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Land-Use Strategies for Climate Action and Biodiversity:

A Concise Guide for Finnish Municipalities

Abstract

Finnish municipalities are emerging as pioneers in carbon neutrality, aiming to balance their greenhouse gas emissions with carbon sequestration capacity. The land use sector (Land Use, Land Use Change and Forestry, i.e. LULUCF) offers significant potential for both emission reduction and carbon sink enhancement in municipal climate action. This sector, encompassing forests, arable land, grasslands, wetlands, and built areas, is also crucial for biodiversity conservation.

KEY RECOMMENDATIONS:

Municipalities should establish baseline scenarios for the land use sector, using current measures as a reference point when setting climate goals.

To achieve carbon neutrality, municipal actions must demonstrably enhance carbon sinks and reduce land use sector emissions beyond the established baseline scenario.

Municipalities should innovate and test new climate actions in the land use sector, exploring their integration with biodiversity objectives. These initiatives should be implemented collaboratively with other landowners and municipalities.

A national emission and sink accounting system for the land use sector should be developed to support municipal efforts.

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DATA AND METHODS
Literature reviews, workshops, calculations and measurements carried out in the Kuntanielu project.

THEMES
climate change mitigation, biological diversity, climate actions, voluntary carbon markets, municipalities, offsetting

DO YOU WANT TO KNOW:

This report presents the core elements of a guide outlining a systematic approach to climate action in the land use sector. It introduces a progress ladder and iterative improvement methodology, identifying specific municipal actions and highlighting synergies between climate and biodiversity initiatives. The guide emphasises the importance of robust, transparent municipal climate claims and encourages collaboration with enterprises and landowners for implementation and funding of climate actions.

The comprehensive guide is available in Finnish and Swedish (*Hildén et al. 2024a; Hildén et al. 2024b*).

Introduction

Forerunner municipalities develop comprehensive climate plans in which the actions in the land use sector should be part of the overall efforts to address climate change. The need to safeguard biodiversity should also be recognised. The municipal climate plan should thus create a base for the co-operation with different actors to develop and implement realistic and effective climate and biodiversity actions.

In Finland, municipal climate plans are voluntary documents, but about 90 % of Finns live in municipalities that by 2023 had set some form of climate objectives (Miettinen et al., 2024). The treatment of the land use sector varies, however, and many municipalities have so far dealt only superficially with sinks and emissions from land use in setting their climate objectives. The municipality is here understood to be the society and geographical area within the municipal boundaries, not just the local administrative entity. The climate objectives therefore refer to the municipality as a society with specific geographical boundaries.

Finnish municipalities vary greatly in size and other characteristics, ranging from large urban cities to small rural municipalities with a few thousand inhabitants or less. Municipalities also have diverse roles, making them key players in advancing climate action in the land use sector. They have statutory tasks in land use planning, but in addition, they can own land, direct enterprises fully or partly owned by the municipality, provide incentives for innovations, procure goods and services, and guide and inform landowners and citizens at large.

The guide was written to support municipal officials in their work but is also expected to provide useful information to anybody engaged in land use issues at the local level (Hildén et al., 2024a). It emphasises the importance of charting the current state of the land use sector and its likely future development in the absence of additional actions (the so-called baseline scenario). Over the past decade, the Finnish land use sector (LULUCF) has changed from being a major carbon sink throughout the country to a source of emission in most regions. Without a significant turn in the development of the sinks and emissions of the land use sector, Finland will not reach its own objective of becoming climate neutral in 2035 and will also miss the jointly agreed targets set for Finland in the EU LULUCF regulation (Regulation (EU) 2018/841 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework).

Municipalities can, through their many and diverse roles, support the needed change in the land use sector. This will require active engagement, and the guide stresses the importance of a systematic implementation of all climate measures, which should be coherent with municipal policies across all relevant policy areas, such as forestry, land use planning, agriculture, and energy.

The overall approach of the guide

Municipal actions in the land use sector need to be planned in an iterative process that starts from charting the present situation with respect to the emissions and sinks in the land use sector and specifying scenarios for the baseline development (*Figure 1*). The following steps include a charting of potential actions in the municipality and the examination of available and possible funding, including the possibility to purchase carbon removal units or carbon credits. Based on this, the municipality can make an informed political decision on its climate objectives for the land use sector, and when relevant, include links to biodiversity objectives. This is then followed by a step covering the implementation, monitoring and evaluation of the actions and fulfilment of the objectives, with a loop back to the starting point and possible readjustment of the plans and actions (*Figure 1*).

