Helsinki-Uusimaa Regional Council

BIG FIVE+
Carbon Neutral Strategies of Six Regions

Publications of the Helsinki-Uusimaa Regional Council C 85 - 2018

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Esterinportti 2 B • 00240 Helsinki • Finland
+358 9 4767 411 • toimisto@uudenmaanliitto.fi • uudenmaanliitto.fi

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Abstract

The report assesses the carbon neutral strategies of several European regions in order to detect best practices and shortcomings. This is for the Helsinki-Uusimaa Regional Council, which is revising its Carbon Neutral Roadmap to reflect the target 2035 for carbon neutrality set by the Regional Council and as stated in its long-term regional development programme Uusimaa 2.0.

The regions within the scope were initially belonging to the "BIG FIVE" initiative launched by the Helsinki-Uusimaa Regional Council, namely the Stockholm County, the Free Hanseatic City of Hamburg, the North Holland Province, the Capital Region of Denmark and the Helsinki-Uusimaa Region. The Jämtland County was incorporated to the analysis since it has several points in common with the Helsinki-Uusimaa context. The following key recommendations can be extracted from the analysis.

Regarding the public process to build the climate strategy, it is highly recommended to involve all stakeholders in a genuine participatory approach when designing the strategy, but also to explore proper actions to maintain this engagement along the execution of the climate strategy. To know the interests, needs and other characteristics of the actors in the playfield of each region is important in order to design the most effective climate solutions.

Concerning the quality of the strategies as policy documents, the government who launches this kind of long-term strategy must consider which is the scope in terms of stakeholders affected and ambition of the measures. It should be clearly stated if the measures described serve as general guidelines or as a comprehensive tailored action plan and if they address just the regional government competencies or cover a wider stakeholder spectrum. The strategies must have a public budget associated for their execution and be provided with an effective monitoring and reviewing mechanisms which clearly states the roles of the different actors and the accountants for executing the strategy. Finally, the way the strategy fits as a puzzle piece with other regional, national and municipal policies should be described together with how the long-term roadmap will take the form of short-term action plans.

The strategies should contain a feasibility study about the GHG abatement potential of the measures, a cost-benefit analysis and the consideration of the socio-economic impacts. This will help to calendarize the measures and establish more accurate indicators and milestones to follow up the strategy. When describing the measures, the policy-makers should avoid generalities and focus on tailor-made measures or guidelines based on specific diagnoses of each sector covered. Depending on the specificity of measures contained in the strategy, it should be also established a specific budget, timeline, follow up indicators and responsible stakeholders.

Keywords
regional development, Helsinki-Uusimaa, Helsinki-Uusimaa Regional Council, climate smart, carbon neutral strategy

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A pdf version of the publication can be found on our website: www.uudenmaanliitto.fi/julkaisut.

KUVAILULEHTI

Julkaisun nimi
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Kuuden alueen hiilineutraaliusstrategioiden tarkastelu

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Uudenmaan liitto

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Miguel Gallardo Linacero

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Tiivistelmä

Selvityksessä analysoidaan eurooppalaisten alueiden hiilineutraalistrategioita, pyritään löytämään niiden hyviä käytäntöjä ja havaitsemaan mahdollisia puutteita. Tämä palvelee Uudenmaan liiton Uusimaa-ohjelman 2.0 mukaista, vuoteen 2035 ulottuvaa maakunnan hiilineutraaliuteen tähtäävän tiekartan laatimista.

Tarkastelun kohteena olevat alueet kuuluvat nk. "BIG FIVE" vertailualueisiin, joihin Uudenmaan ohella kuuluvat Tukholman lääni, Hampuri, Pohjois-Hollanti (Amsterdam) ja Tanskan pääkaupunkiseutu (Kööpenhamina). Lisäksi Jämtlandin maakunta on otettu mukaan tarkasteluun, koska alueella on monia yhtymäkohtia Uudenmaan kontekstiin. Selvityksen perusteella voidaan antaa seuraavat pääsuositukset.

Ilmastostrategian julkisessa prosessissa on erittäin suositeltavaa saada kaikki asianosaiset aidosti osallistettua strategian suunnitteluvaiheessa toteutusvaiheeseen sitoutumisen luomiseksi. On erittäin tärkeää tuntea kunkin alueen toimijoiden tavoitteet ja tarpeet tehokkaiden ilmastotoimenpiteiden aikaansaamiseksi.

Strategiaa laatiessa tulee huolellisesti määritellä sen sisältö, tärkeimmät sidosryhmät sekä esitettävien toimenpiteiden kunnianhimoisuus. Oleellisia kysymyksiä ovat onko kyse yleisistä suosituksista vai hyvin kattavista ja yksityiskohtaisesti toimintasuunnitelmista vai kohdistuvatko esitetyt toimenpiteet alueellisen hallinnon päätettäviin asioihin vai koskevatko ne monia eri toimijoita. Strategioita voidaan oleellisesti parantaa budjetoimalla julkista ja myös yksityistä rahoitusta eri toimenpiteisiin. Niillä tulee olla hyvät seurantajärjestelmät, jotka kattavat eri sektorit ja toteuttajat. Lisäksi tulee esittää, kuinka strategia nivoutuu osaksi alueellista, kansallista ja kunnallista suunnittelua ja miten pitkän tähtäyksen tiekartta näkyy lyhyen tähtäyksen toteutussuunnitelmissa.

Strategioiden tulee sisältää toimintasuunnitelma, jossa esitetään toimenpiteet ja niillä saatava kasvihuonekaasujen potentiaalinen väheneminen, kustannushyötyanalyysi ja sosioekonominen vaikuttavuustarkastelu. Tämä auttaa toimenpiteiden ajoittamisessa sekä seurantaindikaattorien ja välitavoitteiden määrittelyssä. Toimenpiteiden määrittelyssä tulee välttää yleistyksiä ja keskittyä räätälöityihin keinoihin ja erillisten sektorianalyysien käyttöön suunnittelun pohjana. Riippuen toimenpiteiden kohdentumisesta johonkin kokonaisuuteen, tulisi tälle osalle saada aikaan oma erillinen toteutusbudjetti, aikataulu, seuranta ja vastuulliset asianosaiset toteuttajat.

Avainsanat (asiasanat)
aluekehittäminen, Uusimaa, Uudenmaan liitto, ilmastotavoitteet, hiilineutraalistrategia

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PRESENTATIONSBLAD

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Författare
Miguel Gallardo Linacero

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Sammanfattning

I utredningen analyserar man kolneutralitetsstrategier för europeiska områden, strävar efter att hitta god praxis i strategierna samt iakttar eventuella brister. Det betjänar uppgörandet av en färdplan som siktar på ett kolneutralt landskap och sträcker sig fram till år 2035. Färdplanen stämmer överens med Nylandsprogrammet 2.0 som har utarbetats av Nylands förbund.

De områden som är föremål för granskningen hör till de s.k. BIG FIVE-referensområdena som omfattar Nyland men också Stockholms län, Hamburg, Nordholland (Amsterdam) och huvudstadsregionen i Danmark (Köpenhamn). I granskningen ingår också Jämtlands landskap eftersom området har många beröringspunkter med Nylands kontext. Utifrån utredningen kan man ge följande huvudsakliga rekommendationer.

Vad gäller den offentliga processen för klimatstrategin rekommenderas det att på ett genuint sätt involvera alla parterna i strategins planeringsskede så att de förbinder sig till genomförandeskedet. Det är mycket viktigt att känna till aktörernas mål och behov i varje område för att åstadkomma effektiva klimatåtgärder.

När man utarbetar strategin ska man omsorgsfullt fastställa dess innehåll, de viktigaste intressentgrupperna samt hur ambitiösa åtgärder man föreslår. Väsentliga frågor är om det är fråga om allmänna rekommendationer eller mycket omfattande och detaljerade verksamhetsplaner eller om de föreslagna åtgärderna omfattar sådana frågor som den regionala förvaltningen fattar beslut om eller om de berör många olika aktörer. Strategierna blir väsentligt bättre genom att anvisa offentlig och även privat finansiering för olika åtgärder. De ska ha goda uppföljningssystem som omfattar olika sektorer och aktörer. Dessutom ska man föreslå hur strategin utgör en del av den regionala, nationella och kommunala planeringen och hur den långsiktiga färdplanen syns i kortsiktiga realiseringsplaner.

Strategierna ska innehålla en verksamhetsplan som innehåller åtgärder och den potentiella minskning av växthusgaser som de medför, en kostnadsnyttoanalys och en socioekonomisk konsekvensgranskning. Det bidrar till att planera tidpunkten för åtgärderna samt till att fastställa uppföljningsindikatorer och etappmål. När åtgärder fastställs ska man undvika generaliseringar och fokusera på skräddarsydda förfaringssätt och på att använda separata sektorsanalyser som grund för planeringen. Om åtgärderna berör en viss helhet bör denna del få en egen separat genomförandebudget, tidtabell, uppföljning och ansvariga parter som genomför dem.

Nyckelord (ämnesord)
regionutveckling, Nyland, Nylands förbund, klimatmål, kolneutralitetsstrategi

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Publikationen finns i pdf-version på vår webbplats www.uudenmaanliitto.fi/julkaisut.

FOREWORD

The financial crisis beginning in 2008 is nothing compared with the challenges we are facing because of the climate change. The extent of the climate change is immense. Fighting climate change calls for so much more than we have done so far. The European Union is especially in charge and it needs to be visionary, a pre-runner in the international context. The union needs to show the way, which its member states can follow, as well as the others outside of our own continent.

Cities and areas are in the lead when it comes to fighting the climate change and adapting to it. They are the ones deciding upon many things with a direct impact on increasing or decreasing emissions. The traffic and its solutions are mainly in their hands, as they can make choices as to energy systems and decisions upon the land use as to promote climate aims. Local policies at their best make good global policies.

