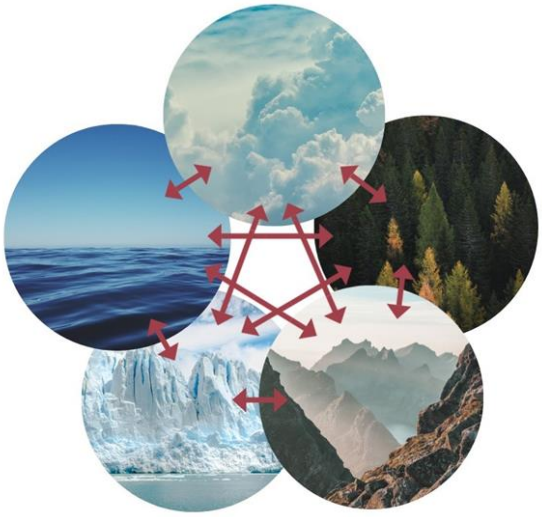
# North Karelia Climate and Energy Programme 2030



**TOWARDS NEW OPPORTUNITIES**

**Summary**

The main goal and vision of the North Karelia Climate and Energy Programme 2030 is to make North Karelia a forerunner in climate resilience by the year 2030. The programme outlines key regional objectives for both mitigating and adapting to climate change. These goals integrate the safeguarding of economic activities, well-being, and biodiversity. The programme aims to create new opportunities for a more diverse economy and to align the goals of various regional programmes and strategies. It also serves to implement the climate and energy objectives of the EU and Finland at the regional level.

Regional Council of North Karelia
North Karelia Climate and Energy Programme 2030

# North Karelia Climate and Energy Programme

## Table of Contents

**Explanations of Concepts and Abbreviations**

| | |
|---|---|
| Timber | Part of the tree trunk with economic value (i.e., wood material suitable for industrial use) |
| AMO | Regional Forest Programme |
| Biodiversity | Biological diversity of nature |
| Biosphere Reserve | A model area for sustainable development |
| CHP plant | Combined heat and power, simultaneous production of heat and electricity |
| $CO_2$-eq | Carbon dioxide equivalent; expressed as mass (e.g. kg or tons per year), converting the impact of other greenhouse gases to $CO_2$ over a 100-year period |
| EFI | European Forest Institute |
| F-gases | Fluorinated greenhouse gases, used e.g. in refrigeration, air conditioning, and heat pumps |
| Geoenergy | Heating and cooling energy sourced from bedrock, soil, or water bodies |
| Green Deal | The European Green Deal (EU climate strategy) |
| Climate-smart forestry | Forest management that enhances carbon sequestration and storage with wood production |
| Climate-resilient | Economically, ecologically, socially, and culturally sustainable and carbon neutral activity |
| JTF | Just Transition Fund (EU) |
| Innovation ecosystem | A network of close interaction between companies, research institutions, the public sector, consumers, and other actors |
| Carbon balance | The change in the amount of carbon stored over time (per year) |
| Hinku | Carbon neutral municipality/ region (Finland's "Towards Carbon Neutral Municipalities" network |
| KAISU | National Medium-term Climate Plan (until 2030) |
| Greenhouse gas | Gases in the atmosphere that absorb the radiations that a planet emits, resulting in the greenhouse effect |
| Luke | Natural Resources Institute Finland |
| LULUCF | EU policy on land use, land-use change, and forestry related to climate impact |
| Forest stand | A relatively small, uniform forest stand, defined by features such as tree age, species, or soil fertility |
| MTK | Central Union of Agricultural Producers and Forest Owners |
| Virgin raw material | Raw material that has not been previously used |
| NT | The highest net income from felling, the highest net income from wood production without accumulation or income restrictions, 5% yield requirement, currently and profitably harvestable material and energy wood felling estimate, logging scenario based purely on the monetary value of felling |
| TH | Realized felling accumulation: felling accumulations comply with the level of timber accumulation and energy wood according to the statistics in the North Karelia region in 2016–2018, 4% yield requirement, does not increase the amount of wood to be felled |
| SY | Maximum sustainable harvesting volume for timber and energy wood: ensures steady or increasing wood yields and net income with 4 % return requirement; maintains the stand value |
| RDI | Research, Development, and Innovation |
| Valtsu | National Waste Plan |
| VMI12 | The 12th National Forest Inventory (conducted 2014-2018) |

## Introduction

The North Karelia Climate and Energy Programme 2030 (CE2030) outlines how the climate targets of the European Union and Finland will be implemented in North Karelia. The programme defines objectives for reducing greenhouse gas emissions in the region and adapting to the climate change. At the same time, it aims to turn the challenges of climate change into opportunities. CE2030 is intended as a shared programme for regional actors. Its objectives have been agreed upon through broad stakeholder collaboration to ensure the programme reflects the region's features and is collectively embraced.

The programme highlights North Karelia's strengths and leadership position, as well as areas for development on the path toward a climate-resilient region. It also examines the impacts of climate change on nature, the economy, and human well-being. An accompanying action plan will present specific measures for both climate change mitigation and adaptation.

The global average temperature continues to rise each year. Recent climate warming is caused by emissions from the human activity, which have increased the concentration of greenhouse gases in the atmosphere.

The greenhouse effect is a natural phenomenon where so-called greenhouse gases in the atmosphere—most commonly carbon dioxide and methane—trap heat from escaping into space. Human activities (such as transportation, energy production, and agriculture) generate greenhouse gases that intensify the natural greenhouse effect, leading to global warming. In addition to direct emissions from human activity, the concentration of greenhouse gases is influenced by interactions between the atmosphere and ecosystems.

Nature-based emissions and carbon sinks are significant. In North Karelia, carbon sinks and carbon storage primarily refer to forests, peatlands, water bodies, and soil.

Key Carbon-Related Terms

1. Carbon sequestration: A process or mechanism that continuously captures and stores atmospheric $CO_2$, increasing the size of the storage
2. Carbon storage: Forests, oceans, soil, peatlands, and wood products
3. Carbon sink: An increasing carbon stock, such as a growing forest
4. Carbon balance: The difference between the amount of carbon sequestered and released over a specific time, e.g., annually
5. Carbon source: Decomposition ($CO_2$), decay (methane), or burning of carbon stocks
6. Carbon neutrality: Equal amounts of carbon are sequestered and released
7. Carbon negativity: More carbon is sequestered than released
8. Carbon footprint: The total climate impact of a product, activity, or service throughout its entire lifecycle
9. Carbon handprint: The positive climate impact of a product, activity, or service
10. Carbon dioxide equivalent ($CO_2$-eq.): Since greenhouse gases differ in their climate impact, emissions are converted into $CO_2$ equivalents based on their 100-year global warming potential to simplify accounting
11. Climate resilience: Activities that are sustainable economically, ecologically, socially, and culturally, and are carbon neutral

According to Finland's National Climate Change Adaptation Plan 2022, the country's average temperature is expected to rise more than the global average. In the best-case scenario, the temperature may increase by 2°C and in the worst case by 6°C. Such significant temperature rises have

considerable impacts. Winters will become milder with fewer severe frost period, and summers will experience more frequent and prolonged heatwaves, with higher peak temperatures. Annual precipitation is projected to increase by 8–20 % between 2070 and 2099. Some changes will already be evident by 2030. Currently, winters are milder, and precipitation is more often rain, not snowing, than before, keeping the ground unfrozen and snowless for longer periods.

These changes also have health effects. Dark, snowless winters may negatively affect mental health. Heatwaves can cause health problems, especially for the elderly or people with chronic illnesses. Various pathogens may also become more prevalent.

There are also significant economic impacts: the annual cost of climate change at the EU level is expected to rise from €100 billion in 2020 to approximately €250 billion by 2050 if adequate adaptation measures are not taken.

In terms of water systems, eutrophication is expected to increase due to greater runoff and surface water flow caused by heavier rainfall. This issue is exacerbated by increased winter precipitation, as there is no protective vegetation or snow cover to slow down runoff during the winter months. In Finland, the most significant impacts on water bodies will be seen in the Baltic Sea, inland waters, shorelines, peatlands, and wetlands. North Karelia, with its abundant lakes, shores, peatlands, and wetlands, is particularly vulnerable to these changes, especially due to the altered winter conditions.

Other parts of Europe face the same climate change challenges as Finland—rising temperatures, droughts, heavy rainfall, and changing winter conditions—although specific extreme weather events vary between regions and countries. As a result, EU member states have developed joint frameworks and policies, such as the Climate Law, the EU Forest Strategy, the New Bioeconomy Strategy for a Sustainable Europe, the Biodiversity Strategy, the Circular Economy Action Plan, and the EU Climate Adaptation Strategy. These initiatives are brought together under the umbrella of the European Green Deal, which serves as a unifying framework for sustainable growth. A key financial instrument linked to the Green Deal is the Just Transition Fund (JTF), which supports equitable transitions toward low-carbon economies. These documents define common goals and measures for mitigating and adapting to climate change, and in some cases, provide financial support through mechanisms like the JTF.

The goals of all these EU-level strategies and programmes have been taken into account in the development of the North Karelia Climate and Energy Programme 2030, and they have helped to define the level of ambition. In many respects, North Karelia is already ahead of these targets and aspires to exceed EU requirements – an important point to emphasize in EU-level influence and advocacy.

Climate change can also be seen as an opportunity, not just a threat. Efforts to mitigate and adapt to climate change open doors for increasing self-sufficiency, enhancing security of maintenance, developing new technologies and smart solutions, attracting investments, creating new products and

services, exploring new ways of working, and fostering new ways of thinking. All of this contributes to well-being and enables the continuation of economic activities even during crises. However, it is critically important to first and foremost deploy all available means to mitigate climate change and support low-carbon operations. For instance, carbon capture, utilization, and storage (CCUS) is already technically feasible. This technology is designed to reduce carbon dioxide emissions from large facilities, such as power plants burning fossil coal. It works by separating $CO_2$ from emissions and storing it in underground geological formations, either on land or under the seabed. While commercial technologies exist for capturing $CO_2$ from major emission sources, a permanent and large-scale solution for $CO_2$ storage is still under development.

## 1 The Impacts of Climate Change in North Karelia

Climate change will affect daily life in North Karelia as well, where agriculture and forestry still play a significant role in regional wellbeing. Warm and rainy winters pose a threat to timber harvesting, as the snow-covered period is getting shorter, snow cover is becoming thinner, and frost in soil is less common than before. Many harvesting sites have traditionally relied on winter conditions, so the lack of frost and snow presents challenges for heavy forestry machinery. Additionally, the risk of root damage to the remaining trees during thinning operations increases, making forests more vulnerable to damage and growth loss. The reduction of frost, combined with strong winds, increases the risk of trees falling and storm damage. Bark beetle infestations are also becoming more common in spruce forests.

This challenges forestry needs to find solutions to secure timber production and harvesting, for example by developing machinery technology so that forestry equipment can be used even during frost-free periods in areas suitable only for winter harvesting. New ways to generate income from forests are also needed, such as products that store carbon for long periods or immaterial services. This requires development of methods in forest management and presents new challenges in tree species selection.

Agriculture faces quite the same problems. With snowless winters, crops that remain in the fields over winter are more exposed to ice damage, as seen in the spring of 2020. Increased dry periods make it harder to achieve good growth and yields. On the other hand, more frequent rainfalls—especially in late summer—can complicate harvesting.

