non-motorized transport	−€32	€57	€106	€130	404%	13	€2,46
	Increased car pooling	€ -	€137	€42	€179	0%	9	€ -
	Electrification of cars + motorcycles	−€249	€106	€24	−€118	−47%	25	€10,02
	Electrification of buses	−€20	€63	€29	€72	356%	25	€0,81
	Optimised logistics	€ -	€9	€53	€62	0%	38	€ -

	Electrification of trucks	−€176	€124	€23	−€29	−16%	34	€5,19
Buildings & Heating	Building renovations (envelope)	−€247	€134	€14	−€99	−40%	9	€26,40
	New energy-efficient buildings	−€62	€24	€2	−€36	−57%	2	€39,10
	Efficient lighting & appliances	−€130	€100	€2	−€27	−21%	3	€50,61
	Decarbonizing heating generation	−€15	€25	€2	€12	78%	32	€0,49
Electricity	Decarbonizing electricity generation	€0	€180	€ -	€180	7849490%	0	€0,04
Waste	Increased waste recycling	−€2	€1	€0	−€1	−52%	6	€0,40
Total		**−€935**	**€ 1 174**	**€340**	**€579**	**62%**	**203**	**€4,61**

Part C – Enabling Financial Conditions for Climate Neutrality by 2030

Part C "Enabling Conditions for Climate Neutrality by 2030" is the third section of the Investment Plan and is intended to identify other enabling factors the city needs to consider in the implementation of the Investment Plan.

Module IP-C1: Climate Policies for Capital Formation and Deployment

C-1.1: Climate Policies for Capital Formation and Deployment

The City of Trondheim has processes in place to finance many of its activities. This also includes climate activities, although these activities and projects can vary a bit when it comes to partners and funding mechanisms. The way we structure our financial assets is working quite well, and it's closely linked to the municipal planning system (table 12). Still, there's potential for aligning and improving this work more towards our climate ambitions. First and foremost this is about how we see the municipal budgets, which are decided by the city council, in relation to other external funding mechanisms needed to succeed with the climate transition.

1) Existing Process for Policy Formulation

Trondheim has over the years developed a comprehensive process for policy formulation that integrates various tools, methods, and cross-sectoral collaboration. Moving forward, this needs to better support financing innovative climate action initiatives as well.

Tools and methods: The city utilises a suite of analytical tools designed to assess the environmental, social and financial impact of proposed projects. These tools include cost-benefit analysis models, sustainability impact assessments, and carbon footprint calculators. By integrating these kinds of tools, Trondheim ensures that capital is allocated to projects that offer the highest potential for both environmental impact and economic return. These tools however, are not fully integrated into all of the decision making and are not yet align to a mission approach.

Transversal working groups: To ensure a holistic approach to policy development, Trondheim has established transversal working groups composed of experts from different sectors, including finance, environment, urban planning, and technology. These working groups work together to develop projects and policies that support a variety of financing mechanisms, public-private partnerships, R&D-projects, etc. The nature of these teams ensures that climate action is embedded across all different policy areas. This creates a good foundation for developing capital deployment strategies, but this pathway needs to be explored over the next couple of years. The development of green bonds and impact investing are still fairly new to municipal practices, but this way of thinking is starting to gain traction.

Procurement and Innovative Contracting: Trondheim has reformed its procurement processes to prioritise sustainability and innovation. The city has adopted green procurement guidelines that require suppliers to meet specific environmental criteria. Additionally, innovative contracting methods, such as outcome-based contracts and collaborative contracting, are being explored to align the interests of all stakeholders and ensure that financial resources are utilised efficiently.

2) Developing Integrated Financial/Funding Policy Input

To avoid siloed operations and ensure that the Transition Team is effectively integrated into the financial policy-making process, Trondheim will implement several key mechanisms:

Cross-Sectoral Policy Input: The Transition Team, which is responsible for driving the city's climate neutrality agenda, is actively involved in the development of financial policies. This involvement is facilitated through regular cross-sectoral workshops and meetings where the Transition Team provides input on financial strategies and identifies funding gaps that need to be addressed. This collaborative approach aims to make financial policies more aligned with the 2030 ambition and that the Transition Team's insights are incorporated into decision-making processes.