The Helsinki-Uusimaa Regional Council wishes to create a good circle among the areas in the report so that they could be and continue to be the best of the best in Europe and elsewhere. These areas are to be found in the top category when fighting climate change, but additional measures are called for and above all, speeding up the them is necessary. The aim of this report is to compete with each other, to learn from the best practices and to develop together.

The strategy work of the Helsinki-Uusimaa Regional Council is based on a comparison of the regions of Stockholm, Hamburg, Copenhagen and North Holland. Instead of Finnish regions, these were chosen as comparative regions, as it is more purposeful to compare the Helsinki-Uusimaa Region with these when it comes to the structure, the amount of population and other characteristics. Simultaneously, we are challenging ourselves, as we know that the comparative regions have such a high standard. The regions show such excellence that we simply need to work hard to reach the same level. Of course this goes for fighting climate change, but also for other development work.

The Helsinki-Uusimaa Regional Council states that the EIT Climate-KIC cooperation has produced a significant report. Mr Miguel Callardo Linacero, a Pioneer of Practice, has done an excellent work providing his observations in a compact report to be used for creating a road map for carbon neutrality.

This report is also used for challenging the comparative and other European regions for ambitious and goal-oriented climate actions.

Helsinki, 29 October 2018

Juha Eskelinen
Deputy Regional Mayor

ABOUT THIS REPORT

The EIT Climate-KIC is a European knowledge and innovation community, working to accelerate the transition to a zero-carbon economy. Supported by the European Institute of Innovation and Technology, they identify and support innovation that helps society mitigate and adapt to climate change. They believe that a decarbonised, sustainable economy is not only necessary to prevent catastrophic climate change but presents a wealth of opportunities for business and society.

The EIT Climate-KIC 'Pioneers into practice' course is Europe's leading professional mobility programme focused on climate change. Operating in fifteen European locations, Pioneers consists of four to six-week placement, bespoke transitions thinking and systems innovation mentoring, delivered through structured workshops and online training. Professionals from industry, small companies, universities, research institutes and local government, as well as non-profit and public organisations, are welcome to apply.

The Pioneers programme funded the author's placement in the Helsinki-Uusimaa Regional Council to undertake the project "Comparison of Carbon Neutral strategies of the Helsinki-Uusimaa peer regions". The project is framed within the Helsinki-Uusimaa Regional Programme 2.0 which states a carbon neutral goal in the region to be accomplished by 2035. It serves as a background report for the Carbon Neutral Roadmap envisaged in the Regional Programme 2.0.

In addition, the report will be useful to the BIG FIVE initiative, a strategy launched by the Helsinki-Uusimaa Regional Council to cooperate with peer regions of the EU which confront similar development challenges, since one of their shared goals is to achieve low carbon economies.

1. INTRODUCTION AND SCOPE OF THE WORK

In order to achieve carbon neutral societies in 2050, the shift from fossil-based sources to renewable energy sources must be of 100%[1]. This means that incremental changes like increasing the efficiency of internal combustion engines or using less carbon-intensive fuel such as natural gas are no longer a suitable solution. The objective to become a carbon neutral region in 2035 fits in this statement. The Exponential Action Roadmap[2] published during the Global Climate Action Summit of San Francisco states that, in order to stay under a 1.5°C global warming scenario, it is possible to achieve the emissions peak by 2020 (at the latest) and halve emissions by 2030 just with current technologies. The Climate Strategy of the Helsinki-Uusimaa Region is more ambitious: it means that the management of systemic innovation is needed in order to turn the region in the front-runner of the socioeconomic transition worldwide.

This research aims to provide the Regional Council with the background information comparing how different regions are tackling carbon neutrality challenge, with special focus in the peer regions of Stockholm County, Capital Region of Denmark, North-Holland Province and the Free Hanseatic City of Hamburg. The outcomes will be the detection of shortcoming and best practices in their regional strategies, allowing them to review and improve their carbon neutral long-term policies.

In each strategy, several sections were analysed. First, general information about the region and its Green House Gases (GHG) emission inventory. Second, a brief description of the carbon neutral strategy quality. Third, the clarification of the carbon neutral target and possible intermediate milestones of the strategy. Finally, the approaches that the strategy envisages in different sectors like transport and energy production. The main highlights of each strategy are displayed at the end of each section.

The analysis undertaken is only focused on the long-term carbon neutral strategies. In other words, the assessment is circumscribed to the policy documents detailing the carbon neutral goals and the background report linked to them. Hence the quality and facts related to other climate and energy strategies/policies/measures of the regions are out of the scope.

1 Dahal K, Niemelä J. Initiatives towards Carbon Neutrality in the Helsinki Metropolitan Area. Climate 2016, 4, 36; doi:10.3390/cli4030036

2 Johan Falk, Owen Gaffney, et al. Exponential Climate Action Roadmap. Future Earth. Sweden. (September 2018).

Since there is no unified terminology, different governments are using indistinctly the concept carbon-neutral to refer to different types of objectives. This leads to different conceptualisations of "carbon neutrality" as a strategy which seeks for the complete decarbonisation of the electricity production system, but that has not into its scope, e.g. transport-related emissions. Many urban carbon neutral objectives are considering the offset[3] of a percentage of their domestic emissions (nearby 15–20%) as part of their objective to achieve the net zero emissions. That is why the section "explanation of the carbon neutral objective" has been added in each regional analysis.

It should be noticed that Carbon Neutral strategies are focused on climate change mitigation measures. Climate change mitigation consists of policies and actions to cut down or prevent GHG emissions. The different bodies such as public administrations undertake regular GHG inventories to be able to quantify the amount of emissions, the sources, to be able to design adequate policies and track the progress of those policies. The body who undertakes this inventory may divide the sources of emissions in different sectors, being typical ones emissions derived from energy production (power plant and other generation sources), energy consumption (electricity consumption, direct energy consumption in district heating or industrial processes, etc.), but also from other sources such as waste management. The inventories are focused usually on domestic emissions (direct emission in the region within the scope and indirect emissions coming from purchased electricity). This means that indirect emission from consumption of goods and services, as well as from flight and boat transport, are not accounted. Neither are the Land Use, Land Use Change and Forestry (LULUCF) emissions.

3 The term "carbon offset" is a reduction in emissions of carbon dioxide or greenhouse gases made in order to compensate for or to offset an emission made elsewhere.

Figure 1. Helsinki-Uusimaa region geographic location

2. SETTING THE GROUND: THE HELSINKI-UUSIMAA REGION

The Helsinki-Uusimaa Region is home of near 1.7 million people. Out of these, a 70% (1.15 million) are concentrated in the Helsinki Metropolitan Area. The city of Helsinki has around 0.62 million inhabitants. The population proportion does not match exactly with the total GHG emissions produced since some industrial areas like the ones in Porvoo can increase a lot the emissions from a municipality regardless of the population. Its 26 municipalities occupy an area of 9440 km^2, produce the 38% of Finland's GDP with an economic system based on services (82.8% of labour force), processing (16.5%) and primary production (0.7%).

In the Helsinki Metropolitan Area in 2014, the largest sources of carbon emissions are district heating (42%), transport (25%) and electricity consumption (16%). Nevertheless, when the scope of the **GHG domestic emissions inventory** is zoomed out to the whole region, the numbers vary substantially: **district heating (36%), industrial processes and fuels (29%), transport (21%), electricity consumption (10%), waste management (2%) and agriculture (1%).** See Figure 2 for a graphical representation. The percentages are calculated in relation to the total amount of 12.1 million tonnes of CO2 equivalents[4], a 21.7% of total Finland emissions. Although the average carbon footprint per capita has been lowered from 2012 levels, the different subregions do not follow a uniform trend due to their own characteristics. For instance, Loviisa municipal emissions have remained almost the same since 1990, while Porvoo or Raasepori municipalities showed periods of increasing and decreasing since that reference date.

4 *GHG emissions inventory of the Helsinki-Uusimaa region (2015). Data available in Finnish at: https://www.uudenmaanliitto.fi/tietopalvelut/uusimaa-tietopankki/alue_ja_ymparisto/kasvihuonekaasupaastot Last visited 11/9/2018.*