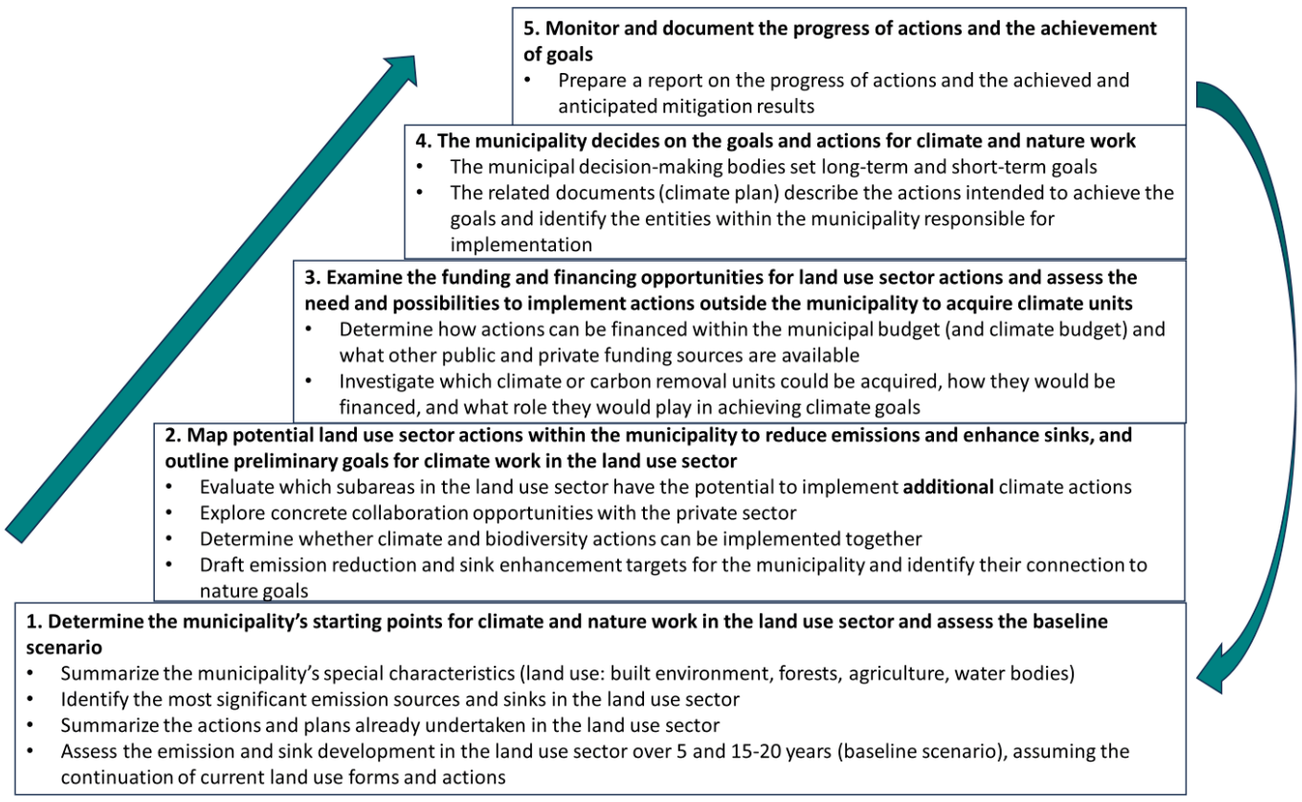

Figure 1 The suggested overall approach for developing municipal climate objectives and actions addressing the land use sector.

The steps of creating the base, setting up, planning, making a decision, implementing and monitoring climate actions are similar to the phases identified in most presentations of policy cycles (Jost et al., 2020). As presented here, the steps make a distinction between those that are mainly led by municipal officials (steps 1-3 and 5) and the decision that is ultimately made by the politically elected representatives (step 4). This distinction is important because effective climate actions need support and acceptance from all actors in the municipality, from landowners to citizens-at-large and enterprises. The officials implementing the work need a strong political mandate.

Determining the baseline and alternative scenarios

The baseline is specified as the development that would materialise if no additional actions or policies were introduced. The baseline is the reference scenario against which the municipality and other actors can gauge policies and actions, and it should be documented in the climate plan of the municipality. One measure of the expected effectiveness of planned climate actions is the difference in the greenhouse gas balance between the development that the actions are assumed to initiate and the baseline.

The baseline of the land use sector is more complex to determine than that of the emissions from other sources of greenhouse gases. Existing policies and actions in the land use sector do not form a coherent set that would provide an unambiguous baseline at the municipal level. In Finland, the policies guiding land use from the point of view of climate mitigation (and adaptation) are mostly weak and based on voluntary action. There are, for example, no policy-based economic incentives that would discourage the conversion of forests to other land uses. Voluntary guidance exists for forestry and agriculture on peat soils, known to generate significant emissions, but the uptake of the actions is still modest (Lehtonen et al., 2021; 2023). Furthermore, the national obligations concerning the land use sector specified in the LULUCF Regulation ((EU) 2018/841), have not been allocated to regions or municipalities. Therefore, the baseline scenario should preferably be developed separately for each municipality, recognising the specific context that is reflected in the general level of forest cuttings and patterns of land use. For example, rapidly growing large cities tend to convert forests to other uses at a high rate, whereas landowners in many rural communities have increased cuttings to high levels, resulting in declining sinks. The approach can be illustrated by base line scenarios and alternative scenarios for the forestry sector in four cities, separately for the forests owned by the municipality and all the forests in the municipality (*Figure 2*).