Collaborative Governance Structure: Trondheim will establish a collaborative governance structure that includes representatives from the Transition Team, financial institutions, and key city departments. This structure enables continuous dialogue and collaboration, ensuring that financial policies are responsive to the evolving needs of the climate neutrality agenda. The governance structure also facilitates the integration of innovative financing solutions, such as blended finance models and climate funds, into the city's broader financial strategy.

Feedback Loops and Adaptive Management: To ensure that financial policies remain effective and responsive, Trondheim will implement feedback loops that allow for the continuous monitoring and evaluation of financial initiatives. The Transition Team will play a critical role in this process by providing real-time feedback on the effectiveness of funding mechanisms and proposing adjustments as needed. This adaptive management approach will ensure that financial policies are flexible and can be refined to meet the city's climate neutrality targets.

3) Leveraging External Partnerships and Funding Opportunities

In addition to internal processes, Trondheim actively seeks to leverage external partnerships and funding opportunities to support its climate neutrality goals.

European and National Funding Programs: Trondheim participates in various European and national funding programs that provide financial support for climate action projects. The city has successfully secured funding through initiatives such as Horizon Europe, Nordic Innovation and national climate funds. These external resources will complement the city's internal financial mechanisms and provide additional capital for high-impact projects.

Private Sector Engagement: Trondheim recognizes the importance of engaging the private sector in its climate neutrality efforts. The city has developed partnerships with institutions and corporations to collaborate on climate projects. These partnerships are getting increasingly important to align private sector interests with the city’s climate goals. Although collaboration with the private sector is crucial to succeed with the city transition, it also shows some existing barriers regarding procurement and partnerships that need to be solved over the next couple of years.

Community Financing Initiatives: To engage the local community and ensure broad-based support for climate action, Trondheim will explore community financing initiatives, such as crowdfunding and cooperative models. Such initiatives may not only provide additional funding but also foster a sense of ownership and participation among residents, reinforcing the city's commitment to a just and inclusive transition to climate neutrality.

Conclusion

Trondheim's approach to capital formation and deployment is characterised by a strong policy framework, cross-sectoral collaboration, and the integration of innovative financing mechanisms. By ensuring that the Transition Teams will be engaged in the financial policy-making process and by leveraging external partnerships, the city can better position itself to achieve its goal of climate neutrality by 2030. The strategies outlined in this chapter will continue to evolve as Trondheim adapts to emerging challenges and opportunities, to keep the city on track to meet its climate commitments.

Table 12: List of Climate Policies to Enable Capital Deployment

Climate Policy	Policy Status (Enacted, In Process, Development, etc.)	Description of the policy (sector, targeted audience, etc.)	Intended Outcome for Capital Formation
Trondheimsløftet - Societal Master Plan	Enacted	A holistic strategy for Trondheim's development, based on UN SGDs.	Describes the co-creation of the city, including new economic models and financing mechanisms.
Klimaløftene - Climate Action Plan	Enacted	A holistic strategy for Trondheim's climate transition.	Helps pinpoint and clarify the climate goals and priorities for the city.
Finance regulations	Enacted	Describes the rules and guidelines for financial activities in the city of Trondheim.	Define the responsibility and opportunities for the municipalities when it comes to financing.
Climate budget	Enacted	Annual action plan connected to the municipal budget plan.	Showcases climate actions and existing financing in the municipal organisations.
Budget and action plan 2025-2028	In process	Plan investment for the city the next four years.	Shows investments and potential municipal financial capabilities.

Module IP-C2: Identification and Mitigation of Risks

C-2.1: Identification and Mitigation of Risks

The successful implementation of an Investment Plan toward achieving climate neutrality by 2030, as outlined in Trondheim's Climate Action Plan, faces several risks that could impact the ability to reach its goals (table 13). These risks range from financial and operational challenges to uncertainties related to policy and climate conditions. While the city has developed a foundational framework for managing risks, there is still room to enhance these processes to ensure they fully align with the complexities of the city's climate goals. A proactive approach to identifying, measuring, and mitigating risks will allow Trondheim to better safeguard its investments and ensure that its climate action projects are resilient to both financial and operational uncertainties.