This raises questions about the suitability of crop species and the need for new cultivation methods. Interest in locally produced, low-carbon food is increasing, which is also an opportunity for organic farming. The greenhouse effect also creates opportunities for rural areas—southern plant species are already thriving at these latitudes. For example, organic apples are being produced at a farm scale in Northern parts of Savo, and even pear cultivation is being tested. The greenhouse effect may also accelerate plant growth. The bright northern summer combined with a warmer climate may make it possible to cultivate new aromatic plants.

The COVID-19 crisis in 2020 highlighted the challenges of the global economy. When the pandemic closed borders, self-sufficiency became a key value. The importance of food security became concrete when Sweden asked Finland for food aid for certain products. Sweden's food self-sufficiency is 50 percent, while in Finland it is still 80 percent. It is essential to maintain this level.

North Karelia is a region with the capacity to produce clean, diverse food. Significant investments have been made to increase farm size and ensure economic viability, and there has been a strong focus on organic production: the number of organic farms in the region increased significantly over a ten-year period (from 271 farms in 2008 to 375 farms ten years later). Climate and energy issues have also

entered the agricultural discussion: the carbon footprint of products is already an important factor influencing consumer choices—and will be even more so in the future.

We need new carbon-neutral energy and technological solutions and innovations for agriculture, in line with the Smart Specialisation Strategy (2019–2023) and the Agricultural Climate Roadmap (The Central Union of Agricultural Producers and Forest Owners (MTK) 2020). The region has the expertise needed to produce clean, climate-resilient food based on local raw materials—if that expertise is used effectively across organizational and sectoral boundaries. Such food is in demand even beyond the borders of the region.

The potential impacts of climate change on human health were mentioned earlier. For the people living on the region, climate change is for example reducing opportunities for winter activities as the frequence of snowless or low-snow winters increases. The risk of various diseases may also rise in the future, as changing climate conditions become more favourable for different pathogens. Fortunately, the situation is not yet this bad, but we must act now to mitigate climate change.

Eutrophication of water bodies also affects North Karelia. Eutrophication alters the biodiversity of aquatic ecosystems, effect on recreational use, and fish populations. Changes in fish population structures, in turn, negatively affect fishing. Eutrophication in inland waters accumulates in the lower parts of the watershed.

Every resident can contribute to mitigating climate change through their everyday choices. Decisions about energy choices in heating and electricity use are part of daily life, as are the choices concerning transportation. Walking, cycling, and public transport are viable options in urban centres and towns, but in sparsely populated areas, private car use is almost a necessity. In such cases, the type of energy source used in the vehicle becomes significant. When it comes to energy use, the best, cheapest, and most emission-free kilowatt is the one that is never consumed.

Recycling and waste management solutions are accessible to everyone. Composting, reducing food waste, and recycling plastic, metal, glass, cardboard, paper, and textiles reduce pressure on natural resources. In addition to these, reducing consumption significantly eases this pressure. It is essential to also consider solutions that prevent waste from being generated in the first place. In these matters, education, guidance, and public policies play a vital role.

## 2 How Were the Objectives of the 2020 Climate and Energy Programme Achieved?

North Karelia's first Climate and Energy Programme 2020 was published in 2012. Its vision was "An Oil-Free Region," and it included 10 qualitative general objectives and 55 specific targets (32 on energy use, 5 on transport, 3 on urban structure and zoning, 4 on construction, 3 on waste management, 3 on

forestry, and 5 on agriculture). Some of these goals were qualitative, others quantitative (see Appendix 1).

Nearly all the qualitative general objectives were achieved, except for the goal stating that "North Karelia is a carbon-neutral region, self-sufficient in renewable energy, with no use of fossil oil for energy production." This goal was not reached, as fossil oil is still used both for transport and heating. The region is also not self-sufficient in renewable energy production. However, other goals related to raising climate awareness, improving energy efficiency, promoting alternative energy sources, advancing the bioeconomy, recognizing opportunities, and enhancing cooperation were achieved.

Climate and energy issues, forest bioeconomy, and smart specialization have been integrated into the regional programme, and approximately 60 percent of regional project funding has been allocated to the development and advancement of these themes so far. In the future, projects aimed at climate change mitigation and adaptation will continue to be supported. Examples of such projects include innovations to develop and enhance carbon sinks while ensuring the operating conditions of agriculture and forestry. Another good example includes projects that offer new business opportunities or solutions to challenging energy issues (especially transport energy).

Among the specific objectives, some related to transport, construction, waste management, and energy were only partially achieved. These sectors remain particularly important and challenging in the region and will require continuous work—seeking solutions through resource efficiency, new technologies and innovations, novel materials, and closer cooperation among different actors.

Wind power remains a significant challenge in the region. It is important to get wind power production started in North Karelia as soon as possible, as wind energy is renewable and emission-free after the construction phase. The region has areas suitable for wind energy, which could be incorporated into land use planning. Wind power would be a valuable tool to achieve energy self-sufficiency and to diversity the of renewable energy sources.

A significant milestone was reached in June 2020 when North Karelia was granted Hinku Region status.. This was a major expression of common commitment to building a climate-resilient region. Hinku refers to "Carbon Neutral Municipality," and the goal is to achieve an 80% reduction in emissions by 2030 compared to 2007 levels. In October 2019 the Board of the Regional Council recommended municipalities in North Karelia to join the Hinku network as part of efforts to promote climate and energy goals. At the same time, the Regional Council of North Karelia was seen as the natural coordinating body to commit to the Hinku targets together with the municipalities. The Board of the Regional Council decided that North Karelia should apply for Hinku Region status, which required demonstrating that the region met all Hinku criteria.

Hinku Region Criteria:

1. An 80 % reduction in greenhouse gas emissions in the region by 2030 compared to 2007 levels
2. The population of committed Hinku municipalities must represent at least 80 % of the region's population
3. A regional cooperation group must be established to create a regional emissions reduction pathway together with key stakeholders, the pathway to be updated annually
4. Not all municipalities in the region need to commit to the emission reduction goals
5. All Hinku municipalities in the region must approve the content of criterion 4 and acknowledge they are part of the region's emissions reduction efforts

According to emission calculations by the Finnish Environment Institute, North Karelia had achieved a 24–25 percent reduction in greenhouse gas emissions by 2018 compared to 2007 levels, depending on

whether the special Hinku calculation method or a broader emission accounting method is used. In Hinku accounting, emissions from carbon dioxide, methane, nitrous oxide, and F-gases across various sectors are expressed in carbon dioxide equivalents. Bio-based fuels are counted as zero emissions for carbon dioxide.

According to the Hinku calculation rules, emissions from sources beyond the municipality's control are not included. This means that the use of fuels by industrial plants included in the emissions trade, industrial electricity consumption, emissions from industrial waste processing, and drive-through traffic by trucks, vans and buses are excluded. Air traffic, foreign ship traffic, icebreakers, industrial processes and the LULUCF sector (land use, land use change and forest sector) are also not included in the calculation. Emission credits for wind power produced in the area are calculated according to the annual electricity emission factor.

Table: North Karelia emissions (kt, $CO_2$-eq.) in 2018 (SYKE, hiilineutraalisuomi.fi)

| North Karelia | Hinku – calculation 2018 | Change 2007–2018 | Emissions 2018 | Change 2007–2018 |
|---|---|---|---|---|
| Consumption electricity | 93 | -50 % | 247 | -43 % |
| Electricity (heating) | 69 | -47 % | 65 | -51 % |
| District heating | 145 | -31 % | 145 | -31 % |
| Oil heating | 51 | -48 % | 51 | -48 % |
| Other heating | 73 | 6 % | 73 | 6 % |
| Industry | 31 | -42 % | 64 | -11 % |
| Work machinery | 107 | -7 % | 107 | -7 % |
| Transport (roads) | 313 | -16 % | 362 | -14 % |
| Transport (railways) | 7 | -55 % | 7 | -55 % |
| Transport (water) | 7 | -24 % | 7 | -24 % |
| Agriculture | 294 | -7 % | 294 | -7 % |
| Waste treatment | 53 | -26 % | 57 | -29 % |
| F-gases | 37 | -22 % | 37 | -22 % |
| Wind energy | 0 | - | | |
| kt $CO_2e$ | 1281 | -24 % | 1516 | - 25 % |

# 3 Vision: North Karelia will be a forerunner in climate resilience by 2030

## 3.1 Common Indicators

Climate-resilient action means not producing more greenhouse gas emissions than can be sequestrated. Such activity must also be ecologically, economically, socially, and culturally sustainable.

Finland's Energy and Climate Strategy 2030 sets numerous targets related to energy and by-products to achieve climate-resilience. These include, for example, reducing the use of imported oil by 50 % and increasing energy self-sufficiency.

North Karelia's goals are more ambitious than the national targets. The share of renewable energy in final energy consumption is already 67 percent (compared to 41 percent nationally), and energy self-

sufficiency is 63 percent. The goal is to replace heating oil with renewable energy sources and to increase regional energy production is at least equal to consumption.

The development and wider use of biodiesel, biogas, other alternative fuels, and electric vehicles also enable low-emission transport solutions in rural areas. This is supported by Finland's national energy and climate strategy aiming to utilize waste and by-products from agriculture, communities, and industry for energy and heat production. The region's strong and internationally recognized research expertise supports these efforts.

Table: Climate and Energy Targets – EU, Finland, and North Karelia

| Target | North Karelia | Finland | EU |
|---|---|---|---|
| Carbon neutrality | 2030 | 2035 | 2050 |
| Greenhouse gas emissions | 2030: 80 % (of 2007 level) | 2030: 39 % (of 2005 level) | 2030: $CO_2$ emission reduction 40 % in 2030 (of 1990 level) |
| Self-sufficiency in energy | 2030: 80 % | 2030: 55 % | |
| Renewable energy | 2030: 80 % | 2030: > 50 % | 2030: 27 % of total energy consumption |
| Energy efficiency | Energy consumption does not exceed 12 TWh | 2030: Final energy consumption does not exceed 290 TWh | 2030: The target for reducing primary energy consumption is 32.5 % (of 2007 level) |
| Electricity and heat nearly emission-free | 2030 | 2030 | Emission reduction requirement for 2050: energy 75 %, industry 12 % |
| Emission reduction in transport | 50 % in 2030 (of 2005 level) | 50 % in 2030 (of 2005 level) | 2050: 25 % |
| Renewable energy in transport | 2030: 40 % | 2030: 40 % | 2030: 14 % of all energy consumption in transport |
| Fossil fuels in heating | 2030: not in use | 2025: Not used in the state-owned buildings, 2030: The share of bio-components is 10 % | 2050: Emission reduction requirement for buildings is 40 % |
| Biodiversity | 2030: impoverishment stopped | 2020: impoverishment stopped | Ecosystem degradation sopped |
| Circular economy, amount of waste | Reducing waste generation and increasing recycling and utilization | 2030: 60 % of municipal waste will be recycled | |

The monitoring indicators for the CE2030 programme are presented in Appendix 2. They have been selected from the indicators of the previous programme, focusing on those that could be monitored during the previous period and remain relevant to the objectives of the CE2030 programme.

### 3.2 Carbon Balance of the Region's Forests

The progress and implementation of climate resilience could be monitored, in addition to various indicators, through the carbon balance of the region's forests (Luke 2020). Creating a comprehensive picture of the region's carbon balance would also require the development of carbon balance calculations for agriculture, but such data is not yet available. Developing this can be set as one of the program's goals for monitoring the carbon balance. The calculation of the forest carbon balance also needs to be refined.