The scenarios highlight the potential to increase sinks relative to the baseline, but the results for the studied municipalities also underline that to strengthen sinks, forest owners in the municipality need to participate actively and modify their forestry practices. In the studied municipalities, the actions in the forests owned by the municipality alone do not increase the sinks significantly, because in the baseline scenario the forests owned by the municipality are already managed with an intention to maintain the carbon sinks (*Figure 2*).

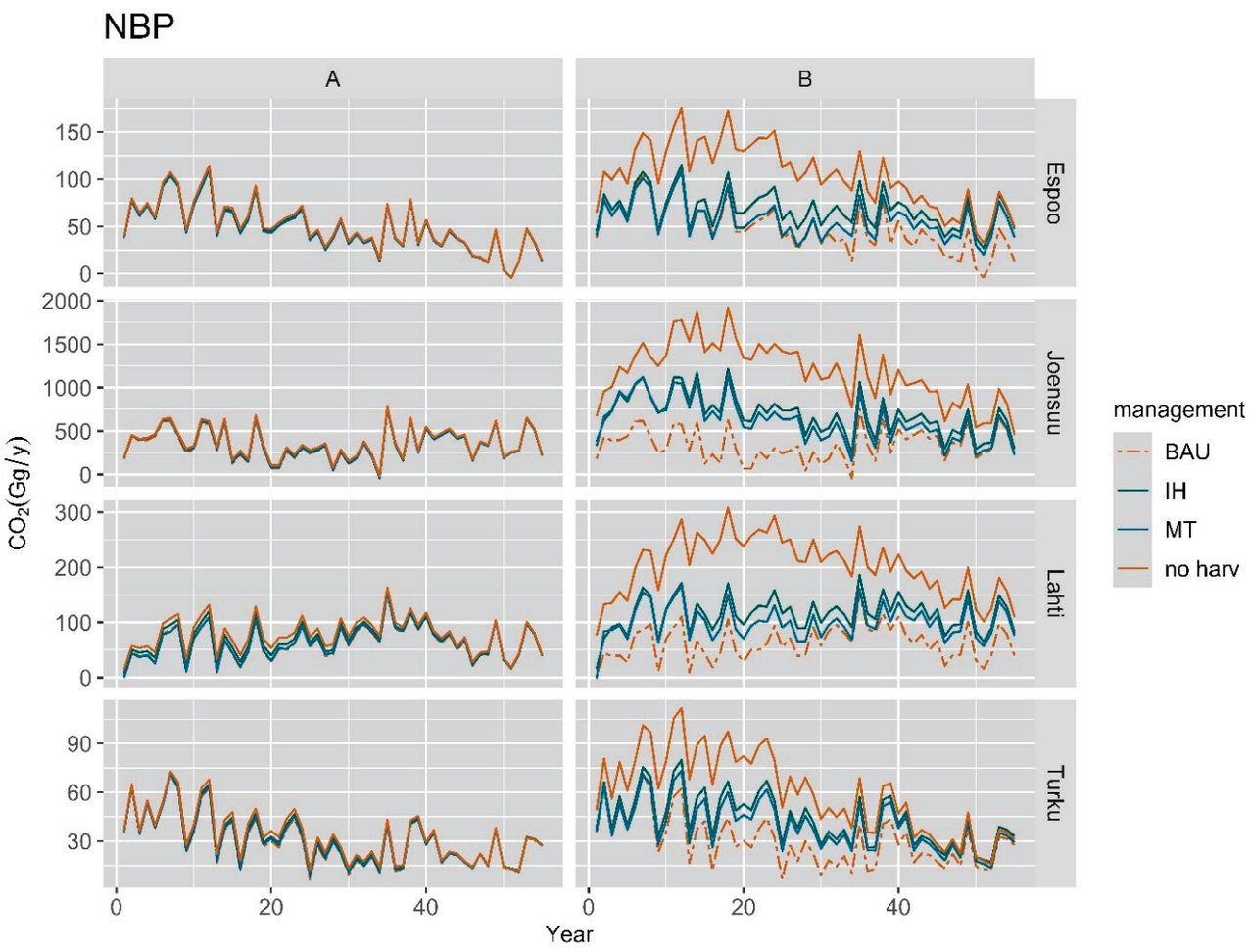

Figure 2. Development of the forest carbon sinks (Net Biome Production, NBP) according to four different scenarios in four Finnish cities. Espoo and Turku are large growing cities, Lahti and Joensuu medium sized cities. Note the different scales on the y-axes. Joensuu has the largest forested area (more than 200.000 ha) and the city owns more than 8000 ha. Turku has about 11 000 ha forests of which the city owns about 4000 ha. Espoo with a total of 17 961 ha and 5 061 ha own forests and Lahti with a total of 30 134 ha and 5 784 ha own forests are intermediate in this respect. The unbroken orange line indicates no cuttings, IH=climate change mitigation focused scenario, MT=scenario emphasising biodiversity conservation in forestry, BAU = base line scenario