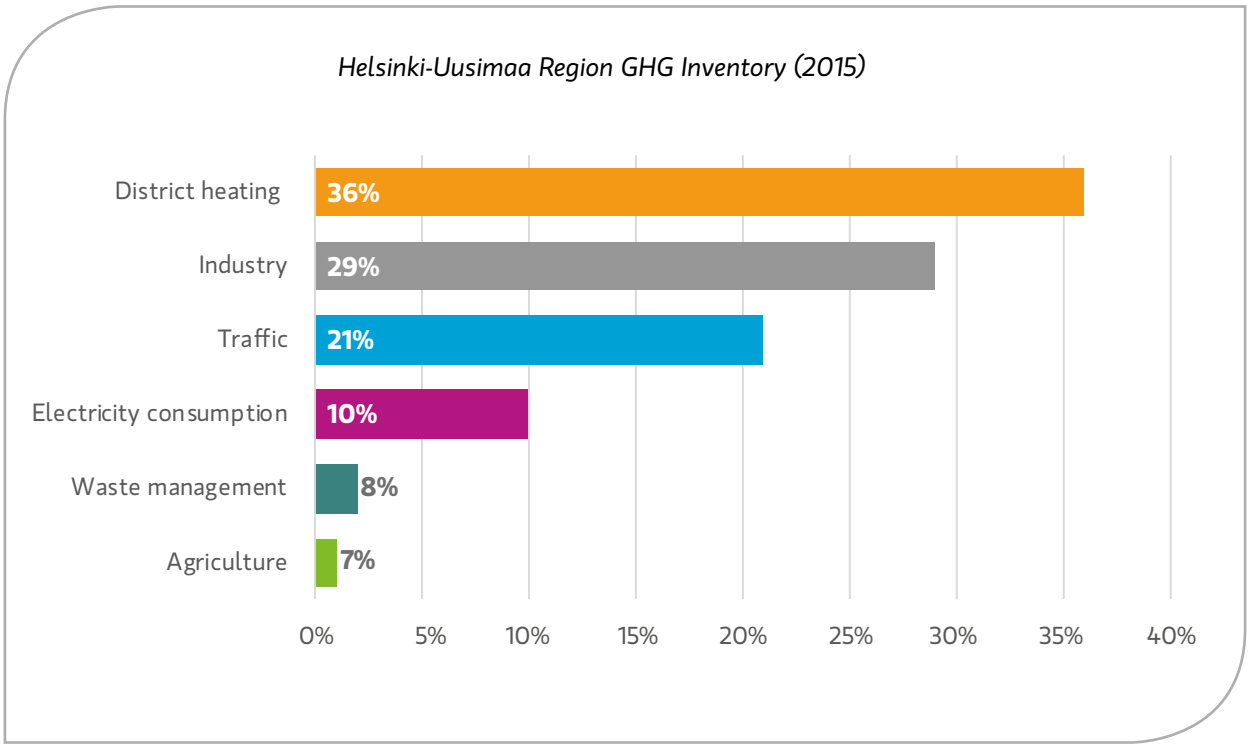


Figure 2. Graphic illustration of the Helsinki-Uusimaa region emissions inventory in 2015

Below, the main facts about the greatest contributing sectors are exposed using the Helsinki-Uusimaa Regional Council GHG Inventory of 2015.

Heating of buildings (36% of emissions)

In the region, 63% of buildings are heated by district heating, a 17% by electric heating and a 13% by oil. The district heating has high shares, especially in the Helsinki Metropolitan Area which is the area of the region with the greatest emissions due to the heating of buildings. The use of biofuels since 2012 is helping to lower emissions due to district heating. Nevertheless, the main fuels used for district heating in the Metropolitan Area are natural gas, coal and also some waste. In other areas of the region (Järvenpää, Kerava, Porvoo, Raasepori), district heating is provided by cogeneration plants that use biofuels (wood chips, mainly).

Electric heating has doubled its emissions since 1990. If the electricity mix has a high share of renewables, this can represent a reduction of GHG emissions when compared to fossil-based district heating. The contribution of electric heating is not accounted here but within the 10% of emissions in the category 'electricity consumption'. Geothermal heating has been growing during the last years, too. Fossil-based oil has slightly increased its contribution during the last years.

Electricity consumption (10% of emissions)

The Helsinki Metropolitan Area is the one with the largest share of emissions due to electricity consumption. Heating electricity consumption has remained almost steady since 2008, and the electricity consumption emissions almost halved since 2008. This emission category depends on the energy savings and energy efficiency measures, but also on the renewable share of the electricity mix in the region. Electricity is consumed by electric and geothermal heating, by households, industries, service sector and agriculture production.

Transport (21% emissions)

The Helsinki Metropolitan Area and its surrounding area are the main contributors to traffic emissions. The surrounding area is included in a logic way due to daily journeys to the capital. Railway traffic has a very reduced contribution in the total share of

transport emissions (1%). The ship transport has also a low share of emissions (7%). Road car traffic is the biggest emitter (58%), followed by other ways of road transport such as vans, buses and trucks (35%). The emission figures have been helped by the fact that the share of biofuel has increase by 8% during recent years.

Industry (29%)

The municipalities of Porvoo and Lohja are the main contributors to industrial emissions in the region, almost 90%. This category excludes electricity consumption and heating of industrial buildings. It just accounts for the emissions of industrial processes and the use of non-transport fuels. Most of the 2.8 million tonnes of industrial output in the Porvoo region were caused by the chemical industry and oil refining in Kilpilahti. The emissions from Lohja are mainly the responsibility of the Tytyri's limestone plant.

The former Helsinki-Uusimaa Region carbon neutral roadmap[5] by 2050 was focused on three branches: energy efficiency, energy production and traffic.

The Helsinki-Uusimaa Regional Council released in 2017 its Regional Programme 2.0[6] which envisaged a carbon neutral region by the year 2035. This is aligned with the municipalities of the region which have already set their own carbon neutral objectives by 2035 or even earlier (Espoo, Helsinki, Vantaa, Porvoo, Lohja, Hyvinkää, Hanko, Inkoo, Raasepori and Siuntio) and that represent an 80% of the population in the region. The Regional Programme states the creation of a Carbon Neutral Roadmap.

5 Helsinki-Uusimaa Regional Council. HIILINEUTRAALI UUSIMAA 2050-TIEKARTTA (2015) ISBN: 978-952-448-427-5 ISSN 2341-8885

6 Helsinki-Uusimaa Regional Council. The Helsinki-Uusimaa Regional Programme 2.0 – Vision • Strategic Priorities • Objectives and Measures (2018) ISBN: 978-952-448-489-3. Available at: https://www.uudenmaanliitto.fi/en/development_and_planning/regional_programming/helsinki-uusimaa_regional_programme_2.0

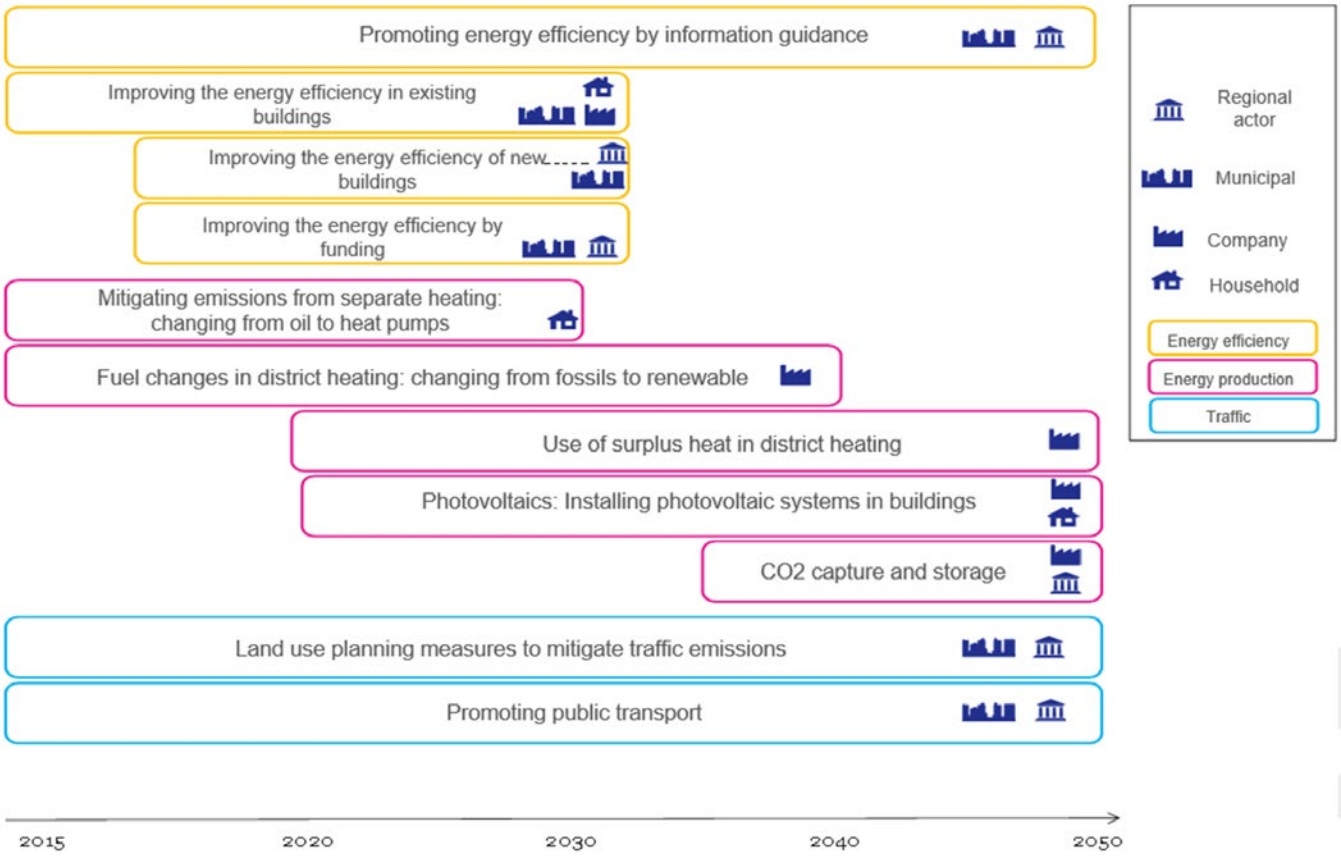


Figure 3. Scheme of the former Helsinki-Uusimaa Carbon Neutral Roadmap 2050

The specific measures which the Regional Programme 2.0 contains related to climate change can be found below.

1. Start drafting a new carbon neutrality roadmap in 2018, defining a more detailed and realistic goal and aiming to achieve it in 2035.
2. Promote production of low-emission and renewable energy, also bearing in mind sustainable bioenergy and the potential of waste heat.
3. Enable the production of solar energy in suitable buildings and land or water areas, with special attention to areas poorly suited to other uses.
4. Look for means to increase the flexibility of the solar energy market.
5. Promote adoption of automotive technology based on renewable energy and low emissions.
6. Ensure that the regional land use plan and municipal land use planning, as well as the transport policy decisions of the Government, the regional state administration and local authorities promote opportunities to use public transport and other sustainable modes of mobility, by creating a more compact community structure and developing urban settlements supported by strong public rail transport in particular.
7. Support the use of renewable fuels, construction of charging stations for electric cars and sustainability in the procurement activities of businesses and the public sector.
8. Diversify housing production and increase the provision of affordable housing, encourage local authorities to offer property developers and construction companies opportunities to try out new concepts which also strive for carbon neutrality. The new concepts must be systematically assessed.
9. Identify the potential of existing building stock and valuable building heritage in reducing CO_2 emissions in construction and encourage renovation based on sustainable methods.
10. Steer public procurement to sustainable choices. It can lead the way to create a market for responsible commercial services and products.
11. Support initiatives from the Helsinki-Uusimaa Region that promote eco-efficiency and responsibility, from early education onwards.
12. Support cooperation between local authorities, research and development institutes and companies to develop housing estates, business premises and working environments into modern and functional entities in the spirit of sustainability.