Risk Identification in the Investment Process

Risk analysis is present in Trondheim's decision-making process, but it is not yet fully integrated across all levels of investment planning. The city currently identifies risks during the initial phases of project design, primarily focusing on financial risks such as cost overruns or potential delays. However, the process for regularly reassessing risks throughout the project lifecycle is not consistently applied. For instance, while larger projects like the carbon capture initiative in district heating or the expansion of electric transport infrastructure undergo more rigorous analysis, smaller or sector-specific projects may not receive the same level of scrutiny.

To improve, Trondheim can establish a more systematic risk identification process that is applied to all projects, regardless of size. This can be achieved by creating a centralised risk register that categorises risks by type (e.g., financial, operational, environmental) and tracks them throughout the

project's duration. Regular updates to this risk register will allow the city to respond more dynamically to emerging threats, such as fluctuations in energy prices or new national regulations that may impact funding opportunities.

Enhancing the Risk Management Framework

Trondheim has made strides toward developing a risk management framework, but it is still in the early stages of implementation. The city has begun to embed risk considerations into its energy and climate plan, but more work is needed to ensure this framework is comprehensive and regularly updated. Currently, the risk management framework primarily focuses on financial aspects, particularly regarding potential shortfalls in funding or cost increases for major infrastructure projects.

To strengthen the framework, Trondheim can expand its scope to include broader categories of risk, such as environmental risks associated with climate change impacts (e.g., extreme weather events) and socio-political risks like public resistance or lack of stakeholder engagement. By doing so, the city can build a more resilient approach to managing risks at both the sector and project level. In addition, regular stakeholder consultations and feedback mechanisms can be integrated into the framework to ensure that risks are identified early and addressed through collaborative efforts.

Opportunities for Improved Risk Quantification and Mitigation

While Trondheim has begun using some risk quantification methods, these are not yet standardised across all projects. Financial risks are typically analysed using budget forecasts and basic scenario planning, but there is limited use of advanced risk quantification techniques such as sensitivity analysis or stress testing. Operational risks, particularly those related to project delays or supply chain disruptions, are often addressed on an ad-hoc basis.

To improve risk quantification, Trondheim can adopt more robust tools and methodologies. For example, expanding the use of scenario planning to include worst-case scenarios - such as significant policy changes at the EU level - can help the city better anticipate and mitigate potential risks. Furthermore, the adoption of risk matrices and scoring systems will allow for clearer prioritisation of risks, helping decision-makers allocate resources more effectively toward risk mitigation efforts.

In terms of risk mitigation, the city can better align its efforts with national and European Union financial policies. Currently, there is potential to better leverage these external funding streams to reduce the financial risks tied to major climate investments. This is also among the main reasons why the city developed the ambition to be a part of the NetZero Cities platform. In addition, Trondheim can explore more innovative mitigation techniques, such as setting aside contingency budgets for high-risk projects or establishing public-private partnerships to share the financial burden of large-scale initiatives like renewable energy infrastructure.

Strengthening the Review and Adaptation Process

Trondheim's risk management framework is still evolving, and while there is a review mechanism in place, it lacks the consistency and frequency needed to adapt quickly to new challenges. At present, reviews of the risk management framework tend to coincide with the annual budget cycle, which limits the city's ability to make timely adjustments based on changing circumstances. For example, rapid technological advancements or sudden shifts in regulatory landscapes at the national or EU level may require more frequent reassessments of project risks.

To address this, Trondheim can implement a more dynamic review process, incorporating quarterly or semi-annual evaluations of the risk management framework. This can include input from various stakeholders - such as local government departments, business leaders, and community representatives - to ensure a wide range of perspectives are considered. In addition, the city can

introduce more structured feedback loops from ongoing projects, allowing for continuous improvement in identifying and mitigating risks as they emerge.