The region's forest carbon balance is based on data from the National Forest Inventory (VMI 12 2014-2018) conducted by the Natural Resources Institute Finland (Luke). The VMI measurements are based on a network of sample plots across Finland, where forest, vegetation, and soil attributes are measured to determine forest volume, growth, and other important metrics. These data can also be used to make predictions about the future of forests under different management options and climate scenarios. These are valuable data, especially for forest planning and the development of forest management practices.

The forest carbon balance reflects the amount of carbon stored in the forest (carbon stock) and the growth of the forest (carbon sink) compared to natural mortality and the removal of wood through logging. Additionally, the carbon in the soil (soil carbon stock, sinks, and emissions) is considered.

Whenever information, other than measured data, is used, it is crucial to understand and consider the assumptions and limitations of the calculation and simulation methods used. The assumptions, initial data, and models behind Luke's carbon balance calculations are described in more detail in Appendix 3. Briefly, the carbon balance estimate is based on three different scenarios, which depend on the amount of wood removed in logging. The alternatives are a scenario that purely maximizes economic value (NT), a scenario that maintains the largest timber and energy wood harvests (SY), and a scenario that follows the current logging levels (TH). The balance does not include emissions from machinery or carbon stored in wood products.

Luke's forest carbon balance for North Karelia, according to the logging scenario, is strongly linked to the amount of wood harvested in the scenario. The assumptions and definitions are presented in more detail in Appendix 3. According to these calculations, the largest sustainable timber and energy wood harvest (SY) at the 2016-2025 level (7.1 million m³/year) would allow the forest to remain a clear carbon sink, but at the higher harvest level of 7.7 million m³/year in the following decades, the sink would diminish. During 2016-2025, the carbon sink for the forest would amount to approximately 1 million $CO_2$ equivalent tons at the SY harvest level, and this would decrease to nearly zero over the next 20 years.

In the scenario of current logging (TH), the regions forests would clearly remain carbon sinks until 2045. The carbon balance will weaken slightly in the next 20 years, if logging remains at the 2016–2018 level, which is still almost 2 million. $CO_2$ equiv. tons. If we only aim for the highest possible net income, forests are no longer carbon sinks.

The calculation of the forest carbon balance, as well as the agricultural carbon balance, is expected to be developed as comprehensively as possible by 2030, so that we can define the region's carbon balance.

### 3.3 Definition of the aims

The Climate and Energy Programme 2030 is a part of North Karelia's new Regional Strategy 2040. It directs activities specifically to climate change mitigation. At its meeting in October 2019, the Regional

Council of North Karelia decided to update the previous Climate and Energy Program 2020 during 2020. The work started in February 2020.

The aims of the Climate and Energy Programme 2030 (CE2030) were initially defined based on various EU, Finnish, and regional programmes and strategies concerning climate, energy, bioeconomy, and biodiversity (Appendix 4). From these documents, common and cross-cutting themes were identified, which can be implemented in the region to ensure that the programme reflects the region's characteristics and is collectively owned.

Cross-cutting Themes:

1. Climate Resilience
2. Biodiversity
3. Sustainable Growth: Economic, Ecological, Social and Cultural Sustainability; Diversity of Businesses, Actors, Research, etc.
4. Resource Efficiency and Circular Economy
5. Networking and Expertise

Among these themes, climate resilience was included to the programme's vision: "**North Karelia is a leader in climate resilience by 2030**." The objectives of the CE2030 programme were defined so that the region's strengths and challenges intersect at the crossroads of these cross-cutting themes. These strengths and challenges were identified through stakeholders and actors, allowing them to commit to the programme. The current CE2030 programme includes objectives corresponding to these intersections.

These themes, derived from various programmes and strategies, and the objectives formulated based on them, were discussed in the steering group meetings of the CE2030 programme (4 meetings), municipal meetings in North Karelia, two identical workshops widely inviting all stakeholders and actors (June 11 and August 11, 2020), a webinar for the Regional Council Assembly held on August 25, and numerous other meetings and events with different stakeholders. These events are listed in Appendix 5. The progress of the CE2030 programme was presented to the Administrative Board in two meetings. In all steering group and Administrative Board meetings, members expressed their views and thoughts on the programme, which were considered in its development as appropriate.

According to the Environmental Impact Assessment (EIA), law, the authority must consider and assess the environmental effects of the plans and programs it prepares. This assessment and report were made for the IE2030 program in October 2020.

In addition to the cross-cutting themes, seven development areas related to the region's climate and energy issues were identified. Some of these can also be considered regional strengths, such as excellent land use planning and urban planning, which are key to all activities. All these development items are included in either one or more goals of the program, because their importance can be seen in many different goals and solving them requires the cooperation of several industries, operators and disciplines.

Development Areas Related to the Region's Climate Issues:

1. Energy: Transport, Heating, Electricity
2. Stopping the Degradation of Biodiversity
3. Climate-Resilient Housing, including Construction, Living, and Mobility
4. Development of New Services and Products (Well-being Services, Substitution of Plastics, etc.) with Sustainable Use of Natural Resources
5. Smart and Cost-Effective Solutions for Operations

6. Circular Economy and Resource Efficiency: Recycled Raw Materials, Sequential Life Cycles, Waste Reduction
7. Land Use Planning and Urban Planning Tools and Opportunities

In 2021, an action plan will be prepared, outlining measures to achieve the objectives and the emission reduction pathway related to the Hinku regional status. The emission reduction pathway will be updated annually as a separate part of the programme.

## 4 Climate and Energy Programme 2030 Goals

The main aim and vision of the Climate and Energy Programme 2030 is that **North Karelia will be a forerunner in climate resilience by the year 2030**. Achieving the aims of the Climate and Energy Programme requires that the proposed actions are integrated into both work and everyday life. The realization of climate resilience also requires that the region has a real will to participate in climate-resilient activities. Willingness makes it possible to prepare for the effects of climate change in all sectors.

From the cross-cutting themes and their intersections mentioned in the previous paragraph, seven aims were formed. All of them relate to the region's most important strengths, while also addressing challenges and areas for development. The aims of the CE2030 programme are:

1. North Karelia is a vibrant region where the population are doing well
2. Stopping biodiversity loss is involved in all activities
3. Energy is low-emission and based on the region's own production from local natural resources
4. Climate-resilient construction and housing are possible in both urban and rural areas
5. Natural resources are used sustainably and with climate-smart approaches, enabling diverse business opportunities
6. Regional knowledge and research data are transferred flexibly by stakeholders, and North Karelia is an inclusive region
7. HINKU goals are achieved: an 80 % reduction in emissions from 2007 levels by 2030.

These aims are further elaborated in the following sections.

Many of the aims align with those of neighbouring regions' various climate, energy, environmental, and natural resource-related programmes and strategies (such as The Environmental and Climate Programme for Rural Areas in Finnish Lakeland 2020–2027 or the Regional Forest Programme). These programmes are referenced where applicable.

Shared and harmonized aims enable learning from others, transferring and utilizing good practices and models for action, and collaboration. Existing networks, such as the climate groups of regional councils and the climate networks of The Centres for Economic Development, Transport and the Environment (ELY Centres), should be fully utilized to ensure the achievement of these aims as well as for communication and outreach.

### 4.1. We take care of the vitality of the Region

The first aim of the CE2030 programme, ***North Karelia is a vibrant region where the population is doing well*****,** refers to a safe and healthy living environment throughout the entire region where residents can live and work. It encompasses mental, physical, and economic well-being, as well as the coordination of different functions to enable quality of life and comfort in both urban and rural areas.

These aspects of economic, social, ecological, and cultural sustainability are also key factors in the region's attractiveness. It is crucial that the region appeals to new residents through job opportunities, equal access to services, rich culture, and clean nature. Maintaining and developing these factors, in turn, supports retention: people who are satisfied with their livelihoods and living environment are more likely to remain in the region.

The location and scale of nature conservation areas, valuable natural sites, residential zones, forest management areas, energy production sites, bio- and circular economy zones, industry, tourism, wellness services, new businesses, and the transport system all impact biodiversity, quality of life, mobility, livelihood opportunities, and business potential. Land-use planning and community development are among the most important tools in this regard.

Land-use planning should aim for a balanced spatial structure between urban and rural areas, with a strong focus on enabling well-being across the entire region through climate-resilient structural solutions. The Finnish Ministry of the Environment's 2015 report *Planning that Advances Climate Goals* is the basis for the programme's term *climate-smart planning*. This approach means integrating sustainable development principles into land-use planning. A climate-smart plan considers the ecological, economic, and social sustainability of the area being developed. Often, this results in rational, cost-effective, and compact land-use planning that benefits both people and nature.

**Kommentoinut [SK1]:** Tarkistatko Petra tämän onko netissä YM sivuilla annettu käännös tälle?

These aims can be realized at all plan levels, from the provincial plan to the detailed site plan. Impact assessment is an important part of climate-smart planning. The comparison of alternative scenarios must be done with awareness of the effects of land use solutions on greenhouse gas emissions and the set climate goals.

In urban areas, compact communities enable efficient land use, saving materials and energy while reducing travel needs. A cohesive, dense urban structure supports sustainable mobility and makes services more accessible and abundant. A fragmented community structure increases costs for residents, but also for municipalities, e.g. in terms of infrastructure construction, maintenance and provision of municipal services. Consolidation of the community structure means additional construction in an already built environment. Preserving green areas and green connections in the plan despite the densification, diversity, carbon sequestration and preservation of important ecosystem services will be secured in addition to the comfort of the residents.

Outside urban areas, climate-smart planning involves sustainable use of natural resources designated in the plan. Planning can guide resource use by quality, location, and quantity. For example, peatland planning must consider both economic and ecological values, including carbon sequestration. This means allocating peatlands for both production and conservation based on quality criteria, with appropriate sizing for intended uses. Peatland planning also ties closely to discussions about future energy sources.

Sustainability is essentially related to transport logistics: planning and land use planning can improve the operating conditions of transport by rail or water, for example, and prioritize the use of resources that are along good transport links. Land use planning and zoning can also be used to control the location of logistics and business areas. This enables smooth traffic connections and transport chains, which are often also climate resistant.

Transport and telecommunications are vital to maintaining and developing a vibrant region, especially with increasingly mobile and multi-locational lifestyles. People live in one place, work in another, vacation elsewhere, travel, visit relatives, and seek recreation in different areas. Commuting and remote work are now common. The COVID-19 pandemic highlighted the importance of multi-locality.

People from densely populated urban areas want to retreat to their cottages in the provinces, where they can stay in a safe environment, avoid crowds, work remotely if necessary and study remotely. This population movement influences regional vitality and needs.

A thriving agriculture and forestry sector, strong expertise, and related entrepreneurship are essential for ensuring food and energy security across the country. It is vital for Finland to maintain services and ensure well-functioning communication networks, roads, and transport connections nationwide.

North Karelia is a region of forests. Forestry is a cornerstone of the local economy, and further developing forest-based industries, such as higher value-added products, is essential for regional vitality. The regional forest sector development plan and work programme are outlined in the *Regional Forest Programme 2021–2025 (AMO)*.

Wood production will face increasing pressure as demand grows for e.g. plastic alternatives and replacements for energy peat. Forest management in the region, as in all of Finland, aims to follow the recommendations for good forest practices. These guidelines seek to balance multiple forest-related aims under the concept of overall sustainability. They also enable forest management that addresses the challenges of climate change — combining good forest practices with climate-smart forestry.