Elaborating on the last twelfth measure, one of the main weaknesses detected by Dahal and Niemelä (2016)[7] regarding Carbon Neutral strategies is that there is a lack of cooperation between cities and regional bodies when addressing climate change, and also the level of commitment is not the same. This can hinder the effectiveness of the regional carbon neutral strategy. Therefore, the role of the Helsinki-Uusimaa Regional Council as an integrating actor is needed to provide the municipalities with the adequate action framework and support to jointly address climate change mitigation in the region. The municipalities and the state government will be the final executioners of most measures, but the Regional Council can play a crucial role to enable the conditions for a synergic and coordinated effort of the municipalities.

7 Dahal K, Niemelä J. Initiatives towards Carbon Neutrality in the Helsinki Metropolitan Area. Climate 2016, 4, 36; doi:10.3390/cli4030036

3. BENCHMARK REGIONS

The Helsinki-Uusimaa Regional Programme 2.0 points out the primary European reference regions, which are the Stockholm County, the Capital Region of Denmark (incl. Copenhagen), North Holland (incl. Amsterdam), and Hamburg. Therefore, the analysis has been focused on these peer regions of interest, as well as in other regions across the world which have carbon neutral objectives in a time-bound similar to the Helsinki-Uusimaa Region carbon neutral goal in 2035.

3.1. STOCKHOLM COUNTY (SWEDEN)

Sweden is divided into 21 counties. The Stockholm County covers an area of 6519 km² and is the most densely populated region of Sweden with more than 2.2 million inhabitants and 26 municipalities. The County Administrative Board coordinates regional efforts to achieve the national energy and climate goals (carbon neutrality by 2045). The main emitters are road traffic and domestic energy consumption. These are the key sectors to keep reducing emissions further than the current 28% reduction since 1990 levels. The Climate Roadmap 2050 for the Stockholm County is the main document which, in line with the latest national and regional policies and strategies, establishes the framework for climate work in coming decades. In a general policy level, the Climate Act (2017:720) is the law containing the climate policy guidelines. The climate strategy of the Stockholm County is interrelated to the regional development plans[8] and cross-cut other sectoral policies.

The direct GHG emissions were accounted as 6 million tonnes in 2014. According to the Roadmap, transport (49%) and built environment[9] (41%) are the main contributors to climate change in the region, followed by industry (8%), agriculture (0.5%) and electricity distribution losses (1.5%). The current renewable energy share for energy production in Sweden in 2015 was 82%. The annual energy consumption per capita in 2014 was 22.4 MWh. The low amount of emissions of the Stockholm County in comparison with the Helsinki-Uusimaa Region is significant: 2.7 tonnes CO_2 eq. per capita in Stockholm against 7.6 tonnes CO_2 eq. per capita in

8 The RUFS2050 is the regional development vision for 2050 for the Stockholm County. Website: http://www.rufs.se/rufs-2050/

9 Built environment is the infrastructure of cities and towns that includes transportation facilities, roadways, buildings, and land-use.

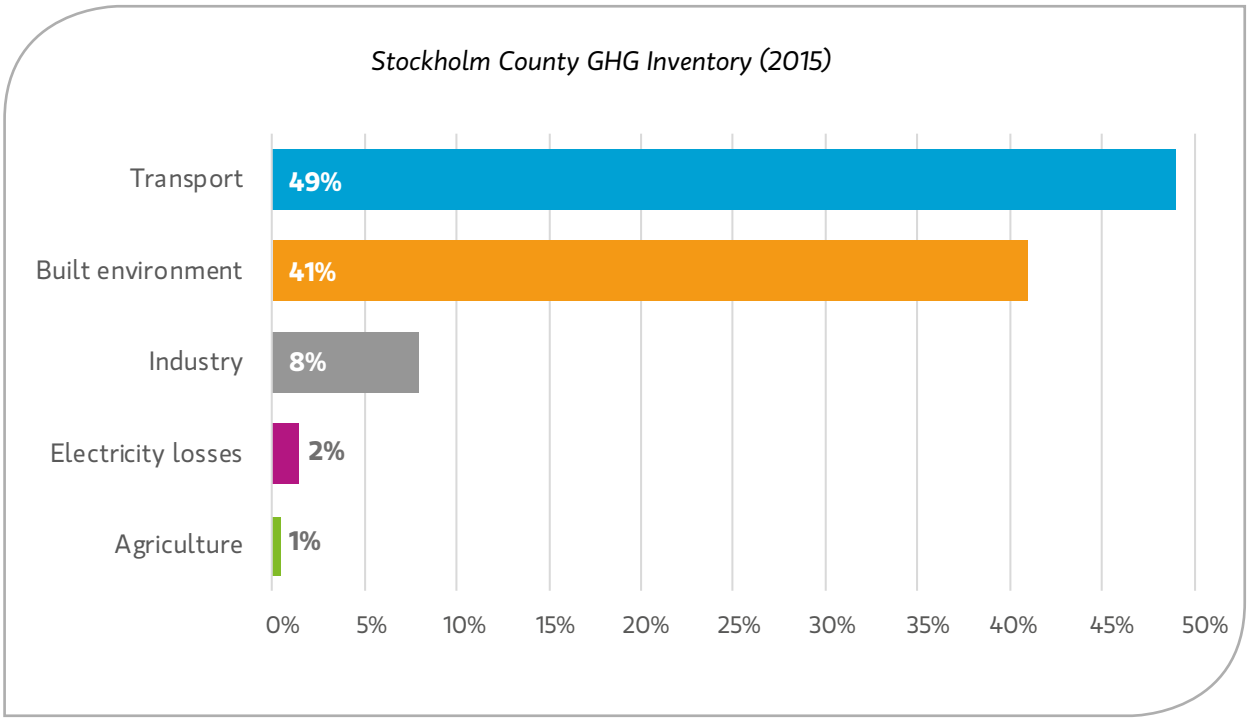


Figure 4. Stockholm County domestic GHG emissions inventory in 2014

the Helsinki-Uusimaa region. The reasons could be: the Stockholm region has experienced a reduction in the industrial (energy intensive) activity in benefit of the service sector and has delivered an outstanding work to increase the renewable sources for energy consumption in the building sector (a 50% of the fuel mix for district heating is based on biofuels). Although the County imports near 90% of electricity, the national production sources are mainly renewable (hydropower plants) and nuclear.

Quality of the strategy

- The Climate Roadmap 2050 describes how it is part of a bigger long-term regional planning process in the region, the RUFS 2050. And how it is built upon previous policy documents like RUFS 2010, County's Energy and Climate Strategy 2013 and other municipal strategies. This intimate link with the regional development and land-use planning strategies is a great asset of the strategy.
- As part of this process, the Climate Roadmap 2050 has counted with the relatively participation of stakeholders (100 answers), but just one consultation in 2017 is mentioned. It is considered that, for a proper and useful consultation process, several consultation / interactions with stakeholders should be performed.
- The main objective of the Roadmap is to provide a knowledge-base to serve as guidance for the regional and local climate-related initiatives.
- The RUFS webpage provides information on the different parallel processes, policy documents and analysis in which the Roadmap relies on. An extensive background report is also available[10]. It is in this last document where the specific measures are listed, classified, allocated in a time frame and assigned to some accountant stakeholders.
- The regional roadmap establishes a long-term goal for 2045 together with the pertinent milestones in 2030 and 2040 for different sectors and indicators, enabling a higher quality monitoring and planning of the strategies. Besides, the 2045 target is clearly explained, and it is mentioned that carbon compensation measures will be implemented to achieve the net-zero emissions scenario in which the real reduction of domestic emissions will be of 85%. However, the specific measures for carbon offset are not described, neither when they will be implemented. This is a minor shortcoming.
- The roadmap measures are not just focused in domestic emissions sectors, it also addresses indirect emissions as food consumption and food waste, circular economy and waste management and public procurement.
- The importance of regional stakeholders' cooperation to achieve targets is emphasized.
- Implementation reviews to two different bodies are appointed. The general monitoring is linked to the overarching RUFS 2050 process (the long-term regional development plan).
- The need to link the Climate Roadmap to the Stockholm County's objectives and budgets is stated.
- The document explains in a general way the role of the County Council and other stakeholders such as Greater Stockholm, local authorities, Regional Transport agency and businesses.
- Cross-cutting issues such as R&D and ICT innovations are mentioned as key levers of the transformation.
- The importance of cost-benefit analyses and risk assessment to choose the best practices to be implemented is highlighted. However, there are no explicit measures to ensure a smooth and fair transition where social and environmental impacts are assessed (energy poverty, job loss, etc.). This is a shortcoming.

10 Available at: http://www.rufs.se/globalassets/h.-publikationer/2018/klimatarbetet-i-stockholmsregionen.pdf

The carbon neutral objective

The net-zero emissions goal by 2045 stated in the Stockholm County's roadmap is referred to the sum of direct energy consumption and other direct emissions, and emissions from imported electricity. The offset measures, both within and outside the region, are accounted as negative items which contribute to the emission goal.