By enhancing its capability in risk management and adopting a more adaptive and proactive approach, Trondheim can not only safeguard its investments but also position itself to respond effectively to the unpredictable challenges that will inevitably arise on the path to climate neutrality.

Table 13: Climate Investment Plan Risk Framework

Selected actions in cursive.

Fields of Action	Sectoral Project	Risks Identified	Description of Risk	Risk Priority	Mitigation of Risk
Transportation	Shift to public & non-motorized transport and electrification of buses */Miljøpakken*	Insufficient infrastructure development	The risk that infrastructure for public (electric buses) and non-motorized transport (such as cycling paths and pedestrian areas) will not be developed quickly enough, hindering project success.	High	Ensure comprehensive long-term infrastructure planning, secure sufficient funding through public-private partnerships, and regular monitoring of project milestones.
	Electrification of cars and trucks *T2.3 / 2.4: Zero emission vans (procurement and infrastructure)*	*Decreasing financial support from national government*	*Transport actors and businesses need incentives to choose emission free transport.*	*Medium*	*Provide local incentives on the use of emission free vehicles.*
Built Environment	Building renovations (energy efficiency)	Cost overruns and funding delays	The renovation projects could experience unexpected increases in costs due to material prices, labour shortages, or supply chain disruptions. This could also delay project timelines.	High	Implement rigorous cost estimation models, establish a contingency budget, and use robust project management to monitor and react swiftly to potential supply chain issues.
	E2.2: CCS from waste incineration	*Lack of economically sustainable financing model*	*The plant owner is seeking a sustainable financing model, and addresses the need for support form the state.*	*High*	*Address this topic with national authorities through the NZC national platform.* *Explore alternative business models*

					including private investments, and sale of carbon offsets.
Energy Generation	Decarbonizing heating generation	Technology risk and public resistance	Uncertainty surrounding the adoption of new technologies (such as heat pumps) and potential public resistance could slow the rollout of decarbonized heating solutions.	Medium	Engage in community outreach and education to ensure public buy-in, and conduct pilot projects to demonstrate the efficacy of new technologies before scaling up.
	Upgrades of hydropower plants and in the electricity grid	*Delays*	*Delays in the projects due to unforeseen challenges.*	*Medium*	*If the projects generates applications to the municipality, the municipality can prioritise the projects to reduce processing time.*
Green Infrastructure & Nature	Expansion of green urban spaces	Regulatory and land-use conflicts	Conflicts between green space expansion and existing land-use regulations could delay project implementation.	Medium	Engage with local and national regulatory bodies early to ensure alignment and consider integrating green space expansion into broader urban development projects to streamline regulatory approval processes.
	Restore nature	*Lack of funding.* *Climate change.*	*Restrains in the municipal budget and lack of interest from citizens and other private capital.* *Climate change might pose challenges to restore nature through floods, droughts etc.*	*High*	*Engage the community and cooperate with businesses.* *Apply for national, EU or UN grants.* *Lobby for increased national funding.* *Explore green bonds and other innovative financing mechanisms.* *Take changing climate conditions into consideration when planning restoration projects.*

Waste & Circular Economy	Increased waste recycling *E2.1: SESAM plant for post-sorting of residual waste*	Market failure for recyclables. *Lack of funding*	The market for recyclables may fluctuate, affecting the viability of recycling programs and circular economy initiatives. *Restrains in the relevant municipalities' budgets.*	High	Introduce financial incentives for recyclables, explore public-private partnerships for recycling infrastructure, and implement flexible contracts with recycling partners to adjust to market conditions. *Engage the community to increase local support. Lobby for increased national funding.*
City Wide Risks (Cross Cutting)	Cross-departmental coordination	Limited capacity for cross-sector coordination	Departments in the municipality may not have sufficient expertise or administrative capacity to manage large-scale, cross-sector climate projects, leading to delays in implementation and misalignment with the climate neutrality mission.	High	Establish a dedicated transition team with cross-sector expertise, provide training programs in climate finance and project management, and regularly assess the capacity and resource needs of relevant departments.