In addition to wood, the forests in the region produce non-wood products and services, especially those related to well-being, such as local food and "new-fashioned" food ingredients (natural plants) as well as nature and well-being services and tourism. The changing age structure of the region's population and the prevention of marginalization also make it necessary to develop even more services and products that promote public health. In this matter, North Karelia can be a pioneer in utilizing nature as a source of human well-being; we have research data on the positive effects of movement in nature and outdoor activities on mental and physical health and well-being. This know-how should be utilized in the development of new livelihoods based on nature.

The AMO vision for North Karelia's forests states:
*"Forests are vital and subject to active, diverse, and responsible use. Vitality means high productivity, biodiversity, carbon sequestration, forest health, and adaptability. Biodiversity loss is brought under control. Forestry can operate on a long-term basis, and forests are a source of economic prosperity and well-being. Wood remains a key commercial product as new long-life products are developed. Simultaneously, other forest products and services, such as tourism and natural products, also grow."*
The CE2030 programme supports this vision. At its best, North Karelia can brand its forestry and sustainable natural resource use as a model of climate-smart operations.

Nature must be easily accessible to all residents. Urban planning must consider the number and location of green spaces, which are essential for the recreational needs of the elderly and people with reduced mobility. Small urban parks within residential areas — even those with limited space — are important as they are easily accessible to people of all ages and enhance the overall comfort of the environment. In addition, broader green corridors and networks connecting urban areas to surrounding natural environments promote walking and cycling, thereby supporting public health.

Sustainable nature tourism development also offers opportunities for climate change mitigation. Various concepts can be developed to reduce tourism's negative climate impacts, such as "offset your flight emissions – plant trees" and similar initiatives.

All the above factors also lay the foundation for creating new, innovative professions and business activities.

### 4.2. We Consider Biodiversity in All Activities

***Stopping biodiversity loss*** involves not only protecting nature reserves, valuable habitats, natural sites, traditional biotopes, and water bodies, but also ensuring the sustainable and diverse use of natural resources. Biodiversity conservation is linked to all human activities and largely to climate resilience. Climate change is considered the second most significant driver of biodiversity loss, following intensified land use.

Addressing the challenges of climate change is essential for securing biodiversity. A key priority is to preserve a broad and diverse network of habitats where ecological corridors allow species to migrate to new areas. Biodiversity conservation is a crucial climate adaptation measure. A diverse natural environment is more resilient to disruptions, such as those brought about by climate change, and it also recovers more effectively. Additionally, biodiversity enhances nature's ability to store and sequester carbon.

In Finland, protecting old-growth forests and natural wetlands is of particular importance. Alongside strengthening the network of nature reserves, biodiversity must also be integrated into agriculture, forestry, land use planning, and all activities that modify nature. For example, closer to nature like forest management (see the Regional Forest Programme 2021–2025) is a key tool for slowing biodiversity loss. In addition to avoiding harm to nature, it is possible to mitigate and compensate for environmental impacts.

Securing biodiversity must be part of everyday life and embedded in all our actions. The Finnish Biodiversity Strategy - Conservation and Sustainable Use of Biodiversity — *"For nature – for people"* — aligns well with the aims of this programme. The strategy's aim to integrate nature considerations into all sectors of society is central to protecting biodiversity. This is not just the responsibility of conservation — it must be reflected in business, economic activities, and in the everyday choices and consumption of every resident of North Karelia. Small actions bring strategies and programmes into practical implementation. These include reducing and reorienting consumption, recycling, and making climate-smart choices in transport, housing, and construction.

Since 89% of North Karelia's land area is forested, the greatest concerns regarding biodiversity are related to forests. The Finnish Biodiversity Strategy notes that while the rate of species decline in forests has slowed, negative trends still outnumber positive ones.

Positive developments have been achieved through increased forest protection and closer to nature like forest management. A good example is the growing amount of deadwood in the region's forests. According to the 11th National Forest Inventory (NFI11, 2009–2013), the amount of standing and fallen deadwood was 3.8 m³/ha; in NFI12, the figure increased to 4.8 m³/ha. Increasing deadwood volume is included in the forest management guidelines of the Regional Forest Programme (AMO). Its aim to stop biodiversity loss supports both the CE2030 programme's biodiversity aims and those of the national biodiversity strategy.

A key element in addressing biodiversity decline is implementing climate-smart forestry, which considers climate change impacts alongside biodiversity and wood production. Climate-smart agriculture and forestry — which are economically and socially sustainable — could also become significant export concepts in the future.

The following AMO aims related to closer to nature like forest management directly support the CE2030 programme's biodiversity objectives:
:

1. Productive forests and strong carbon sinks

2. More game scraps and high-quality decayed wood to commercial forests
3. Vital and adaptable forests
4. Growth in forest bioeconomy and circular economy
5. Nature tourism, non-wood wild products from forest, and other nature-based services


The *Environmental and Climate Programme for Rural Areas in Finnish Lakeland 2020–2027* is a collaborative programme between five regions, including North Karelia, with a rural focus. It includes several aims and actions for achieving carbon-neutral agriculture and considers biodiversity in farming. Therefore, its agricultural objectives are also compatible with the CE2030 programme.

The aims of the Environmental and Climate Programme for Rural Areas in Finnish Lakeland 2020–2027 are:

1. The water quality in the Finnish Lakeland region is at least good or improved to a good level
2. The Lakeland region becomes carbon-neutral
3. Biodiversity in the Lakeland Region is maintained or increased
4. Responsible and profitable business and sustainable housing are promoted

The *Agricultural Climate Roadmap* (MTK), published in summer 2020 with target year 2035, sets similar and complementary aims for agriculture. Among these are reducing greenhouse gas emissions from peatlands and increasing carbon sequestration in mineral soils, which align with the Finnish Lakeland Region programme. The roadmap also proposes aims that are especially relevant for the CE2030 programme: increasing biogas production and using solar power. Promoting both energy sources is highly important for achieving the aims of this programme.

### 4.3. We Develop Self-Sufficient and Low-Emission Energy Production and Use

The third goal is to achieve ***low-emission energy production in the region, primarily based on North Karelia's own energy production from local natural resources***. Energy—whether for transport, heating, or electricity—is the greatest challenge and development area within this programme. North Karelia has the ability to increase its energy self-sufficiency using local energy sources. This requires the use of plant-based biomass (including wood-based bioenergy), solar and wind power as well as geothermal energy in suitable areas. Geoenergy and geological storage of surplus and waste heat are interesting options in the future. In addition, the utilization of waste and side streams in energy will be diversified. Waste should not only be burned, but the possibilities of, for example, gasification can be considered. We need comprehensive solutions to increase the share of renewable energy and environmentally friendly fuels.

Hydrogen is undoubtedly one of the most promising future energy solutions. Hydrogen is not an energy source itself, as it does not occur naturally in its pure form on Earth—it must always be produced. If the hydrogen is generated using electricity from carbon-free sources (hydro, wind, solar, or nuclear power), the resulting hydrogen is carbon neutral. When produced from biomass—or potentially even from water—hydrogen can, in principle, be carbon-free.

Improving energy efficiency is a vital aspect of reducing emissions from energy use. This is in connection not only with diverse energy solutions but also with sustainable construction and housing. Building materials, insulation solutions, electrical appliances used in homes, and many other factors provide consumers opportunities to influence their own energy consumption. Changing consumer's energy behaviour—and encouraging that change—requires continued public awareness efforts and, when necessary, education.

The public sector plays a significant role in implementing energy-efficient solutions in construction and procurement. Examples and pioneers are needed in the field of energy efficiency. Land use planning is critical tool. Part of energy efficiency includes utilizing waste heat. Many industrial facilities, production plants, and service sectors produce surplus heat that is not currently being used. This calls for the development of systems to capture and store waste heat. Opportunities for utilizing waste heat should be considered in urban planning. For instance, could waste heat from ice rinks be used to heat public buildings like swimming halls? In such cases, the best available and practical technology should be used to achieve significant energy savings.


Utilizing local energy also requires decentralized energy production. Decentralized energy production, such as CHP (combined heat and power) plants and energy cooperatives, would enable broader production and use of wood-based bioenergy (forest chips) and biogas. This calls for changes in energy subsidy policies. Farms should be allowed to sell energy without losing eligibility for investment support. Flexibility and reduced bureaucracy are needed in this area.

One solution for producing local energy is to form a network of energy companies involving raw material producers, logistics companies, and energy producers. The previously mentioned Climate Roadmap for Agriculture also includes the goal of increasing biogas production.

Greenhouse gas emissions from transport account for about 20% of Finland's total emissions and about 28% of emissions from the energy sector. According to Statistics Finland's energy data, transport has accounted for approximately 16% of Finland's final energy consumption in recent years. A clear majority of domestic transport emissions and energy use comes from road traffic. In a sparsely populated region like North Karelia, where distances are long, low-emission and sustainable way to travel—both within the region and to/from it—are essential for achieving carbon-neutral transport. Key areas for development include low-emission fuels for road and air transport, as well as improvements to the rail network and water transportation. Railways and inland waterways make it possible to transport goods efficiently and with low emissions. At the same time, we need to rethink how residents of the region can travel in more resource-efficient and low-emission ways—particularly

through improving public transport and making active travel options (walking, cycling) more attractive and viable.

Achieving carbon neutrality in transport also depends on ensuring and developing local services in rural and village areas, as well as improving the availability and functionality of comprehensive telecommunications networks. The share of fossil fuels used in transport energy must be reduced while also developing carbon capture and utilization technologies. At present, North Karelia has few electric vehicle charging stations or biogas fuelling stations, due to limited demand. However, there is no demand because there is no supply—and this cycle must be broken.

Carbon-neutral synthetic fuels are also a promising alternative. The required technology has been developed in Finland (e.g., Lappeenranta University of Technology), and the technology for industrial-scale production is already mature.

In 2018, heavy vehicles accounted for 45% of Finland's transport-related emissions. If diesel fuel used in heavy transport could be replaced by either biodiesel, biogas, or both, we would be well on our way to solving a major part of the problem. The creation of a refuelling network would also create the conditions for a change in the energy used in private cars. Both biodiesel, biogas and electricity as an energy source for cars are possible with raw materials from the region. Renewable diesel, biogas and ethanol made from waste and residues, as well as electricity produced with sustainable renewable energy (wind and solar energy) are forms of energy of the future.

Finland aims to cut domestic transport emissions by at least half by 2030, compared to 2005 levels. This goal can also be adopted in this programme. The *North Karelia Transport System Plan*, completed in 2020, includes numerous solutions and objectives that support the implementation of the CE2030 transport goals.

The key objectives of the North Karelia Transport System Plan are:

1. Sustainability: People's opportunities to choose more sustainable way to travel will improve – especially in the Joensuu urban area
2. Accessibility: The transport system ensures accessibility throughout North Karelia and meets the needs of business, commuting, and housing
3. Efficiency: The socio-economic efficiency of the transport system will improve

### 4.4. We have Climate-Resilient Construction and Housing in Both Urban and Rural Areas

Enabling ***climate-resilient construction and housing in both urban and sparsely populated areas*** combines many elements: land use planning as a tool (the location of buildings, materials used, energy solutions, and mobility opportunities), wood construction, the development of concrete construction toward carbon neutrality, as well as regional employment and business activity. All these elements—and their interconnections—should be considered together, as they are essential components of climate-resilient building and living. Other important considerations include the comfort of living and the renovation of old buildings to extend their lifecycle.

Housing density, and the optimization of land use, combined with improvements in transport services, integration, and accessibility, play a major role in achieving the CE2030 programme's goals for climate-resilient living and transport. The vision of the new North Karelia Transport System Plan is: *"The transport system supports the development of the region's economy and offers sustainable mobility options for all population groups, regardless of where they live."* This vision fits very well with the aim of the CE2030 programme to promote climate-resilient housing.