Table 1. Stockholm County's carbon neutral targets

Year	Milestone	Indicator
2030	Non-ETS[11] sector reduction	63% reduction from 1990
2030	Reduction of domestic transport emissions	70% reduction from 2010
2030	Total annual emission rate	3.3 million tonnes eq.
2030	Regional energy production	100% renewable*
2030	Annual energy consumption per capita	Below 16 MWh
2040	Non-ETS sector reduction	75% reduction from 1990
2045	Non-ETS sector reduction	85% reduction from 1990
2045	Total net-zero emissions	100% reduction from 1990

11 European Trading System (ETS) is the EU policy to combat GHG emissions cost effectively based on the 'cap and trad' system which covers the energy intensive sectors and the airlines operating in EU countries. More information available at the European Commission website: https://ec.europa.eu/clima/policies/ets_en

** without the peak load of the county's thermal, cogeneration and backup power. The peak load capacity secures the supply security of electricity in situations of the power system where the planned electricity procurement is not sufficient to cover the anticipated electricity consumption.*

Measures envisaged

The official roadmap 2050 document states slightly the type of measures to execute, without properly describing the types of measures, responsible entities for execution or the objectives. The "Background report to the climate roadmap 2050 Stockholm" offers more information. However, it does not contain any development on the specific measures listed per each sector.

Regarding what the Stockholm County is doing in the short-term, the Climate and Energy Strategy of the County Administrative Board was published in 2013[12]. It revolves around transport and travel, energy in buildings, energy production, land use planning, consumption and capacity building. Several reports dealing with these specific issues can be found in their public repository[13].

12 Stockholm County Administrative Board. Rapport 2013:8 Klimat- och energistrategi for Stockholm län (2013). Available at: http://extra.lansstyrelsen.se/energi/SiteCollectionDocuments/Regionala%20strategier%20och%20energibalanser/Stockholm/Klimat-och-energistrategi-Sthlm-WEBB.pdf

13 Available at: https://www.lansstyrelsen.se/stockholm/tjanster/publikationer.106.1dfa69ad1630328ad7c4ad6.html#query/%3A**

In summary, the approach followed by the Stockholm County is the following.

Energy

- Reduce the **electric system** base-load by increasing the integration of electricity production sources, storage technologies and smart management of the power system.
- The incentives for **decentralised electricity production** in the public and private built environment are pointed out. In this sense, aids for acquiring **photovoltaic (PV) panels** is expected and the inclusion of them in all new and retrofitted[14] buildings.
- Public support of a bio-based energy market through procurement for transportation and energy consumption and development of bio-clusters.

Transport

- **Electrification of road transport.** Regarding car passenger transport, the need of deploying massively a charging infrastructure and the support for carpooling and light electrified vehicles options is stated. The use of electric buses and the electrification of the freight transport fleet is also mentioned.
- The zoning of city areas in urban planning to ban certain types of vehicles and charged vehicle parking lots are depicted as measures to reduce **passenger cars** traffic, together with tax-related practices to charge vehicles emissions. At the same time, the optimisation of freight transport with 'City Logistic Areas' is envisaged. To promote **public transport,** several measures are recommended, such as: ICT integration of the different modalities, general investment in the sector, improvement of public transport network capacity, range, security and accessibility, creation of new transport facilities, extension of city bike infrastructures, new solutions for rural areas and tax incentives for companies to encourage the employees' usage of public transport.
- Regarding **freight transport**, several approaches are taken into account: fossil-free freight vehicles and the associated charging and refilling facilities, new logistic models which are climate-friendly, digital solutions for better integration and efficiency, inclusion of criteria in public procurement, multimodal logistic centres, shift towards rail freight transport, highway corridors and taxation of heavy fuel vehicles.

Buildings

- Advance towards **near-zero emissions (NZE) buildings** by new buildings standards and retrofitting of existing ones.
- Make use of figures such as energy **certificates** for buildings and districts and energy **declarations**, etc. The subsidise of building retrofitting solutions linked to the national ROT (Renovation, Remodelling, Extension in English) programme is mentioned. The ROT programme is a stimulus program for the construction industry in Sweden in the form of tax breaks.
- Increase **energy efficiency** with detailed plans. Apart from certificates and energy declarations, smart lighting in public spaces is mentioned.
- Regarding **district heating**: the integration of the different district heating networks is recommended. Also, to increase the share of waste heat recovery from sources such as industrial systems or waste incineration and set up smart management systems is advised.

International bunkers

- Knowing this is one of the sectors where the County has less capacity to influence, the Stockholm County bases its action in advocacy work to convince global companies to reduce the number of **business trips** (virtual meetings instead), create partnerships to promote **close tourism** destinations and the use of less carbon-intensive **transport** such as train instead of plane. Regarding **shipping**, the incentive of fuel reduction measures undertake by companies and speed limitations in waterways and harbour areas are mentioned.

14 Retrofitting refers to the addition of new technology or features to older systems.

Industry

- To increase **industry efficiency** the advancement toward industry 4.0 concept, R&D efforts and a higher implementation of the industrial symbiosis concept are encouraged. **CO_2 capture and storage** at pilot and full scale are mentioned, but the absence of the CO_2 utilisation concept is remarkable since the viability of captured CO_2 upgrade into valuable marketable products is a key lever.

Agriculture

- The introduction of **biofuels**, the sustainable management of silviculture[15] and agriculture as **carbon sinks** and the gas separation of **methane** from livestock facilities are the measures envisioned for this sector. The inclusion of **climate-friendly criteria** in the grant of public land for farming activities is mentioned, too.

Highlights

- The Stockholm County is a region less carbon-intensive than Helsinki-Uusimaa, with less contribution of the industry and a greater share of renewables in energy consumption, both in building heating and electricity generation.
- The Climate Roadmap 2050 and its Background Report have high quality when setting the policy context and the parallel work of the county in the regional planning are, explaining clearly the link with the Climate Roadmap.
- The Roadmap provides clear milestones and targets, together with the appointment of a general monitoring and review framework which ensures a high quality of implementation. In the background report, the carbon reduction is clearly quantified per sector.
- In the industry and agriculture sectors, the focus is on greater efficiency rather than on the support of radically different and environmentally friendly business models. For instance, the support to expensive Carbon Capture and Storage (CCS) projects is envisaged, instead of supporting a shift in the industrial activities to less carbon-intensive ones. The lack of support for less carbon-intensive farming practices which are extensive instead of intensive, organic-based and integrated with local systems in a circular scheme is evident in this strategy.
- The indirect emissions are addressed as part of the strategy, although they are not accounted in the carbon neutral objectives. Nevertheless, the measures are quite generic. Ambitious educational and awareness activities oriented toward all stakeholders are missing.

15 *Silviculture is the practice of controlling the establishment, growth, composition, health, and quality of forests to meet diverse needs and values.*

3.2. JÄMTLAND COUNTY (SWEDEN)

The case of the Jämtland county is interesting since they have a carbon neutral goal even more ambitious. The region aims to become fossil-fuel free and achieve a GHG reduction of 100% by 2030. So far, this is the EU region which plans to achieve faster carbon neutrality understood as net-zero emissions.

Jämtland is home of 112 000 inhabitants and its territory occupies 34000 km². It is a low-density province, being the biggest city Östersund with nearby 50000 residents. The GHG inventory of the region in 2016 indicated that transport is the largest contributor (52%), followed by agriculture (17%), machinery (16%) and energy production (9%). Why is the Jämtland County a potential asset of interest for the Uusimaa region? Their sprawl distribution of population and transport-related emissions are the main climate challenges. Therefore, the solutions that the County might develop are interesting for the Helsinki-Uusimaa Region, which also has sprawl areas and a great share of transport emissions.

Quality of the strategy

The Jämtland region has stated the carbon neutral goal in 2030 contained in the County Council 2018–2024 Climate Strategy[16]. The main highlights of this strategy are the following.

- The strategy foreword adequately addresses the energy transition as a growth opportunity of the region.
- The Climate Strategy is depicted as a base document until an Action Plan is released in 2019. It is supposed to have the role of describing the main goals and strategic steps.
- The strategy clearly identifies the areas of action and links all the important regional plans and other related documents.
- The strategy states the County Administrative Board as the main responsible for the development of the strategy and its action plans, which will be also in charge of the monitoring of actions and stakeholders, evaluation and review.

16 *Jämtlands län. Diarienummer 424-1426-2018 Klimatstrategi Jämtlands län 2018-2024 (2018). Available at: https://www.lansstyrelsen.se/download/18.2e0f9f621636c84402717aed/1527680094090/Klimatstrategi%20J%C3%A4mtlands%20l%C3%A4n%202018-2024.pdf*