Module IP-C3: Capacity Building and Stakeholder Engagement for Capital and Investment Planning

C-3.1: Module IP-C3: Capacity Building and Stakeholder Engagement for Capital and Investment Planning

The success of Trondheim's ambition to become climate neutral by 2030 hinges not only on sound financial planning but also on the strength and capacity of the teams involved, as well as the engagement of relevant stakeholders (table 14 and 15). This chapter explores the capacity building efforts within the Transition Team, the identification of gaps, and the strategic approach to stakeholder engagement essential for developing a robust Investment Plan.

1) Transition Team Resourcing and Skillsets

The effectiveness of the Transition Team is critical to the development and implementation of a robust investment plan. Trondheim will take steps to ensure that the team is well-resourced and equipped with the necessary skillsets.

Resource Allocation: Trondheim will commit to resourcing and setting up the Transition Team, recognising that the expertise and capabilities of this team are pivotal to the city's climate neutrality goals. The team needs to be composed of professionals with diverse backgrounds, including finance, environmental science, urban planning, project management, and community engagement. The city council has also highlighted the importance of the mission of becoming climate neutral, as one of their priorities for the upcoming period.

Skill Development Programs: To further enhance the capabilities of the Transition Team, Trondheim will explore the use of skill development programs. These programs include specialised training in areas such as sustainable finance, risk management, and innovative contracting methods. The city also encourages team members to participate in conferences, workshops, and knowledge exchange programs to stay updated on the latest trends and best practices in climate finance and investment planning.

2) Identifying Capacity Gaps

Trondheim municipality recognises the importance of continuously assessing and addressing capacity gaps to ensure the successful development and implementation of the investment plan.

Capacity Gap Analysis: Trondheim will need to conduct a capacity gap analysis to identify both knowledge and personnel gaps within the Transition Team. This analysis should evaluate the team's competencies against the demands of developing a comprehensive investment plan, to ensure the presence of key elements like specialised expertise in areas such as green bond structuring, impact assessment, and stakeholder engagement.

Addressing Knowledge Gaps: To address knowledge gaps, the city might gain from initiating partnerships with academic institutions, private companies, and industry experts. These partnerships may provide the Transition Team with access to cutting-edge research, case studies, and expert consultations. Additionally, a knowledge-sharing platform where team members can exchange insights, lessons learned, and best practices with peers from other cities and organisations might be helpful both to Trondheim municipality and other organisations.

Strengthening Personnel Capacity: To fill personnel gaps, Trondheim will need to actively recruit additional experts in fields identified as critical to the investment plan's success. The city should also consider opportunities, where professionals from other departments or external organisations are temporarily assigned to the Transition Team to provide targeted support. This approach can ensure that the team is sufficiently staffed with the right mix of skills and experience.

3) Stakeholder Identification and Engagement Strategy

The development of a successful investment plan requires the active involvement of a wide range of stakeholders. The city has identified relevant stakeholders and will develop a clear engagement strategy to ensure their meaningful participation.

Stakeholder Identification: The city has identified a diverse group of stakeholders essential to the further development and implementation of the investment plan. These stakeholders include local government departments, financial institutions, private sector investors, academic institutions, non-governmental organisations (NGOs), community groups, and citizens. Each of these stakeholders brings unique perspectives, resources, and expertise that are vital to the investment plan.

Stakeholder Mapping: Trondheim has categorised stakeholders based on their level of influence, interest, and potential contribution to the investment plan. High-priority stakeholders, such as financial institutions and key government departments, are engaged more intensively, while other

stakeholders are involved through targeted consultations and participation in specific aspects of the plan.

Engagement Strategy: Trondheim's stakeholder engagement strategy will be built on principles of inclusivity, transparency, and collaboration. The strategy needs to include a mix of engagement methods tailored to different stakeholder groups:

- **Public Consultations:** Trondheim needs to conduct more regular public consultations to gather input from citizens and community groups. These consultations should be held in various formats, including meetings, online surveys, and focus groups, to ensure broad-based participation. The feedback collected from these consultations will be integrated into the investment plan to reflect the community's priorities and concerns.
- **Collaborative Workshops:** For key stakeholders such as financial institutions, private investors, and NGOs, Trondheim regularly organises collaborative workshops. Now, we will need to organise workshops and other platforms for co-creation, where stakeholders can contribute their expertise, explore partnership opportunities, and help shape the strategic direction of the investment plan. The collaborative nature of these workshops might foster a sense of shared ownership and commitment among participants.
- **Stakeholder Advisory Committees:** Trondheim will consider to establish several stakeholder advisory committees, each focusing on a specific domain, such as sustainable finance, urban development, or renewable energy. Such committees might provide advice and feedback to the Transition Team, ensuring that stakeholder perspectives are continuously integrated into the planning and implementation process.