The region has a strong will to increase the use of wood in all forms of construction. So far, the greatest obstacle has been the cost of timber construction compared to concrete. Therefore, developing cost-effective wood construction is a key part of this objective. A regional working group has been considering the opportunities and prerequisites for wood construction. The group includes representatives from the Regional Council, the University of Applied Sciences, the University of Eastern Finland, the Natural Resources Institute Finland (LUKE), the European Forest Institute, Business Joensuu, and various companies.

According to this group, North Karelia's strengths in wood construction are the multidisciplinary research, educational expertise, cooperation between organizations, and networking both in Finland and across Europe. The group's shared vision is that North Karelia provides climate-smart solutions for construction. These solutions are based on wood as a renewable material and carbon sink, though they do not exclude the combined use of different materials. The aim must be not only climate-resilient but also cost-effective construction. This requires developing structural engineering solutions that increase climate resilience of the buildings. This also calls for more research in the field.

The region should also attract production facilities related to construction—especially wood construction—which would create employment, income, and entrepreneurial opportunities.

Climate-resilient construction and housing means diverse construction practices, a variety of climate-resilient solutions in urban planning, mobility, and energy systems, as well as resource efficiency. Concrete construction has a strong position in the building sector and plays an important role in regional employment. Efforts are underway to make concrete more carbon neutral, and all measures supporting this development are important.

Resource efficiency and the circular economy must become an integral part of standard construction practices throughout the entire value chain and building lifecycle—from procurement and raw material production to demolition and the reuse of demolition waste as recycled raw materials. One of the aims related to construction waste in the national waste plan (VALTSU2023) is to raise the recovery rate of construction and demolition waste to 70%. In addition to this, reducing the overall amount of construction waste is also a key target.

When circular economy aspects in construction and demolition are in question, material safety must be considered. Increasing the use of recycled materials in construction should not come at the expense of safety. Promoting circular economy principles in construction need investments in planning and research. The role of the client or project owner is also significant in promoting circularity. This requires shifting toward environmentally friendly building material choices.

Resource efficiency also refers to the efficient use of spaces—utilizing existing buildings more effectively and for longer periods. Naturally, this requires healthy, professionally built structures. It also implies energy efficiency, which can be advanced through building technology solutions and the energy transition, such as through local energy communities, where consumers increasingly also act as energy producers.

### 4.5. We Implement Climate-Resilient and Innovative Business

The fifth goal of the program, "***Natural resources are used in a climate-resilient manner enabling diverse business activities***," refers to climate-smart agriculture and forestry, improving material efficiency, and promoting resource efficiency and the circular economy. The sustainable use of natural resources is closely tied to the diversification of livelihoods. In the region, traditional industries based on sustainable use of natural resources, such as agriculture and forestry, continue to play a significant role now and in the future. Alongside them, new, equally sustainable activities must be developed. Sustainable use of natural resources is inherently linked to the idea of reducing consumption.

The utilization of raw materials should aim for multiple successive cycles. In addition to virgin raw materials, side streams and recycled materials should be utilized. Increasing the circulation of materials is a key part of implementing a circular economy. In the bioeconomy, the most valuable portion of virgin raw materials should be used first, followed by the utilization of side streams and so-called waste. In circular economy processes, side streams and waste are seen as raw materials that circulate through various uses for as long as possible. Everything we produce must have a long lifespan and multiple life cycles following the cascade principle. The cascade principle means utilizing raw materials as efficiently as possible so that the material is used for products with a high processing value before it ends up as an energy source. The goal is to minimize the use of virgin natural resources and maximize the value of the materials.

Smart specialization is one way to implement sustainable and innovative business and to increase value-added production. The region's current smart specialization strengths are forest bioeconomy and technologies and materials. Forest bioeconomy forms the region's strongest research- and competence-based sector. Experts in the field work across various educational levels, from vocational education to doctoral programs and research institutions. The field also includes strong national and international actors.

Expertise in the "technologies and materials" sector is focused on technological industries and high-tech solutions. The region has substantial specialized knowledge in areas such as the university of applied sciences' precision technology environment, production control expertise in ICT companies, VR and AR technologies, advanced optics, geoeconomics, and chemistry-based materials expertise. Automation helps to increase production efficiency, ensure consistent quality, and improve cost-effectiveness.

Technology expertise should be increasingly focused on developing climate-resilient production and technologies. The importance of clean solutions is growing, and as a theme, it could unify many of the region's areas of strength and desired development directions. For example, photonics, nature tourism, sustainable geoeconomy, or clean, specialized food production could become new smart development priorities for the region alongside forest bioeconomy and the technology industry. Choices should be based on top-tier expertise, sufficient business activity, and economic growth potential.

Material efficiency means achieving the greatest possible output or service with the smallest possible input, in a way that minimizes environmental impact. The goal is to use materials, raw materials, and energy as efficiently as possible, reducing both the amount and harmfulness of waste and minimizing

the environmental impact of the product or service over its entire life cycle. The environmental impacts of production inputs can be influenced by choosing appropriate raw materials. The more efficiently natural resources are used, the smaller the material input required per product or service—leading to cost savings and improved business competitiveness.

Material efficiency plays a crucial role in the circular economy. The circular economy aims to retain the value embedded in products and materials and keep them circulating in the economy. The goal is to generate as little waste and loss as possible in production and consumption and ensure products and services can be reused or recycled.

*The national waste plan* (VALTSU) sets objectives for Finland's waste management and aims to reduce both the quantity and harmfulness of waste. The target for 2030 is a reduction in waste, high-quality waste management as part of a sustainable circular economy, and increased recycling and reuse. The plan also envisions safe material cycles and decreasing use of hazardous substances in production. Material-efficient production and consumption are expected to conserve natural resources and mitigate climate change.

Regional goals support the goal of the national waste plan, especially regarding the sustainable and versatile use of natural resources and climate wisdom. As consumption behaviour and production processes change towards circular economy principles, opportunities arise for new business concepts and services (e.g. repair and maintenance services, acquiring things as services or sharing economy concepts).

In the future, emphasis should be placed on product longevity over single-use consumption, and consumption habits should be transformed. According to the revised Waste Directive, 60% of municipal waste must be recycled by 2030. Additionally, 70% of all packaging waste must be recycled by 2035. Achieving these goals will require broad and comprehensive measures to increase recycling.

In North Karelia, as part of the *Circwaste – Towards Circular Economy* project, a regional circular economy roadmap has been developed to implement the national waste plan.

The main goals of the regional circular economy roadmap are:

1. To promote the region's material and energy efficiency and the sustainable and optimal use of natural resources
2. To integrate circular economy into the everyday operations of all sectors and strengthen the regional circular economy cooperation network
3. To strengthen and generate new circular economy businesses and develop new technical solutions and expertise in the region

The focus areas of North Karelia's circular economy roadmap include increasing the recycling of construction waste and improving on-site sorting of municipal waste. The target is to achieve at least a 70% material recovery rate for construction waste by 2030. Other objectives include active monitoring of construction waste volumes, emphasis on planning and supervision of construction projects, and ensuring that recycled materials play a significant role in construction. The goal for municipal waste is a 60% recycling rate by 2030. Additionally, circular economy must be actively and comprehensively integrated into decision-making and planning.

Achieving all the above requires cross-sectoral collaboration and a shift in mindset, turning ideas into innovations and business opportunities. The region must be able to increase the degree of refinement of many products and develop its own processing industries. Real innovations are needed from cross-disciplinary interfaces—here, the region's strong research expertise is an advantage and must be

effectively transferred to business activities. Smart solutions and affordable new technologies must be developed to create new products and services from forests. Materials and raw materials need to be reevaluated and redefined, as climate change will significantly affect resource availability, logistics, and production locations. The region's strong expertise and actors in forest bioeconomy must be utilized even more in these efforts.

The impacts of climate change on business are examined, for example, in the Confederation of Finnish Industries (EK 2020) background report on "The Impacts of Climate Change on Finnish Business." The report states that industry will suffer more from the direct impacts of climate change than service sectors, energy issues will become even more critical, and access to skilled labour will influence business operations and domestic demand. However, the report also sees opportunities. Developing low-emission technology and the associated research expertise can become a competitive advantage in international markets. Finland could also become an attractive destination for investment due to its technological know-how and shared determination to combat climate change. These are all strengths of North Karelia as well and must be fully utilized.

National-level decisions that support business in sparsely populated areas are needed—for example, locally tailored investment and wage subsidies and guarantee instruments. Organizational activities that support community should not be shackled by too much regulation, but society should encourage people's voluntary activities. These are all especially relevant for North Karelia.

The climate-smart and sustainable use of natural resources and its further development also fulfil North Karelia's global responsibility regarding climate change. By producing climate-resilient products and developing their markets and exports, we ensure that our actions promote a sustainable global future. This is realized in two ways: first, by manufacturing products in a climate- and resource-smart way using clean technologies and steering consumption toward such products, we reduce the need to produce similar goods—possibly less sustainably—elsewhere in the world. Secondly, climate-resilient products and models developed in the region—such as climate-resilient forest management—can serve as examples for other countries and regions.

### 4.6. We Effectively Transfer Knowledge and Expertise to the Field

North Karelia has excellent research and education, as the region is home to a university, a university of applied sciences, the Natural Resources Institute Finland (Luke), the European Forest Institute (EFI), and vocational education institutions. In addition to these, there is a need for increased investment in experimental agricultural research in the region. The area also hosts actors such as the Finnish Forest Centre, Business Joensuu, and numerous development companies, which have strong and effective connections to the business sector and a solid understanding of the problems and challenges

encountered in the field. These strengths underpin the sixth goal of the program: ***Regional knowledge and research data are effectively transferred to the field, and North Karelia is an inclusive region.***

By actively utilizing the described network and improving interactions, it is possible to transfer validated and research-based knowledge to meet the needs of the business sector. This requires approaches like innovation ecosystems. A culture of experimentation, new perspectives, open-mindedness, interdisciplinary collaboration, and a shared commitment to sustainable and renewable solutions are all essential. This also includes strengthening educational services—including continuous learning—as well as applied research related to climate resilience and international research and development cooperation. In addition, increasing climate awareness and integrating it into daily actions is important. Practical, hands-on implementation and the ability to recognize climate-related issues in both work and everyday life must be promoted.

The work done within North Karelia's biosphere reserve provides a strong foundation. The biosphere reserve implements regional sustainable development activities that, through research, education, and cooperation, promote both economic and environmental well-being while raising environmental awareness. The aim is to develop regional practices that consider nature, economy, culture, and communities. The expertise gained from these activities should be fully utilized.

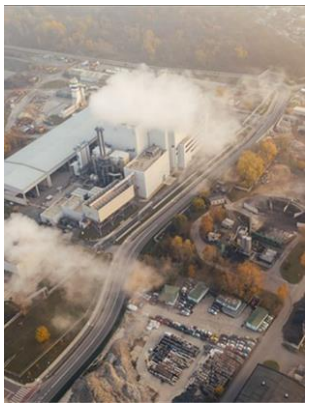
Effective implementation of this goal creates jobs in the region and enhances its attractiveness, especially to students graduating from local educational institutions. If employment opportunities are available locally, it may help prevent the "brain drain" from the region.

The region's residents must not be forgotten in this context. Active villages and associations often provide the most agile and flexible means to bring the latest knowledge about natural resources directly into practice. This means that researchers and research institutions must be able to present their findings in a clear, accessible, and practical manner. The significance of societal engagement will grow in the future, and research should increasingly be open to input and knowledge from outside the academic world—in the form of so-called *citizen science*.