Possible climate actions in the land use sector

The impacts of different measures on the carbon sinks and the emissions from the land use sector vary significantly. Local conditions and opportunities should be carefully examined to identify the most effective measures for mitigating emissions. They are usually those that limit the conversion of woodland to other uses and those that limit emissions from peat land. Carbon sinks can rapidly be strengthened by forestry actions that decrease cuttings and extend the rotation periods. Other potential measures include carbon farming, the establishment of protected areas and restoration of peat lands.

The City of Lahti has investigated the restoration possibilities of peat fields owned by the city. Based on a preliminary study by the Natural Resources Institute Finland (Luke), more detailed plans for raising the water level began for a 6-hectare field area. Utilizing the city's fields in climate work is mentioned as an action in Lahti's climate program, and in 2024, a clause was added to the city's field rental terms stating that peat-based fields can be rented only under special conditions. For example, fields that are deemed not relevant for the city's climate actions could still be rented. According to the preliminary plan, the rewetting measures will be implemented in 2025. Luke has conducted greenhouse gas emission measurements in the area to monitor the effects of rewetting in the future.

Examples of different measures based on literature reviews and a compilation of cost estimates provide a base for the identification of possible actions. To identify effective measures, the municipality should consider both its possibility to actively influence stakeholders in the municipality and the potential scale of the actions. For example, municipalities which have a large share of peat soils face different challenges than those which are endowed primarily with mineral soils, because peat soils can be a large source of greenhouse gas emissions.

There are possibilities to combine climate actions with actions for biodiversity. As shown by the scenario analysis (*Figure 2*), also biodiversity-oriented forestry scenarios tend to be beneficial from the point of view of increasing carbon sinks relative to the baseline.

Documenting the climate actions in the municipal greenhouse gas inventory

Finnish municipalities are only beginning to develop greenhouse gas inventories. An open-access usage-based emission inventory that provides data for all Finnish municipalities is available and municipalities can download data on their own emissions. Similar data do not yet exist for the land use sector, but individual municipalities have calculated their carbon storages and sinks. As the exact assumptions, methods and underlying data vary, the data are not fully comparable across municipalities and municipalities may find that estimates ordered from different consultants do not e.g. provide a proper time series and are often not repeatable due to lack of transparency. Special attention should therefore be attached to the specifications in procuring sink estimates.

The guide suggests that municipalities should rely on four general guiding principles in using and documenting land use mitigation results to ensure comparability and coherence in the greenhouse gas inventory and the tracking of actions. The suggested principles are as follows.

1) The municipality should ensure that in setting climate objectives, implementing measures, and monitoring the results of its climate actions in the land use sector, it relies on processes and rules that are compatible with those that Finland follows in the EU and internationally.
2) To avoid double counting the municipality cannot claim emission reductions or sinks that are registered in the greenhouse gas inventory of another municipality.
3) The greenhouse gas inventory for the land use sector should be based on estimates of annual mitigation results (reduced emissions and increased sinks) and corresponding losses (increased emissions and loss of sinks).
4) It should be possible to assess the mitigation results of the land use sector using relevant EU and international criteria.

The principles support transparent and consistent reporting and provide a base for meaningful climate claims by the municipality. Most climate actions in the land use sector are foreseen to be taken within the municipal borders. In this case, they are documented in the municipal greenhouse gas inventory, which, if it is detailed enough, documents change in emissions and sinks (*Figure 3*).

A municipality can carry out or finance additional land use measures outside its own borders, for example, jointly with a neighbouring municipality or further afield (*Figure 4*). In this case, the municipality needs to agree on how to share the mitigation results with the municipality in which the measures are implemented and with others involved, such as the landowner. Draft contract documents for buying additional climate actions help all parties in making agreements that are clear and fair. Enterprises can also voluntarily boost the municipal climate (and biodiversity) objectives by supporting the implementation of measures that have been jointly agreed upon. However, carbon credits that an enterprise acquires outside the municipality (or even national borders) to make a claim of being carbon neutral cannot be included in the municipality's greenhouse gas inventory.