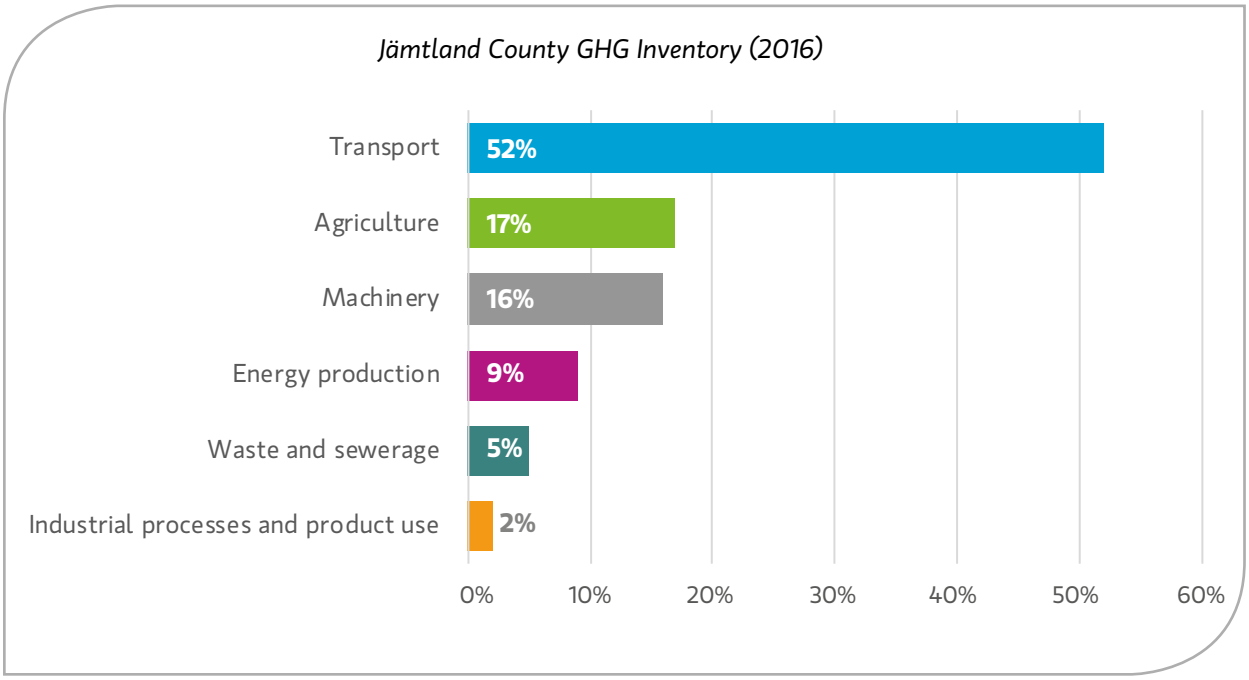


Figure 5. Jämtland County domestic GHG emissions inventory in 2016

- Information about the construction process of the strategy is missing both in the document and the County's webpage. Nevertheless, it can be confirmed that the Climate Council of the Jämtland County was involved in a participatory approach.

The carbon neutral objective

The region aims to become carbon neutral in 2030 by achieving a 100% reduction of GHG emissions and 100% share of renewable energy. The country is currently an exporter of renewable electricity: it exports 6 times what it consumes.

Measures envisaged

The Climate and Energy Strategy of the County has been planned for the period 2018–2024. The measures revolve around three axes: collaboration & learning, energy and climate adaptation. The third one is out of the scope of this analysis.

Collaboration and learning

The county has created in 2015 the Climate Council of the Jämtland County[17] to encourage the cooperation of different stakeholders as industry, NGOs and public administrations. In this permanent structure, the County Council is able to plan, monitor and execute all the climate actions together with the stakeholders. The Climate Council wants to design and anchor the overall direction of regional climate work, assess strategic and prioritized climate activities, as well as identify the driving forces, obstacles, vulnerabilities and opportunities in the county's climate coordination, energy conversion and climate change.

The County has detected that the indirect emissions owed to consumption were increasing while domestic emissions are decreasing. In order to reduce this externalisation of the environmental impacts of Jämtland inhabitants, several activities are envisaged: raise awareness in education areas and among the consumers, include sustainability criteria in public procurement, promote consumption of local products and implement monitoring methods and indicators to better follow up the impacts.

17 *Website: http://www.klimatradz.se/*

Table 2. Jämtland County's carbon neutral targets

Year	Milestone	Indicator
2024	Reduction of GHG emissions	50% reduction from 1990
2024	Energy efficiency	30% improvement from 1990
2024	Renewable energy exports	Increase 25% from 2012
2030	Reduction of GHG emissions	100% reduction from 1990
2030	Fossil-free energy	100%

Energy

Since the county is already an exporter of renewable electricity, the measures are mainly focused on reducing transport and energy consumption emissions. The goal is to increase the use of biofuels in vehicle fuel blends and to deploy a charging structure for electric vehicles under the scope of the Green Highway project[18]. This is a cross-national project between Sweden and Norway: a green corridor to transport people and goods by road, train or sea with zero-emission electric technologies.

The increase of energy efficiency in the transport sector are to be achieved by means of fleets renewal and public transport promotion, improved and coordinated management of freight transport and the transport shift from road to rail transport. However, no measure regarding a shift on how transport is used has been envisaged so far.

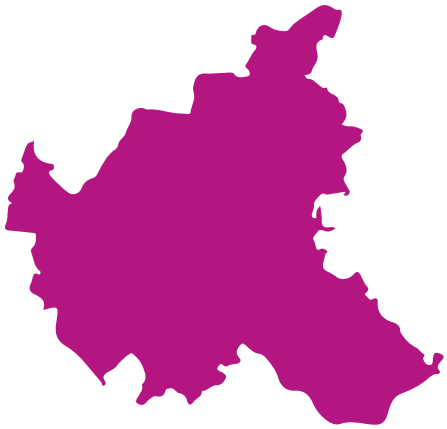
To increase the share of renewable energy production, the County expects to reinforce the existing wind generator farms, PV panels in urban environments (1 m² of panel surface per person) and new biofuel production plants in the region, with plenty of biomass feedstock available.

18 *Project website: http://www.greenhighway.nu/*

Highlights

- Although the strategy starts mentioning the sprawls urban structure of the County, no specific measures to address transport in these areas are described.
- The gender dimension has been included in the strategy. This is a very positive fact of the strategy since this issue is not addressed in other strategies. Nevertheless, the analysis of other societal facets is still missing.
- The strategy in which the County involves stakeholders in a permanent structure, the Climate Council, is smart. It can help to involve actively key stakeholders in the design and implementation of climate action measures.
- The structure of the Jämtland County strategy is divided into cooperation measures, giving a strong role to these measures which are not addressed deeply in other regional documents, and energy measures focused on the two main priorities, transport and energy consumption.
- The measures also comprise indirect emissions, since the strategy recognises the responsibility of the County's consumption in the global GHG emissions. Environmental education, awareness and promotion of local, less GHG-intensive products are encouraged. This is positive in the strategy, although it could be far more extended.

3.3. HAMBURG (GERMANY)



Hamburg is a city-state located in the Federal Republic of Germany. There is no division between city and state levels regarding administrative tasks. It is the second largest city in Germany, with more than 1.8 million inhabitants and an area of 755 km².
The Hamburg Metropolitan Region spreads out into the neighbouring states of Lower Saxony, Mecklenburg-Vorpommern and Schleswig-Holstein, representing an area around 30000 km² and more than 5 million inhabitants. The Metropol Region Hamburg is the interstate body which coordinates the different spatial development plans. Within this cooperative body, there are working groups dealing with settlement, traffic, nature conservation and local recreation. However, no official joint document addressing climate change has been published by the Metropol Region Hamburg so far.

Regarding the city-state, the Climate Action Master Plan (2013)[19] is the main document addressing climate change mitigation. It states a goal of at least 80% reduction of GHGs by 2050, 40% by 2020 and 50% by 2030. This plan was later developed in 2015 to the Hamburg Climate Plan[20]. This document states qualitative objectives for 2050 for all climate-related sectors and establishes the goals and measures to address the issue until 2030.

19 BÜRGERSCHAFT DER FREIEN UND HANSESTADT HAMBURG. Drucksache20/8493 Masterplan Klimaschutz – Zielsetzung, Inhalt und Umsetzung (2013). Available at: https://www.hamburg.de/contentblob/4356136/7601507cdff399f1d9a7434b8a2a3a78/data/d-20-8493-masterplan-klimaschutz.pdf

20 BÜRGERSCHAFT DER FREIEN UND HANSESTADT HAMBURG. Drucksache 21/2521 Hamburger Klimaplan (2015). Available at: https://www.hamburg.de/contentblob/4658414/b246fbfbbf1149184431706972709508/data/d-21-2521-hamburger-klimaplan.pdf;jsessionid=E94C5ADCA6B34FD0E9AC9A343F59AB29.liveWorker2