Communication and Feedback Mechanisms: To maintain ongoing engagement, Trondheim needs to strengthen clear communication channels and feedback mechanisms. Regular updates on the progress of the investment plan will need to be part of future stakeholder communication. Stakeholders will be encouraged to provide feedback at key stages of the plan's development.

4) Designing multi-level and multi-sector portfolio

Trondheim's portfolio design, as part of a broader national framework, will play an important role in achieving climate neutrality by 2030. The portfolio gravitates around three main dimensions:

- ★ Actions: What do we need to do?
- ★ Actors: Who will need to do the job?
- ★ Assets: What resources are available for the mission?

By embracing multi-level governance and systemic integration, the portfolio contributes in several ways:

- **Scalability of Climate Solutions:** The portfolio aligns local actions with national goals, allowing scalable projects. This enables Trondheim to replicate successful pilots and benefit from national expertise and resources, enhancing the impact of local initiatives.
- **Accelerating Investment:** By coordinating with national actors, the portfolio makes climate projects more attractive to investors, unlocking diverse funding streams for large-scale infrastructure such as renewable energy and sustainable mobility.
- **Fostering Innovation:** The portfolio encourages experimentation and learning from diverse approaches, allowing Trondheim to test and scale effective climate solutions, benefiting both the city and national strategies.
- **Risk Mitigation:** Shared risk management across governance levels reduces the financial risks of ambitious projects, enabling Trondheim to undertake larger initiatives, backed by national resilience strategies.
- **Unlocking Synergies:** Aligning local and national efforts creates synergies, where Trondheim's projects contribute to national climate goals in areas like transport and energy, multiplying the impact of individual initiatives.

- **Engaging Stakeholders:** The portfolio mobilises a broad range of actors - from city residents to national agencies - fostering collective action and political support for climate initiatives.
- **Strategic Alignment:** By integrating local efforts into a national and international framework, the portfolio ensures Trondheim's initiatives are aligned with long-term climate policies like the EU Green Deal, making them more sustainable and adaptable.

Through these contributions, Trondheim's portfolio approach increases the effectiveness, scalability, and financial viability of its climate initiatives, ensuring progress toward the 2030 climate neutrality goal while aligning with broader national and international objectives.

Conclusion

Capacity building and stakeholder engagement must become cornerstones of Trondheim's strategy for developing a robust investment plan. By ensuring that the Transition Team will be well-resourced and equipped with the necessary skills, addressing capacity gaps, and implementing a comprehensive stakeholder engagement strategy, Trondheim will create a solid foundation for its climate neutrality goals. The active participation of stakeholders will not only enrich the action plan and investment plan but also strengthen the collective commitment to achieving a sustainable, climate-neutral future by 2030.

Table 14: Stakeholder Engagement Mapping. All costs are incremental.

Stakeholders involved	Required Investment (€)	Network	Influence	Interest	Level and Type of Engagement
Statkraft Varme	€261 mill.	Energy sector, municipal waste management	High – critical to reducing emissions and compensate residual emissions.	High – district heating is competing with renewable electric energy and needs to cut emissions.	Waste-to-energy plant owner: Pushes for technology improvement and a sustainable business model for CCS.
Statkraft	€100 mill.	Energy sector	High - providing renewable energy.	High economic interest from providing clean energy	Owner of hydropower plants.
Tensio and Statnett	€157 mill.	Energy sector	High – grid management and power supply	High economic interest from providing clean energy	Grid owners with responsibility to provide electric energy.
Trønderenergi	Investments in renewable energy projects, including hydro and wind energy	Energy sector	High – key renewable energy producers	High economic interest from providing clean energy	Engaged in the development of local renewable energy solutions.
Miljøpakken	€1270 mill.	Mobility and transport	High - providing public transport and infrastructure for walking and cycling.	High - responsible to cut 20 % of car transport.	Multi-level governmental cooperation state-region-city.