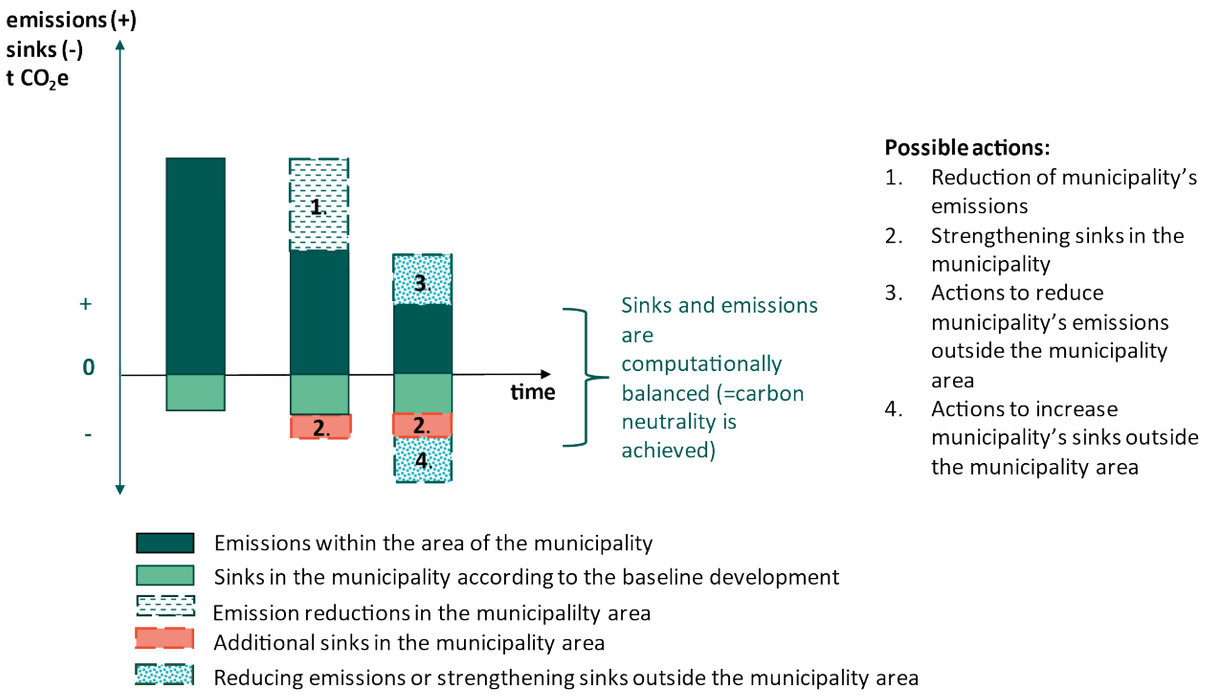

Figure 3. Possibilities to achieve carbon neutrality in a municipality using a combination of emission reductions (1), creating additional carbon sinks (2), participating in additional emissions reductions outside the municipal borders (3) and participating in the generation of additional sinks outside the municipal borders (4).

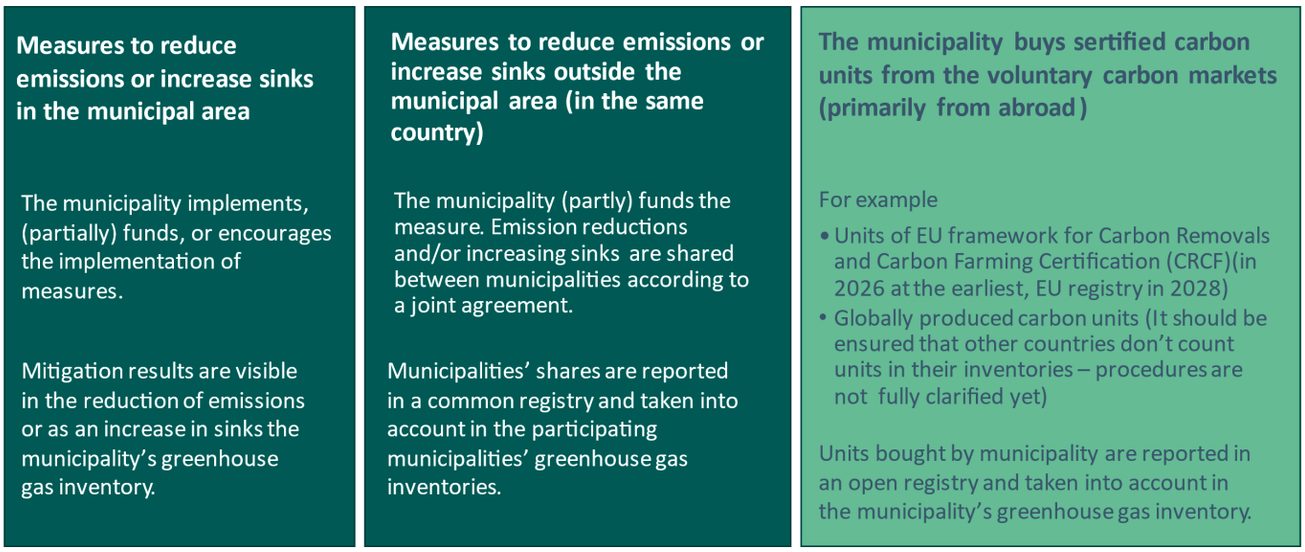

Figure 4. The implementation of municipal climate action on different spatial scales. Light green indicates actions that are mainly carried out abroad, although the EU CRCF regulation may change this when fully implemented.