### 4.7. We Commit to the Hinku Targets

The region of North Karelia achieved Hinku status in June 2020. This means that, as a region, we are committed to reducing greenhouse gas emissions by 80 percent by 2030 compared to 2007 levels. Of the region's 13 municipalities, eight (8) are currently Hinku municipalities (updated information June 2025: eleven (11) Hinku municipalities). In 2018, emissions in North Karelia had decreased by 25 percent compared to 2007 levels (updated information June 2025: on 2023 the GHG emissions reduction is 43 %). There is still a significant way to go to reach the required 80 percent reduction, and the realism of this target must be assessed considering technological developments and other emission-reducing measures over the coming decade.

Achieving emission reductions will require new innovations and investments in the region, research and its practical implementation, as well as strong societal support and advocacy. The major challenges in this effort are related to energy use in transport and heating, construction, and the development of carbon-sequestering products.



The Hinku municipalities in North Karelia are: Nurmes, Lieksa, Ilomantsi, Joensuu, Outokumpu, Liperi, Tohmajärvi and Kitee (updated June 2025: the new Hinku municipalities are Juuka, Kontiolahti and Rääkkylä) . In early 2021, Heinävesi joined North Karelia; while not yet a Hinku municipality, the criteria set for the region are still met.

The Hinku target of achieving an 80 percent reduction in greenhouse gas emissions is also one of the goals of the CE2030 program. As part of the CE2030 implementation plan, an emissions reduction pathway will be developed and updated annually. This work can build upon studies already conducted by the Regional Council, which have analysed, for example, the sources of North Karelia's emissions in 2017 and identified measures to reduce emissions (CLEAN – Technologies and Open Innovation for Low-Carbon Regions project).

# 5 Climate Resilience, Responsibility, and Clean Solutions: The Focus is on New Opportunities

## 5.1 We Take Our Share of Global Responsibility

The North Karelia Climate and Energy Programme 2030 sets targets for mitigating and adapting to climate change, while also aiming to open new opportunities for a more diverse economy. The programme implements the EU's and Finland's climate and energy targets as well as the UN's Sustainable Development Goals at the regional level. The starting point of CE2030 is to take responsibility in issues we can affect and to act in a climate-resilient way by not increasing greenhouse gas emissions, reducing energy consumption, and overall consumption.

Mitigating climate change means reducing greenhouse gas emissions and maintaining carbon sinks. The purpose of emission reduction is to slow down and eventually stop the increase in atmospheric carbon dioxide concentration, i.e., to slow down the rise in temperature. Climate change does not follow national borders; we all have an equal responsibility for changes in the Earth's atmosphere and for mitigating climate change.

Adapting to climate change refers to the ability of humans and natural systems to function in the prevailing climate and to prepare for changes in the climate. The purpose of adaptation is to reduce exposure and vulnerability to the effects of climate change. Adaptation aims to prevent or mitigate the negative impacts of change while also benefiting from positive outcomes. Compared to mitigation measures, the effects of adaptation measures are often visible over a shorter time frame and more locally. Ideally, mitigation and adaptation go hand in hand. The importance of adaptation alongside mitigation increases the slower the progress in mitigating climate change.

Factors influencing how we cope with and adapt to climate change include, among others, standard of living, food security, health, education level, natural resources, ecosystem status, the possibility of using renewable energy sources, attitudes towards the environment and climate change, and participation.

The importance of recycling and the circular economy alongside bioeconomy will increase. Bioeconomy utilizes renewable natural resources sustainably and diversely, respecting the preservation of biodiversity. The circular economy, on the other hand, is based on resource efficiency; raw materials taken from nature are used as efficiently as possible, preferably entirely, in durable and repairable products. Bio- and circular economy also include the development of sustainable services as a business. Bio- and circular economy offer a way to combine the mitigation and adaptation of climate change with business.

According to the Medium-Term Climate Plan (KAISU) aiming for 2030, significant emission reduction requirements are set for energy, starting from a 40% target for phasing out heating oil. Regarding wood energy, it is important to promote and strengthen the clean combustion of pellets, chips, and logs as part of heating energy and electricity production emission targets. For work machines, carbon dioxide emission reduction targets are set for the first time; the aim is to improve energy efficiency and transition to alternative fuels.

Our region can meet this challenge: we have research expertise and globally competitive equipment manufacturing, and increasing and strengthening their collaboration enables the development of cleaner combustion and low-emission work machines.

## 5.2 North Karelia is a Forerunner

Being a forerunner in climate resilience requires strong will and visibility of action at all levels. Various related programmes must be put into practice. Regional actors can highlight positive thinking towards climate resilience: we are the positively climate-resilient North Karelia region. This requires communication among actors and outwards from the region. The message must convey that climate resilience is not just a burden but an opportunity, and through cooperation, we can achieve more while avoiding overlapping work.

By focusing on opportunities, we gain courage to innovate and renew in all activities and attract investments to the region. At the same time, we can adapt to climate change more effectively across all sectors.

Pioneering also requires societal support. Coordinating funding from different sources for environmental, climate, and renewable energy projects has been a long-term effort in North Karelia since the 1990s. The regional programme states that there are three main principles in directing structural fund resources in North Karelia:

1. Coordination of European Regional Development Fund (ERDF) and European Social Fund (ESF) funding
2. Partnership of structural funds with the European Agricultural Fund for Rural Development (EAFRD)
3. Structural fund projects as a launch pad for accessing EU-specific programme funding

The aim is to achieve the main objectives of the Regional Programme, namely new jobs and new RDI jobs, and to promote low-carbon development. By coordinating different funding sources, overlapping funding has been reduced, and exemplary results have been achieved.

Finland's climate and energy strategy outlines that "investment subsidies for renewable energy are primarily targeted at commercializing new technology and facilities producing advanced biofuels outside the emissions trading sector, such as in transportation, promoting alternative fuels in transportation, and on-site or other non-emissions trading electricity and heat production for businesses and farms." This is an opportunity for North Karelia's business activities. This requires cooperation and development at the interfaces of bioeconomy, circular economy, clean technology solutions, energy efficiency, zero-emission energy production, storage solutions, and carbon capture development and market introduction, as well as resources for research, development, and innovation activities.

Climate change is a strategic-level risk for local and regional actors. Its potential impacts are so significant that they must be comprehensively considered in strategic decision-making and in planning activities and the economy.

Forest bioeconomy is one of the region's areas of expertise, based on internationally leading research clusters, increasing the degree of processing, and promoting climate-resilient forestry. This creates opportunities for local investments and the need to ensure infrastructure and regional accessibility. In other words, the region needs smart and sustainable growth based on innovative technologies and materials, as well as new solutions in forest bioeconomy that support the vitality of the area while implementing climate and energy targets towards a climate-resilient region.

North Karelia has large global players in the field as well as smaller specialized actors, such as machinery and equipment manufacturers and software expertise. In the region, where all elements are in place, efforts should be made to ensure the operational capability of significant actors. Activities and supply security are needed in all sectors; global operations bring not only the opportunities of the

global economy but also its weaknesses, and to cope with the latter, we must have our own production for crisis situations. Developing this is also an opportunity to increase exports.

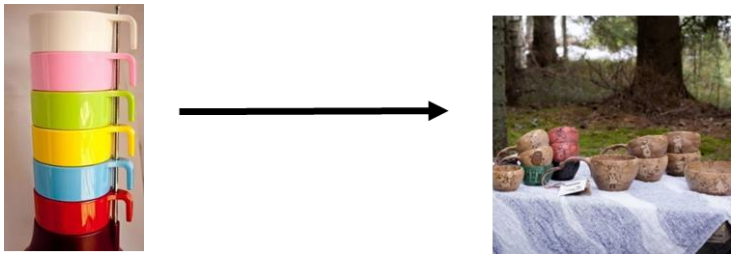
Energy and related emission reduction requirements are another significant opportunity for forest bioeconomy enterprises. North Karelia has bio-raw materials available and the necessary expertise to develop clean combustion of wood and to produce biogas, bio-oil, and other environmentally friendly energy sources. However, this still requires strengthening research, supporting experiments, pilots, and feasibility studies, and attracting actors to the region based on strong international expertise. According to the principle of resource efficiency, the possibilities of circular economy and waste management should be explored, for example, through large-scale biogas production—not utilizing waste solely by burning it for energy.

Traditionally, the utilization of peat in the region has focused on energy and horticultural uses. The national goal is to phase out the use of peat for energy by 2035. In the future, the region can utilize peat for higher value-added products, such as activated carbon or other high-quality materials. The development of horticultural peat—another traditional use—should also continue, while remaining open to other alternatives. At best, adapting to climate change offers new business opportunities and potential for technology exports.

A report published by The Finnish Innovation Fund (SITRA) in the summer of 2020, *"Phasing out peat use – Means to support a just transition in Finland"*, recommends the complete cessation of peat use by 2035 for climate mitigation reasons. The CE2030 Programme acknowledges this need. However, its short-term objective is to phase out peat for energy use by 2030 and to efficiently develop alternative uses and peat-substitute raw materials by the same year.

The chemical forest industry and plastics industry have traditionally been strong sectors in North Karelia. Most of the region's pulp production is exported. North Karelia aims to safeguard production, further increase the value-added level of products before export, and thereby fully utilize the region's raw materials and expertise.

Further development of side streams from pulp production is also needed. For example, the reuse of so-called waste wood through carbonization for soil improvement, filtration, and increasing carbon stocks in soil presents interesting opportunities. Enhancing soil carbon stocks could serve as a target for corporate carbon offsetting. In the plastics industry, the goals are to replace fossil-based oil with bio-based solutions and to increase the share of recycled plastics used—thereby improving the carbon footprint of products.



The strong expertise of the region's research, education, and development organizations must be utilized more effectively in business operations. Research knowledge must be directed to practical users, and skills development must respond efficiently to emerging needs. At all operational levels, there is a need for information about the risks and vulnerabilities of climate change—especially in

sectors that are particularly sensitive to its effects. Communication related to climate change, including the content and methods of communication, must be developed to suit different stakeholders.

Development priorities and related measures will be defined in the action plan to be prepared in spring 2021. These priorities are also necessary for the annual implementation plan of the Regional Programme.

Climate change and adaptation to it should be turned from a threat into an opportunity, and we must learn to recognize and adopt new ways of doing things. This requires a shift in mindset—toward openness and a willingness to seek, implement, and embrace interdisciplinary and cross-sectoral cooperation. We must move beyond the mindset of "this is how it has always been done," and instead consider how things can be done better in today's context. This inevitably requires compromise from different actors. When everyone is willing to meet halfway and explore new solutions, we can achieve win-win outcomes.

Increasingly, we need to examine the intersections and interfaces between sectors, industries, and scientific disciplines—to look for solutions, raw materials, technologies, and methods through open-minded collaboration. This opens new opportunities for diverse business activities, helps maintain employment and social well-being, and attracts investment to the region.