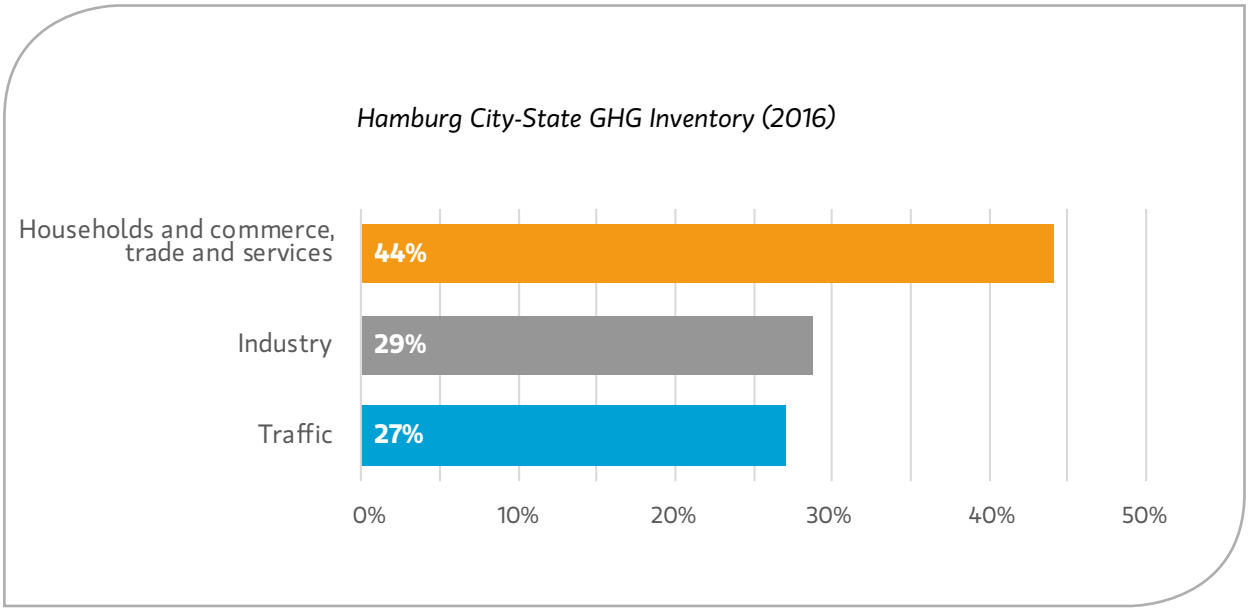


Figure 6. Hamburg City-State domestic GHG emissions inventory in 2016

Quality of the strategy

- The Hamburg Climate Plan 2015 contains methodological frameworks to achieve long-term goals. It does not only look at individual areas of actions but also to cross-sectoral strategic clusters of green economy, urban areas transformation with a neighbourhood focus, city as a model and air travelling.
- In order to achieve the goals for 2050 step by step, the approach of adaptive management is used.
- Due to the complex feedback and unpredictability of a dynamic transformation process until 2050, traditional planning methods fall short: the classical forecast method assumption of a specific situation is not enough. Instead, answers must be developed using backcasting techniques[21]. The Hamburg plan acknowledges this.
- The further developed action program 2020–2030 sets goals and measures in 14 fields of action with a focus on achieving the goals for 2050, establishing indicators and explaining ongoing projects.
- The plan has quantified the budget required to be executed and the financial sources, together with controlling, monitoring and reporting mechanisms.
- The efforts of the city-state in integrating climate action with other policies are remarkable, with initiatives such as 'Jobs and climate'[22] and 'Business for Resource Protection'[23].
- The strategy establishes indicators, objectives and measures for each sector addressed, together with a summary of the ongoing projects. This is positive.

21 *Backcasting is a planning method that starts with defining a desirable future and then works backwards to identify policies and programs that will connect that specified future to the present.*

22 *Behörde für Stadtentwicklung und Umwelt, Freie und Hansestadt Hamburg. Initiative Arbeit und Klimaschutz, Bildung und Information (2007). Available at: http://nun-dekade.de/fileadmin/nun-dekade/dokumente/Kurzvortrag_Pinnau.pdf*

23 *Unternehmen für Ressourcenschutz website: https://www.hamburg.de/ressourcenschutz/4239160/ifb/*

The carbon neutral objective

The Hamburg Climate Plan states several indicators and quantitative or qualitative objectives in different areas. The overarching climate mitigation objectives of the city are:

Table 3. Hamburg's carbon neutral targets

Year	Milestone	Indicator
2020	Reduction of GHG emissions	40% reduction from 1990
2030	Reduction of GHG emissions	50% reduction from 1990
2050	Reduction of GHG emissions	80% reduction from 1990

Measures envisaged

There are 14 individual fields envisaged in the Hamburg Climate Plan with measures and objectives established until 2030 with the 2050 long-term horizon in mind. Eight action fields are analysed here, excluding those related to climate adaptation. Nevertheless, it should be noticed the pertinence of addressing jointly the climate mitigation and adaptation measures in cities, to avoid (i) duplication of efforts and (ii) full integration of the actions to execute.

Urban development

This action field is defined as a district-focused one, linked with most of the rest of action areas. This is to test and replicate different parallel concepts in several city districts. It is planned to combine the use of sustainability standards, smart systems and renewable energies. The district of Wilhelmsburg[24] is a city flagship project to advance toward climate-adapted neighbourhoods. It deals with building retrofitting and new energy-efficient building stock, decentralised and renewable-sourced district heating networks totally integrated with industrial waste heat and renewable energy production. The city is testing decentralised energy system for electricity and heat generation using 5 different

24 *INTERNATIONAL BUILDING EXHIBITION HAMBURG. Wilhelmsburg Central Integrated Energy Network (2014). Available at: https://www.iba-hamburg.de/fileadmin/Slideshows_post2013/02_Wissen/01_Whitepaper/140719_WHI_EVWBM_english.pdf*

technologies: photovoltaics, geothermal heat pumps, combined heat and power, solar thermal energy and ventilation and air conditioning with heat recovery.

The plan also highlights the Green Roof Strategy, which is based on financial incentives, dialogue, regulation and technology. An amount of 3 million € until 2019 is dedicated to creating 100 hectares of green roofs, e.g. 60% of installation costs funded by the Government. The benefits are lower maintenance costs due to the longer lifetime of green roofs, lower energy costs due to improved building insulation and 50% reduction of rainwater fees thanks to greater rainwater retention.

Energy

The overarching objectives are to reduce consumption and increase efficiency, to reduce emissions of the heat and electricity distribution and generation systems and to increase the share of renewable energy. The specific measures planned for renewable energy are: support wind energy expansion and execute a Renewable Heat Programme, green electricity purchase and use of bio natural gas by public institutions. The last measure is being gradually implemented since 2012. Regarding district heating, energy district planning, thermal register (to represent the spatial distribution of heat demand and heat supply structures) and repurchase of energy supply networks are envisaged.

Building

Many of the measures for urban development and energy are pertinent to this section. Other measures planned are:

- Building retrofitting (insulation, HVAC[25], lighting and other energy-efficient systems) through existing support programmes. Define timetables for public buildings renovation in cooperation with the competent authorities. The renovation of public buildings aims are: (i) the energy-related modernisation will exceed the statutory standards if economically feasible, (ii) the refurbished building will have at least a 30% share of renewable energy, (iii) analyse the environmental life-cycle impacts and the life cycle costs of the renovated buildings for the next 50 years when assessing the measures to implement in the building. It is also envisaged reviewing and implementing internal contracting, also known as Intracting, as a financing and return model to finance climate-friendly, high-quality refurbishments with the help of a revolving fund[26].
- Follow guidelines for climate-adapted and efficient buildings in the area (modular construction, materials, design, etc.).

Mobility

- The plans are to keep reinforcing and expanding the cycling infrastructure. Since 2008 the city has had an ambitious plan to reach the 25% of cycling share in the city displacements[27]. The monitoring report is based on a 2-year period. Last report[28] divided cycling plans into 9 action areas: good cycling pathways and conditions, better linking of cycling and public transport, green mobility behaviour and greater road safety, develop public relations to create a better cycling acceptance, harness the potential of cycle tourism, more Service around the wheel and structures for the implementation, quality assurance and success control.
- Improve intermodal networking structures to switch among the different mobility options, including e-car sharing and cycling.
- Digitalisation and ICT support to manage traffic planning.
- For the electrification of fleets, the City Administration fleet and public companies' fleets have minimum objectives to comply with by 2020; the uptake of electric cabs in the city taxi fleet and the deployment of charging infrastructures.

25 HVAC is the abbreviation of "Heating, ventilation, and air conditioning" and it refers to the technology of indoor and vehicular environmental comfort.

26 The idea of Internal Contracting (also called Intracting) is to enable the municipality to finance multiple investments aimed at energy savings without being bound to an external contractor.

27 Hamburg city website, Radverkehrsstrategie Mit Plan zum Ziel. Available at: https://www.hamburg.de/hamburg-auf-dem-weg-zur-fahrradstadt/2995602/radverkehrsstrategie-ziele/ Last visited: October 10th 2018

28 Freie und Hansestadt Hamburg. Radverkehrsstrategie für Hamburg Fortschrittsbericht 2015. Available at: https://www.hamburg.de/contentblob/4538022/f80b2806d74a33dba4f404dd319d10ce/data/fortschrittsbericht-2015.pdf

Economic measures

50% of emissions are due to industrial and private businesses. The city climate policy addresses some private sectors separately, for instance the maritime industry and the agriculture. For businesses, in general, consulting services as well as some financial subsidies are available.

Consumption and disposal

The strategy offers green procurement guidelines. In addition, the actions recommended are oriented towards reducing air conditioner consumption, using recycled paper, strengthening awareness through ICT tools and improving recycling management.

Education

The Hamburg Government wants to reach all levels of education, from kindergarten to university, but also other training and consulting activities. The awareness will be brought by educational projects such as 50/50 energy saving and efficiency projects and, in the non-formal education level, some events, shows, energy education for low-income homes and consumer information guides, etc.

Highlights

- The clustering approach to group the different action fields can help to exploit synergies and optimise efforts. The consideration of both climate mitigation and adaptation measures can have advantages to avoid duplication of structure and efforts.
- The establishment of indicators in each field enables a good quality monitoring framework. In the case of the Helsinki-Uusimaa region, this would help to build a unified monitoring and reporting framework followed by all municipalities.
- This strategy focuses on a district approach, adapting the measures to the specific neighbourhood needs. This can enable effective and fair implementation.
- The plan allows the reader to understand how the State of Hamburg has based its strategy in testing solution at district-scale and, later on, scaling them up through city plans. The city-state has experience in the mainstreaming of new sustainable practices which could be further studied. It can also be of special interest the district of Wilhelmsburg flagship project and its district heating solutions.

3.4. CAPITAL REGION OF DENMARK, INCLUDING COPENHAGEN

With a total amount of 29 municipalities, this region of 2568 km² is inhabited by 1.8 million people. The city of Copenhagen has an ambitious carbon neutral goal by 2025 which was stated in 2012. Current objectives[29] of the Capital Region are divided into the fossil-free energy supply for electricity and heat consumption by 2035 and the complete decarbonisation of the region by 2050 thanks to a zero-emissions transport sector. The region's plan for the decarbonisation of their power system, both district heating and electricity generation, has the same time scale as the Helsinki-Uusimaa region. The report "Means on the way to a fossil-free energy and transport system by 2050" [30] is the document containing the long-term vision and strategies of the Capital Region towards a fossil-free society.

The GHG inventory of the region is characterised by large collective systems as district heating, natural gas infrastructure, public transport and business structures. Last inventory in 2012 accounted for 8.8 million tonnes of CO_2 equivalents. The emissions are distributed among the following concepts: transport (28%), heating, oil and gas (17%), district heating generation (16%), electricity supply (36%) and process heat (3%).