In principle, it is possible to combine climate actions with actions aiming at supporting biodiversity, including voluntary ecological compensation as defined by the Finnish Nature Conservation Act. To achieve dual benefits careful planning is important if the goal is to use the results both to improve the municipal greenhouse gas balance and to implement ecological compensation according to the legal standards. The separately specified criteria for both types of actions must be fulfilled, including the additionality of the actions.

Setting objectives

For Finland to become carbon neutral by 2035 as stated in the Finnish Climate Act (423/2022), emissions from the land use sector must be reduced and carbon sinks significantly strengthened from their present levels. The desired development requires actions at the local level in the land use sector and therefore the objectives of the municipalities are highly relevant.

Forerunner municipalities have set ambitious climate objectives to reduce emissions in several sectors covered by the effort-sharing regulation ((EU) 2023/857), often around an 80% reduction relative to a reference level. However, this often has left the route to carbon neutrality unspecified. Some municipalities have boldly stated that they will 'compensate' the remaining emissions, without considering how such compensation or offsetting could be achieved or what it would imply.

In Finland, many municipalities have set more ambitious climate targets than the state. For example, Joensuu and Lahti originally aimed to be carbon neutral by 2025, Turku by 2029, and Espoo by 2030. Turku's goal is to reduce emissions by 90%, Espoo and Lahti by 80%, and Joensuu by 60%. The remaining emissions are intended to be absorbed by the region's carbon sinks or using other measures. Awareness of the challenges has led for example Lahti to reconsider its target and currently no date is specified for the point of reaching carbon neutrality.

For a municipality it is essential to transparently state how the land use sector fits into the overall objectives of the municipality and to be explicit and clear about the claims that the municipality makes vis-à-vis its climate actions. To achieve this, municipalities should avoid general statements on 'emission/climate compensation' and instead use more specific descriptions of the actions and claims that the municipality is pursuing. A clear distinction should be made between municipal objectives and actions that support national policies and objectives (national contribution claim) vs. those that clearly aim higher towards making the municipality a net-zero entity (offsetting claim) (*Figure 5*).