**Appendix 1. Objectives and Implementation of the North Karelia Climate and Energy Programme 2020**

| **Qualitative Indicators** | **2018, realization** |
|---|---|
| **General Objectives** | **Yes/No/Partially** |
| Municipalities, communities, companies, and residents of North Karelia are aware of climate change and its mitigation methods and recognise their responsibility and opportunities in climate-related matters | Yes |
| North Karelia is a carbon-neutral region, more than self-sufficient in renewable energy production, where fossil oil is not used in energy generation | No |
| The region utilizes and develops the opportunities of the bioeconomy and acts as an international player in the climate and energy sectors | Yes |
| North Karelia is known for sustainable development solutions that promote the well-being of people and the environment | Partially |
| The share of renewable energy is increased and diversified, and energy efficiency is improved | Yes |
| Cooperation between private and public organizations is strengthened, and climate change is considered in all planning and decision-making | Yes |
| The export of technology and services is growing | Yes |
| Municipalities are aware of the current state of greenhouse gas emissions and the main sources of emissions. They have also defined their own climate policy goals and actions based on this information | Partially |
| The use of natural resources in North Karelia is sustainable, and the biodiversity values of forest nature and agricultural environments are considered | Partially |
| **Specific Objectives: Energy** | |
| Improving the energy efficiency of the existing stock | Yes |
| Local companies utilize the opportunities offered by energy efficiency and energy saving in their business operations | Partially |
| Energy counselling is an integrated (project-based) part of the operations of various organizations | Partially |
| The region is self-sufficient in heat production, which is almost entirely generated from renewable sources | Partially |
| Decentralized energy production improves energy self-sufficiency and creates business opportunities | Partially |
| A well-networked, internationally high-level research and education base provides a foundation for new business and for growing the importance of the sector in the region | Partially |
| Renewable energy companies in North Karelia operate internationally, with a particularly strong role in machinery and equipment manufacturing related to the sector | Partially |
| The forest energy and broader renewable energy cluster attracts new, young professionals to the field: the sector is seen as full of opportunities and appealing | Partially |
| **Specific Objectives: Transport** | |
| Walking, cycling, and public transportation are functional and attractive alternatives to private car use | Partially |
| Biogas and other locally produced energy sources for transport are increasingly used | No |
| The region's rail transport is efficient and user-friendly | Partially |

| | |
|---|---|
| Freight logistics are efficient and have shifted, where suitable, to rail and waterways | Partially |
| Remote work and carpooling are popular; electronic communication tools are used effectively | Partially |
| **Specific Objectives: Community Structure and Land Use Planning** | |
| The community structure is functional and economical | Yes |
| Cooperation between municipal officials and between municipalities is effective and close | Yes |
| Village areas outside growing urban centres are vibrant and viable; an evaluation criterion could be the development of population numbers in urban and sparsely populated areas | Partially |
| **Specific Objectives: Construction** | |
| Buildings are more energy-efficient than before, and their operational efficiency is high | No |
| North Karelia is the leading region in wood construction | Partially |
| Renewable energy is used as the primary heating source in buildings | Partially |
| Regional energy advisory services are active and knowledgeable | Partially |
| **Specific Objectives: Waste Management** | |
| The goals of the Eastern Finland waste management plan for waste prevention, sorting, and the development of bio-waste and sludge treatment have been achieved | Partially |
| There is functional and active waste advisory service in the region | Yes |
| Waste-to-energy is utilized efficiently | Partially |
| **Specific Objectives: Forestry** | |
| Forests as carbon sinks – good forest management increases forest growth, timber reserves, and opportunities for timber use | Yes |
| Forests as energy source – the share of renewable energy in total energy production and use is growing significantly, and exports are increasing | Partially |
| The region is prepared for the harmful extreme weather events caused by climate change | Partially |
| **Specific Objectives: Agriculture** | |
| Farms and agricultural transport consume less fossil fuel | No |
| North Karelia is leading region in local food production and organic farming | Partially |
| Farms produce less waste | Partially |
| Farms have decentralized and self-sufficient energy production, including biogas, solar panels, and wood chips from damaged forest areas | Partially |
| The region offers expert-level agricultural training and advisory services | Yes |

| **Quantitative Indicators** | | |
|---|---|---|
| **General Objectives** | **2008** | **2018** |
| Greenhouse gas emissions in North Karelia re reduced beyond the EU reduction target (by 2020) | EU -20% | 25 % |
| Greenhouse gas emissions (ktCO2e) | 1671 (2007) | 1281 |
| **Energy** | **2008** | **2018** |
| All municipalities in North Karelia have signed an energy efficiency agreement | 0 | 2 |
| 50 companies in the region have signed an energy efficiency agreement | N/A | 40-50 |
| Turnover of renewable energy SMEs in the region is €500 million | 40 (2011)* | 52 (2017)* |
| Employment impact of renewable energy in the region is 5,000 person-years | 345 (2011)* | 254 (2017)* |
| Total energy consumption (TWh) | 10.0 | 11.8 |
| Renewable energy consumption (TWh) | 6.3 | 7.9 |
| Share of renewable energy in total energy consumption (%) | 62.6 | 67.0 |
| Use of peat in heat and electricity production decreases from current levels (TWh) | 0.691 | 0.515 |
| Share of renewable energy in the final energy consumption of the region's transport sector is at least 25 % (%) | 0 | 10,8 |
| Energy self-sufficiency (%) | 69.7 | 64 |
| Fossil greenhouse gas emissions from industry and large heating and power plants (t CO2-eq.) | | |
| Use of black liquor:2,500 GWh; energy use of industrial by-products: 1,500 GWh (GWh) | 2400 (black liquor)<br>1300 (industrial by-products) | 3013 (black liquor)<br>1572 (industrial by-products)<br>(Eastern Finland energy statistics) |
| Use of forest chips: approximately 1 million m³, i.e., 2,000 GWh for heat, electricity, and processed biofuels (1,000 m³) | 273 | 351 |
| Firewood use: approximately 400,000 m³, i.e., 800 GWh (used in detached houses) (GWh) | 700 | 632 |
| Production of wood pellets and torrefied wood: approximately **double** the current pellet production capacity, i.e., around **700 GWh** of energy (150,000 tonnes). Use of wood pellets in the region: **three times** the current use, i.e., around **150 GWh** of energy (32,500 tonnes) industrial pellets and torrefied wood (GWh) | 280 (production)<br>50 (use) | 32 (use)<br>in the section on the use of pellets and torrefied wood |
| 500 GWh of liquid biofuels are produced in the region | 0 | 193 |
| The field biomass production area is about 10,000 ha, production 40 GWh. Production area of woody field biomass about 200 ha, production 10 GWh | 17 | |
| Biogas production: 100 GWh for heat, electricity, and transport fuel (GWh) | 14 | 20.6 |
| 150 GWh of waste-to-energy is utilized in North Karelia | 10 | |

| | | |
|---|---|---|
| In accordance with the National Waste Plan and the Eastern Finland Regional Waste Plan, approximately 30% of municipal waste is utilized for energy, and at least 70% of construction and demolition waste is prepared for reuse, recycled, or otherwise recovered. | | |
| Hydropower production in the region: 1,000 GWh (GWh) | 940 | 765 |
| Wind power production in the region: 150 GWh | 0 | 0 |
| Solar energy production in the region: 20 GWh | <1 | <1 |
| Energy production with heat pumps in the region: 400 GWh (GWh) | 80 | 260 (Eastern Finland energy statistics) |
| Geothermal energy production: 10 GWh | 0 | 0 |
| **Community Structure and Land Use Planning** | **2008** | **2018** |
| Number of building permits for new small houses (% shares of the total): urbanized areas | 65.2 (2010) | 74.2 |
| Number of building permits for new small houses (% shares of the total): other areas | 34.8 (2010) | 25.8 |
| **Construction** | **2008** | **2018** |
| Share of population living in urban areas (%) (YKR) | 69 | 72 |
| Number of wooden apartment buildings | 0 | 7 |
| **Transport** | **2008** | **2018** |
| Number of employed persons commuting by public transport | Impossible to measure; share of the public transportation would be better indicator | Impossible to measure; share of the public transportation would be better indicator |
| Road traffic performance (million vehicle-km) (LIPASTO) | Does not distinguish power sources; difficult to calculate and separate them. On average, new cars are driven more. | Does not distinguish power sources; difficult to calculate and separate them. On average, new cars are driven more. |
| Accessibility of workplaces by public transport | Not defined | Not defined |
| Share of renewables in transport energy consumption | Existing data available, e.g., fuel sales, but it is difficult to obtain figures on how much electricity is used in transport. | Existing data available, e.g., fuel sales, but it is difficult to obtain figures on how much electricity is used in transport. |
| Fossil greenhouse gas emissions from transport (kt $CO_2$-eq.) (SYKE, hiilineutraalisuomi.fi) | 353 | 313 |
| **Forestry** | **2008** | **2018** |
| Average growth of tree stands on forest land ($m^3$/ha/year)** | 6.2 | 6.0 |
| Use of forest chips ($m^3$) | 273 000 | 350 000 |
| Forest carbon balance (million tonnes $CO_2$-eq.) (Luke)*** | | nearly 2 (2016-25) |

| **Waste Management** | **2008** | **2018** |
|---|---|---|
| Total amount of municipal waste (tons/year) | 77128 | 59673 (-23%) |
| Municipal waste disposed to landfill (tons/year) | 50057 | 0 |
| Amount of separately collected biowaste (tons/year) | 6751 | 6534 |
| Amount of biogas produced and utilized (GWh/year) | 16.3 produced<br>14.5 utilized | 24.8 produced<br>22.2 utilized |
| Number of municipal biowaste sorting obligations (number) | 11/16 ((units / number of municipalities)) | 13/13 ((units/ number of municipalities) |
| Co-incineration (tons/year) | 804 | 7517 |
| **Agriculture** | **2008** | **2018** |
| Number of farms | 2694 | 2084 |
| Number of livestock farms | 1364 | 711 |
| No. of grain and plant farms (grain + special plants + trees and garden plants) | 1330 | 1373 |
| Number of organic farms and their production area | 271 (11041 ha) | 375 (23 256 ha) |

* Monitoring has only included a survey of about 50 key renewable energy service and technology companies. Comparability has been challenging, and therefore the indicator has not been reliably trackable. Notably, renewable energy production is entirely missing.
**Figures from Luke's statistical database: VMI11 (2009–2013) and VMI12 (2014–2018). VMI11 was used for comparison, as the figures are easily verifiable; VMI10 data is not available in the statistics for the respective growth.
*** Figures from Luke's carbon balance calculation by Kari T. Korhonen, 2020