Trondheim havn	€5,9 mill	Sea transport	High - authority, providing infrastructure	Medium - authority for Trondheim and neighbouring municipalities	Local authority - takes action to implement shore power for cruise ships.
Local transport actors and businesses	Not estimated	Mobility and transport	High - important to cut emissions from goods and utility transport.	High/medium: Many transport actors prepare to be competitive. Many business actors need to demand more emission free transport.	Service providers and customers. Many transport actors are proactive with more or less emission free fleets by 2024.
Construction actors, developers and other stakeholders in the value chain for buildings and constructions	Not estimated	Built environment	High - important to cut emissions from machinery and to increase area, energy and resource efficiency.	Varying from proactive actors responding to public procurement, to laggards arguing for lower environmental ambitions and regulations.	Private actors - engagement in procurement and land use.
TRV-group	€87 mill.	Waste and circular economy	High - responsible for household waste.	High - there are strong demands to increase material recovery and resource efficiency.	Inter-municipal operator of household waste treatment. Practical responsibility for implementing measures that increase material recovery.
Rockwool facility	Not estimated	Built environment	High - important to phase out fossil fuels from industry	Medium - subject to EU ETS and national quotas.	Low engagement.
Small and medium size industry actors	Not estimated	Built environment	High - important to phase out fossil fuels from industry	Low - not subject to EU ETS or other regulations.	We have little knowledge on these actors.
Renergy Renewable Energy Cluster	Not estimated	Energy sector. Industry, innovation clusters	Medium – innovation and collaboration	High – promoting new business models	Facilitating cooperation for energy-related innovations, projects and business models.

Commercial Banks (e.g. Green Loans)	Not estimated	Finance and lending institutions	Medium – financial enabler	High – opportunity to expand green financing	Providing loans for sustainable projects such as CCS and energy efficiency through green loans.
Innovation Norway Trøndelag	Not estimated	Government innovation and funding agencies	Medium – funding and business support	High – economic and sustainable growth	Engaged in funding and supporting sustainable business projects.
NTNU	Not estimated	Academic and research institutions	High – research and knowledge creation	High – strong focus on sustainability	Research partnerships and collaboration on climate and energy projects.
SINTEF	Not estimated	Academic and research institutions	High – research and development	High – strong interest in innovation	Engaged in R&D projects related to sustainable technology

Table 15: Stakeholder Activity Cost

Stakeholders involved	Activity	Cost to Municipality (€)
Non-profit organisations	"Trondheim Green Life"	N/A
Business and R&D actors	"Trondheim green deal"	N/A
National and regional authorities	"National Cities Mission Platform" to affect the framework for climate transition that applies to many of our proposed actions	N/A
Transport actors	"T2.1 / 2.2: Improved logistics for goods transport", "T2.3 / 2.4: Zero emission vans (procurement and infrastructure)", "T3.1: Zero emission zone for cars", "T3.2 / 3.3 / 3.4: Zero emission zone for vans, heavy vehicles and buses".	N/A
Industry actors	"I2.1: Phase out fossil fuel from the Rockwool facility", "I3.1: Energy transition in industry"	N/A

Construction actors, developers and other stakeholders in the value chain for buildings and constructions	"O2.1 / 2.2: Phase out gas for heating construction sites and buildings", "AT1.2 / 2.2 / 3.1: Emission free off-road mobile machinery", "Limit climate footprint of buildings and constructions in zoning plans", "Trøndelag resource bank for industrial materials", "Renovation of buildings and infrastructure", "Reuse Centre (Gjenbrukslageret)", "Area neutral area planning"	N/A
Actors in sea transport	"S3.2: Mandatory use of shore power and battery operation for all cruise ships, freighters and tankers"	N/A