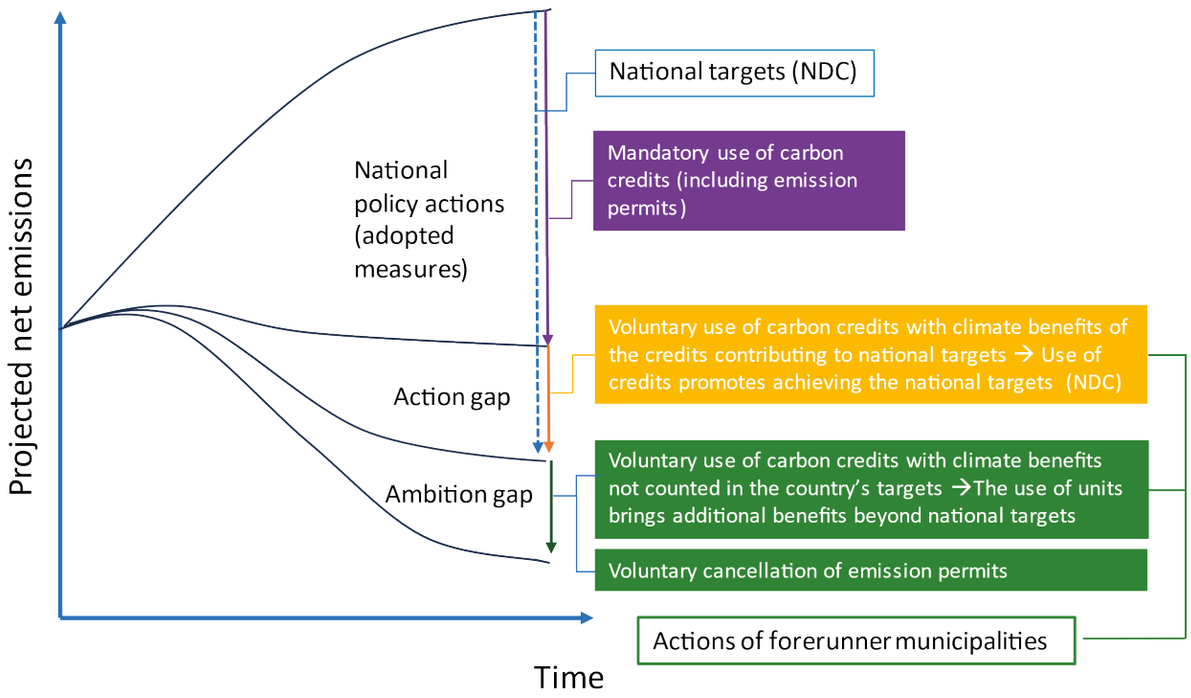

Figure 5. Schematic positioning of the municipal objectives and actions in relation to the national targets (NDC – nationally determined contribution). Especially in the land use sector there is currently a significant gap between the national policy actions and the targets that have been set. Forerunner municipalities can contribute to the progress towards national targets by taking actions that are not sufficiently promoted at the national scale (national contribution claim). In principle municipalities can also go beyond the currently set national targets and contribute to globally additional actions (offsetting claim). Figure based on Laine et al. (2024).

Claims of support for national objectives are the natural starting point for a municipality, which is a public body. Such objectives and claims help in closing the 'action' gap that also Finland suffers from, especially in the land use sector. Objectives on complete offsetting and aims to reach an 'independent' net-zero state make sense if the municipality truly aspires to challenge the 'ambition gap' in the national objectives and measures (*Figure 5*).

Joint action by enterprises and municipalities

Whenever an enterprise carries out a climate action related to land use in a municipality, the action will be recorded in the greenhouse gas inventory of the municipality. However, the approach to carbon neutrality differs between municipalities and companies. While a municipality considers the emissions and sinks of its entire geographical area in efforts to become carbon neutral, a company's emission calculations focus on the emissions of its operations, including its value chain (so-called scope 3 emissions). The municipality cannot claim or use mitigation results that enterprises operating in a municipality take or buy outside the municipal and even national borders to offset their own emissions and to justify their climate (or biodiversity) claims. Enterprises can instead engage in joint activities with a municipality and make claims of support for climate actions as part of their corporate responsibility policy. To avoid double counting, the mitigation actions cannot be used to offset emissions of both the municipality and the enterprise. If an enterprise wishes to 'donate' additional land use mitigation results to a municipality it should occur outside the calculation of the carbon balance of the enterprise.

Joint implementation of climate and biodiversity actions

Actions in the land use sector can benefit both biodiversity and mitigation of climate action. An issue that municipalities need to consider is to what extent the two different objectives can be combined. One justification for such combined actions would be that the funding of the actions can become easier if they deliver multiple benefits.

In Turku, joint afforestation projects between businesses and the city have been implemented. Turku Energia, the energy company fully owned by the city, and the City of Turku have together carried out afforestation projects in the summers of 2021 and 2022, planting a total of over 10.000 tree seedlings at selected sites. At the same time, summer jobs were offered to young people. The afforestation projects support both Turku Energia's and the City of Turku's climate and environmental goals by increasing carbon sinks and safeguarding local biodiversity.

There are different possibilities to combine climate and biodiversity actions. In the simplest case, a municipality implements within its own borders land use actions that benefit climate mitigation as well as biodiversity. The results in terms of mitigation of climate change and conservation of biodiversity are documented in the municipal greenhouse gas inventory and biodiversity monitoring respectively. More complex situations arise if the actions and their results should qualify for voluntary carbon markets and voluntary ecological compensation according to the Finnish Nature Conservation Act (9/2023, Chapter 11). Then care must be taken to ensure that the actions fulfil the quality criteria of both voluntary carbon markets (for example those compiled by the Integrity Council for the Voluntary Carbon Market (2024)) and those of ecological compensation (Finnish Nature Conservation Decree 933/2023).

A key issue is to ensure additionality, meaning that the actions must be planned jointly. An action that has already been implemented based on one or the other objective cannot afterwards be used retrospectively to fulfil the other objective because it would violate the additionality requirement. Care must also be taken in delimiting the area(s) of action. If a single site is designated for the implementation of both market-based climate actions and ecological compensation, the land use restrictions that ecological compensation introduces, will apply to the whole site. For example, even if the action to develop ecological compensation is restricted to a part of the site, restrictions on land

use change apply to the whole site, not just the immediate vicinity of the spot where the biodiversity action has been implemented. If there is a risk of conflict between future land use and the actions, it is usually best to use separate spatial delimitations for these two types of actions.

The City of Espoo examined how forest conservation can balance the loss of carbon stocks and sinks caused by urban development. The study simulated forest development one hundred years into the future to assess the effects of constructing a new data center in Hepokorvenkallio while simultaneously protecting a four times larger recreational area owned by the city. The results indicated that protecting the Hynkänlampi forest area could increase the carbon stock by at least as much as the carbon stock decreases due to the construction in Hepokorvenkallio (Järveläinen et al., 2024).