**Appendix 2: CE2030 Programme Monitoring Indicators**

| **Monitoring Indicators** | | | |
|---|---|---|---|
| **General Objectives** | **2008** | **2018** | **2028** |
| Greenhouse gas emissions in North Karelia are reduced beyond the EU's reduction target (2020) | EU -20% | 25 % | |
| Greenhouse gas emissions ktCO2e | 1671 (2007) | 1281 | |
| **Energy** | **2008** | **2018** | **2028** |
| Total energy consumption (TWh) | 10.0 | 11.8 | |
| Renewable energy consumption (TWh) | 6.3 | 7.9 | |
| Share of renewable energy in total energy consumption (%) | 62.6 | 67.0 | |
| Use of peat in heat and electricity production decreases from current levels (TWh) | 0.691 | 0.515 | |
| Renewable energy accounts for at least 25 % of transport end-use energy in the region (%) | 0 | 10.8 | |
| Energy self-sufficiency (%) | 69.7 | 64 | |
| Black liquor use: 2,500 GWh and industrial by-product energy use: 1,500 GWh (GWh) | 2400 (black liquor)<br>1300 (industrial by-products) | 3013 (black liquor)<br>1572 (industrial by-products)<br>(Eastern Finland energy statistics) | |
| Use of forest chips approx. 1 million m³ = 2,000 GWh for heat, electricity, and refined biofuels (1,000 m³) | 273 | 351 | |
| Use of firewood approx. 400,000 m³ = 800 GWh (residential wood heating) (GWh) | 700 | 632 | |
| Use of wood pellets and torrefied wood | 50 | 32 | |
| Liquid biofuels production in the region: 500 GWh | 0 | 193 | |
| Biogas production: 100 GWh for heat, electricity, and transport fuel (GWh) | 14 | 20.6 | |
| Hydropower electricity production in the region: 1,000 GWh (GWh) | 940 | 765 | |
| Wind power electricity production in the region: 150 GWh | 0 | 0 | |
| Solar energy production in the region: 20 GWh | <1 | <1 | |
| Heat pump energy production in the region: 400 GWh (GWh) | 80 | 260 | |
| Geothermal energy | 0 | 0 | |
| **Community Structure and Land Use Planning** | **2008** | **2018** | **2028** |
| Share of new single-family house building permits: zoned areas (% of total) | 65.2 (2010) | 74.2 | |
| Share of new single-family house building permits: other areas (% of total) | 34.8 (2010) | 25.8 | |
| **Construction** | **2008** | **2018** | **2028** |
| Urban population share (%) (YKR) | 69 | 72 | |

| | | | |
|---|---|---|---|
| Number of wooden apartment buildings | 0 | 7 | |
| **Transport** | **2008** | **2018** | **2028** |
| Modal share of walking, cycling, and public transport (in municipal centres), trips/person/day | - | 0.8<br>(in 2016) | |
| Share of low-emission energy sources in the vehicle fleet, % of registered vehicles | - | full electric 0.03<br>hybrid 0.23<br>biogas 0.03<br>(in 2019) | |
| **Forestry** | **2008** | **2018** | **2028** |
| Average growth of growing stock on forest land, m³/ha/year | VMI11 6.2 | VMI12 6.0 | |
| Use of forest chips (m³) | 273 000 | 350 000 | |
| Forest carbon balance (million tons $CO_2$ equivalent) (Luke) | | nearly 2 (2016-25) | |
| **Waste Management** | **2008** | **2018** | **2028** |
| Total amount of municipal waste (tons/year) | 77128 | 59673 (-23 %) | |
| Share of municipal waste incinerated (%) | 1 | 55 | |
| Municipal bio-waste sorting obligations (number of municipalities) | 11/16 ((units/ number of municipalities)) | 13/13 ((units/ number of municipalities) | |
| Co-incineration (tons/year) | 804 | 7517 | |
| **Agriculture** | **2008** | **2018** | **2028** |
| Number of farms | 2694 | 2084 | |
| Number of livestock farms | 1364 | 711 | |
| Number of grain and plant farms (grain + special plants + garden plants) | 1330 | 1373 | |
| Number of organic farms and organic production area | 271 (11041 ha) | 375 (23 256 ha) | |

## Appendix 3: Assumptions and Harvesting Scenarios in Luke's Carbon Balance Calculation

The carbon balance of the region's forests, based on VMI12 data, is built on the following assumptions:

- Forestry practices follow current silvicultural recommendations; limitations: no uneven-aged forest management
- Decisions regarding forest protection and other land uses, along with related forest use restrictions, remain unchanged during the calculation period
    - No forest management activities are applied to areas outside of forestry operations
    - On restricted forest management areas: no clear-cutting or energy wood harvesting
- Tree growth levels are assumed to remain
- Climate assumptions include the change in average temperature and $CO_2$ concentration as of 2017
- In industrial timber harvest, the amount of waste wood has been calibrated in simulations according to VMI12

Three different forest harvesting scenarios were used: maximum sustainable harvesting, actual level, and maximum net revenue:

1. Maximum Net Revenue (NT): Aims to maximize net revenue from timber production without constraints on yield or income; 5% return requirement; includes the highest immediately harvestable and economically viable roundwood and energy wood volume
2. Maximum Sustainable Yield (SY): Ensures steady or increasing harvest volumes (roundwood, sawlogs, energy wood) and net revenues; maintains initial forest value; 4% return requirement
3. Actual Harvesting Level (TH**):** Follows the actual industrial roundwood and energy wood volumes recorded in North Karelia during 2016–2018; 4% return requirement

The following assumptions apply to greenhouse gas emission calculations from forests in the carbon balance assessment:

- Emissions originate from harvesting, tree mortality, harvesting residues, and soil
- Harvest levels are based on the three scenarios: maximum sustainable, actual, or maximum net revenue
- Harvesting generates residues in quantities dependent on harvesting intensity; these decompose according to modelled assumptions, producing GHG emissions
- Tree mortality is predicted by models that primarily respond to stand density (i.e., thinning levels assumed in each scenario)
- Soil carbon sinks and emissions on mineral soils are predicted using the Yasso model, which reacts to factors such as clear-cutting area and litter input from trees; separate models are used for peatlands to estimate emissions caused by regeneration felling
- Emissions are not assumed to be constant but result from the scenario-specific forest operations
- Emissions from machinery and carbon stored in wood products are not included in the calculation

## Appendix 4: EU, National, and North Karelia Strategies and Programmes Considered in the Preparation of the Programme

International / EU Level
EU Climate Law
EU Forest Strategy
New Bioeconomy Strategy for a Sustainable Europe
EU Biodiversity Strategy (old and new)
Circular Economy Action Plan
The European Green Deal (EU climate strategy)
Just Transition Fund (JTF)

National Level
National Energy and Climate Plan 2030 (NECP)
National Energy and Climate Strategy 2030
National Forest Strategy 2025
Finnish Bioeconomy Strategy 2025
National Medium-term Climate Plan (KAISU)
National Climate Change Adaptation Plan 2022
Finnish Biodiversity Strategy - Conservation and Sustainable Use of Biodiversity
Climate Roadmap for Agriculture (MTK 2020)
The Finnish Innovation Fund (SITRA): Phasing Out Peat Use – Measures to Support a Just Transition in Finland, working paper, English summary
Carbon Neutral Finland 2035 – Scenarios and Impact Assessment (Technical Research Centre of Finland (VTT) report)
Roadmap for a Fair Transition Towards a Carbon Neutral Finland 2020
National Waste Plan (VALTSU 2023)
CANEMURE – Project
SITRA: Nordic Green to Scale for Cities and Communities

Regional and Interregional Level
The Environmental and Climate Programme for Rural Areas in Finnish Lakeland 2020–2027
Smart Specialisation Strategy for Eastern and Northern Finland 2023
North Karelia Regional Strategic Programme and Strategy, including Environmental Report
North Karelia Regional Strategic Programme 2021 Implementation Plan 2020–2021 and update for 2021–2022
Eastern Finland Bioenergy Programme 2020
Roadmap to an Oil-Free and Low-Carbon North Karelia 2040
Regional Forest Programme 2027
North Karelia Circular Economy Roadmap (published December 2018)
North Karelia Bioeconomy Growth Package North Karelia's regional strategic programme

## Appendix 5: Stakeholder Engagement and Discussions Related to the CE2030 Programme

1. Regional Council Administrative board policy decision on programme preparation, 28 October 2019
2. Sustainable Growth Forum, 29 November 2019
3. "Transport Now and in the Future" seminar, 29 January 2020
4. Establishment of the CE2030 working group by the Regional Council of North Karelia and ELY Centre, work started on 12 February 2020
5. Meetings with municipalities in North Karelia, 11 sessions from 12 February to 17 June 2020
6. Meeting of the Bio Team (Regional Council, ELY Centre bioeconomy representatives), 14 February 2020
7. First article about the CE2030 Programme in *Karjalainen*, 24 February 2020
8. Regional Council Administrative Board meeting, 24 February 2020
9. Presentation of the CE2030 Programme at climate project meeting, 26 February 2020
10. Presentation at the 1st Wood Construction group meeting, vision for wood construction, 27 February 2020
11. Puumiehet Association annual meeting, 28 February 2020
12. Info session for Regional Council staff, 10 March 2020
13. "Let's Talk About Forests" event, 11 March 2020
14. Presentation to the ELY Centre's climate forum, 17 March 2020
15. First meeting of the CE2030 Programme steering group, 19 March 2020
16. Presentation to the Expert group of the Regional Council, 25 March 2020
17. CE2030 working group meeting, 3 April 2020
18. Role of wood construction in CE2030 discussed in group meeting, 7 April 2020
19. Negotiation on rural carbon balance calculation with ProAgria / Biocode, 20 April 2020
20. CE2030 working group meeting, 24 April 2020
21. Negotiations with AgroRes project on cooperation for renewable energy roadmap, 29 April 2020
22. Negotiations with Luke / Kari T. Korhonen on regional forest carbon balance calculation, 5 May 2020
23. Continued negotiations with Biocode on rural carbon balance, 11 May 2020
24. Wood construction group meeting: wood construction's role in CE2030, 11 May 2020
25. Workshop on CE2030 objectives for Regional Council staff, 18 May 2020
26. CE2030 working group meeting, 25 May 2020
27. Presentation at the Regional Cooperation Group meeting, 27 May 2020
28. Second meeting of CE2030 Programme steering group, 28 May 2020
29. Presentation at POKAT forest bioeconomy group meeting, 1 June 2020
30. Presentation at cooperation meeting between EFI and the Regional Council, 2 June 2020
31. 1st stakeholder workshop on defining CE2030 objectives, 11 June 2020
32. Presentation to the Regional Assembly, 15 June 2020
33. Discussion with peat company on CE2030 and peat targets, 22 June 2020
34. Presentation of CE2030 at BIOEASTsUP Webinar: Planning sectoral analysis and exchange of good practices for bioeconomy value chains 9 July 2020
35. 2nd stakeholder workshop on defining CE2030 objectives, 11 August 2020
36. Finalisation of CE2030 wood construction content with the wood construction group, 13 August 2020
37. CE2030 working group meeting, 19 August 2020

38. Presentation at Strategy 2040 webinar to Regional Assembly, 25 August 2020
39. Third meeting of CE2030 Programme steering group, 26 August 2020
40. Presentation at "Eastern Finland Lives from Forests" seminar, 31 August 2020
41. Progress report to ELY Centre climate forum, 1 September 2020
42. Lecture on CE2030 at Lyseo Upper Secondary School theme day, 5 September 2020
43. Presentation to North Karelia ELY Centre management group, 7 September 2020
44. CE2030 working group meeting, 14 September 2020
45. Presentation at BioForEco project final seminar, 17 September 2020
46. Presentation at ESEIA summer school course, 17 September 2020
47. Progress report at POKAT forest bioeconomy group meeting, 18 September 2020
48. Presentation at climate project meeting, 21 September 2020
49. Fourth meeting of the CE2030 Programme steering group, 23 September 2020
50. Presentation at regional climate cooperation group, 25 September 2020
51. Strategic environmental assessment of the CE2030 Programme, 28 September 2020
52. Presentation to North Karelia rural plan steering group, 30 September 2020
53. Presentation at Strategy 2040 webinar for POKAT groups and staff, 2 October 2020
54. CE2030 Programme featured at Koli Forum board meeting, 9 October 2020
55. CE2030 Programme featured at AgroRes final seminar, 20 October 2020
56. Presentation at Eastern Finland Transport Strategy Group meeting, 26 October 2020
57. CE2030 Programme featured at ELMO Forest Bioeconomy Seminar, 28 October 2020
58. CE2030 Programme featured at regional webinar for Finland's Bioeconomy Strategy update, 6 November 2020
59. CE2030 working group meeting, 18 December 2020
60. Fifth and first 2021 meeting of the CE2030 Programme steering group, 13 January 2021