Funding and economic monitoring of land use actions

Land use policies and actions are often partly economic instruments, and they should therefore be linked to municipal budgeting and economic strategies. There are many possibilities for funding land use actions, but the focus and criteria of funding differ between funders. In this context, the municipality can have multiple roles. It can be a (co) funder, a beneficiary, or a co-ordinator of funding applications. In all cases, the municipality needs to ensure that the funding is transparent. Whenever the municipality uses funds to finance actions in the land use sector, it should ensure that the actions are additional relative to what is required by legislation and approved decisions on land use and land use change. Otherwise, there is a risk of paying for actions that would anyway materialise in the baseline scenario.

By budgeting climate action and by tracking the development of the carbon stock and sinks in its budget, a municipality creates a strong base for its climate action within its own organisation. It will allow the municipality to judge the cost-effectiveness of actions, which helps the municipality to prioritise its climate actions and to identify “low-hanging fruits”.

The City of Joensuu has piloted the use of a climate account and the implementation of local carbon sink projects. Funds collected in the climate account are used for local carbon sequestration projects, with the city responsible for practical implementation. Anyone can contribute to these projects through the climate account. So far, projects have been funded by the city, participating companies, and the Kuntanielu project. The funds have been used for afforestation on former peat extraction areas and the establishment of wetland cultivation areas in Joensuu. These projects enhance Joensuu’s carbon sinks, and participating companies can claim to support voluntary climate actions and carbon sink enhancement.

Perspectives on the development of the climate actions in the land use sector

The land use sector has become an important topic in climate policy in Finland and in the EU. Until so-called technological sinks have been developed to a level where they provide cheap and reliable carbon capture and storage, land use offers the cheapest and most extensive ways to balance carbon emissions on the road to carbon neutrality and beyond.

In Finland, actions to reduce emissions from the land use sector and to increase sinks are mainly voluntary. The rapid reduction of carbon sinks below previously set targets due to land use change and forestry has triggered discussion on the need for stronger policy instruments. Such instruments could be based on regulation, economic incentives, or combinations. The policies can be implemented jointly by the public sector or the private sector. The framework regulation for voluntary instruments is rapidly evolving in interaction with direct public action. This will affect how targets are set and how the actions in the land use sector are shared between the private and public sector in aiming for the national and international climate goals (*Laine et al., 2024*).

Land use and land use planning is ultimately a local and spatially explicit activity, which emphasises the role of municipalities. Growing municipalities, in which land is extensively converted from e.g. forests to other uses, often lose a substantial share of their carbon sinks and it becomes increasingly challenging to reach carbon neutrality. In municipalities in which large peat soil areas are in agricultural use or have been drained for forestry, there is a need for active work to reduce emissions. All in all, every municipality should systematically chart its current and baseline trajectory in the land use sector to identify relevant and realistic actions that the municipality can encourage through various means and incentives.

The emerging EU framework for Carbon Removals and Carbon Farming Certification (CRCF) Regulation (2022/0394 (COD)) aims to support the emergence of voluntary carbon markets by identifying different categories of carbon removals, some of which could have very short life-times, even less than 10 years. The framework may boost also national markets for domestic carbon credits, in which municipalities may participate.

The EU certification is expected to start in 2026, and an EU-wide registry is due by 2028. However, it would make sense for Finland that has potential sinks, to initiate systematic piloting and testing of different approaches to influence and prepare for the EU-wide operational phase.

A public service that helps municipalities in tracking their carbon stocks and sinks is one of the key conditions for an improvement of the municipal actions, including a more widespread use of and support for voluntary action. A challenge to be solved is a sufficiently fine-scale monitoring system that also adds up to the national inventory of greenhouse gases and sinks. Development of the monitoring and documentation of actions that are implemented and traded should also be initiated already before EU-wide registry is planned to become operational.

There are possibilities for further development of economic incentives in the land use sector. Linking payments for ecological compensation or climate action could be connected with payments for building permits or a broader charge for land use change would require legislative change (Timonen, 2020). It would strengthen the user or polluter pays principle, but since municipalities are competing for inhabitants and builders, it is likely to encounter political opposition.

There is scope for developing the monitoring of land use and the municipal carbon inventories further. In the national inventory, wood products are part of the monitoring of sinks, but so far, they are not tracked at a municipal level as such, and monitoring would require data on the use and fate of wood with fine-grained spatial resolution. Another potential area is the tracking of the formation of aerosols that cool the atmosphere. The formation of aerosols above vegetated areas is still poorly known, but recent studies suggest that not only forests, but also

agricultural land, parks and gardens may contribute to the formation of cooling aerosols (Dada et al., 2023; Kulmala et al., 2024). The total effects of land use on the climate should be followed and, in the future, it is conceivable that not only carbon sequestration but also other beneficial climate effects from land use can become tradeable on the voluntary markets.

Active municipalities can also in the future develop and propose new actions and good practices through experiments and piloting. Co-creation with researchers has proven to be fruitful. There are several sources of funding and active municipalities can obtain extramural funding that carries its climate and other objectives forward.

Acknowledgements

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