29 Capital Region of Denmark. Press release " Capital Region of Denmark is the first region to take global responsibility for the climate " October 16th 2016. Available at: https://www.regionh.dk/english/press-and-news/latest-news/Pages/Capital-Region-of-Denmark-is-the-first-region-to-take-global-responsibility-for-the-climate.aspx Last accessed 17th September 2018.

30 Region Hovedstaden. Virkemidler på vej mod et fossilfrit energi- og transportsystem i 2050 Sammenfattende overblik (2015). Available at: https://www.regionh.dk/miljoe/en-groennere-region/Energiomstilling/Documents/Virkemidler%20p%C3%A5%20vej%20mod%20et%20fossilfrit%20energi-%20og%20transportsystem_sammenfattende%20overblik.pdf

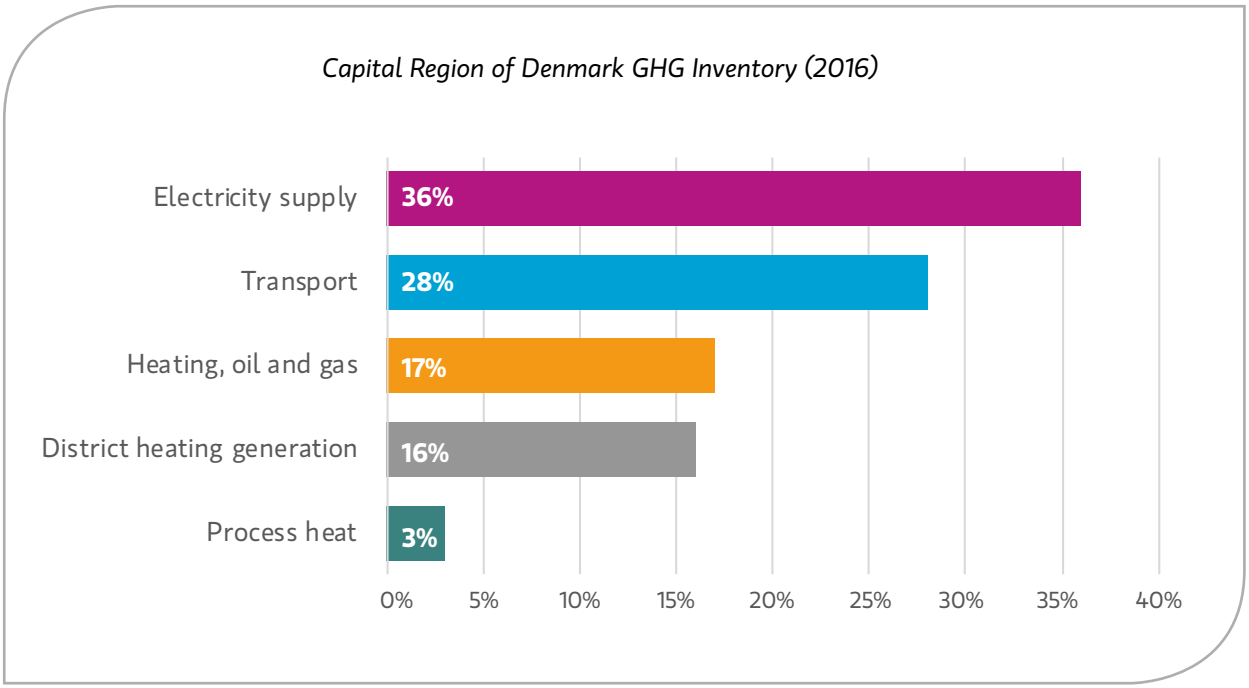


Figure 7. Capital Region of Denmark domestic GHG emissions inventory in 2012

Quality of the strategy

- The roadmap is supported by four thorough academic background analyses on the transport system, energy system, energy efficiency in buildings and energy efficiency in process industries and machinery performed by national organisations.
- An analysis of the societal consequences of the transition has been included. However, just positive effects have been depicted. There is neither definition of negative counterparts during the transition project nor specific quantification of the socioeconomic consequences of the transition.
- The document underlines the importance of stakeholder cooperation and offers a brief overview of the relevant actors in each sector.

The carbon neutral objective

The regional climate mitigation strategy aims to achieve carbon neutrality in the district heating and energy supply systems by 2035 and the complete carbon neutrality of the region by 2050. No quantitative milestones are indicated.

Measures envisaged

The roadmap divides the climate action into three areas: switching the energy system, energy efficiency and transport. Under these areas of action, there are 13 specific themes. It envisages a further focus on energy savings, increased utilization of biomass and wind power and a high degree of electrification of the heat supply. However, the strategy is not describing specific measures, but only possible paths.

Energy system

- **District heating production.** Biomass and geothermal energy facilities are exempted of taxes in Denmark. The main current district heating power sources are coal and natural gas. The shift towards renewable sources is already going on in the metropolitan area. The alternatives for district heating power generation will be based in (i) refurbishment of fossil-based CHP plants into biomass CHP plants[31]; (ii) testing activities and tax incentives expected for large electrically-powered heat pumps as complementary devices of solar and wind energy systems supplying district heating; (iii) deep geothermal energy with good prospection though its great upfront investments, supported by guarantee scheme to reduce economic risks of companies; (iv) large solar thermal plants replacing natural gas in both large and small district heating areas, though they have a limited supply share due to seasonal mismatching between the sunniest months and the colder months; and (v) seasonal and short-term thermal storage to increase cogeneration systems and the power system in general. The role of biogas remains uncertain until further decisions.
- **Individual heating.** This topic is referred to the private natural gas and oil heating sources in housing and commercial buildings. The first measure is to connect buildings with individual heating to the district heating since this last type of heating is more efficient. In the areas where this shift is not possible heat pumps are the most preferable option due to increased district heating powered by wind and solar energy. Also, wood pellets heating systems are recommended when the building is not suitable for heat pumps due to high energy requirements.
- **District heating losses and networks.** There are possibilities to improve the efficiency of the existing networks thanks to renewed pipe insulation which can improve by 50% heat loss. The next measure is to optimise the networks by monitoring, forecasting and controlling the heating supply. In addition, low-temperature district heating[32] can become a relevant instrument.

31 A CHP power plant is the one which produces Combined Heat and Power. This approach is also known as cogeneration, and it implies recovering the waste heat from the power production to provide heat in other industrial or urban areas, increasing the power plant efficiency from 45% to levels as high as 80%.

32 Low temperature district heating reduces the network supply down to near 50°C or even less. It can be applied in community buildings with low heating demands for space heating and brings the opportunity for greater efficiency and the integration of renewable energies.

- **Local production of renewable energy.** The plan is to locate renewable energy production sites in the metropolitan areas, which are then connected to the retrofitting of decentralised and centralised fossil-based power plants into bio-sourced ones. This set of measures is focused mainly on wind and solar power, although the waste heat and biogas are also under the scope. Regarding wind energy, the potential is limited to domestic wind turbines in urban areas and off-shore wind farms. These possibilities will be assessed since technology prices are about to fall by 20-30% by 2030. Biogas is referred as a source of limited potential which could use manure, crop residues, organic industrial waste, wastewater and municipal organic waste. The solar PV potential for electricity production is already known, and the scenario envisaged is that municipalities will play a starring role in the mainstreaming of rooftop PV panels.

Energy efficiency of buildings, equipment and facilities

- **Cross-cutting instruments.** A joint regional body to benchmark the performance of the different municipalities in the topic of energy efficiency in building, equipment and facilities is proposed. The joint effort of all municipalities is directed toward a common goal while monitoring their activities. Big data is seen as a tool to gather and analyse multiple data flows from building and housing register, business register and Danish Meteorological Institute. This data availability can be used in promoting energy savings, targeted information campaigns, pattern recognition and energy companies' efficiency. The region wants to use pre-agreements which help to allocate benefits of the energy efficiency investment and encourage investing. A regional body supporting energy-savings and energy-efficiency investments is envisaged, acting as an energy consultant/ resident advisor. No innovative financial measures are depicted, apart from the already known ESCO model[33]. Training programmes for regional workforce with the pertinent skills and knowledge when advising private parties and citizens already exist. They will be boosted to meet the daily updates in the sector regarding new technologies, building requirements and regulations.
- **Single-family houses.** The goal is to show the consumption levels to raise awareness. This, combined with information about energy label status, comfort and indoor climate improvements, possible property valuables and relevant energy savings proposals, with an overview of the annual energy savings, can shape an awareness information package offered through a house online portal. It would be an energy advisory service that is impartial and offered free or for a limited fee that may promote interest in initiating energy renewal.
- **Public buildings, facilities and procurement.** A benchmarking system for reporting the indoor climate and energy consumption of schools and encouraging investments in energy savings. To save up to 50% of outdoor and road lighting consumption, replacement of current old lighting systems is pointed out. Regarding public procurement, the document affirms that there is still significant potential for achieving energy savings through energy-efficient public procurement. More ambitious recommendations and guidelines will be released, together with useful tools for public procurers and capacity building programmes. There is also a potential in improving, developing and testing methods to standardize procurement requirements and formulations, public-private innovation (OPI), intelligent procurement and joint market dialogue.
- **Businesses.** Efforts in improving energy efficiency in small businesses concentrate to savings potentials in heating installation, ventilation systems and climate screens. For this purpose, the use of big data and funding instruments supported by consultancy services will be needed.

33 An ESCO is an energy service company – commercial or non-profit business – offering an innovative financing method called EPC (Energy Performance Contracting). The EPC means a contractual arrangement between the beneficiary and the provider of an energy efficiency improvement measure, verified and monitored during the entire term of the contract, where investment in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement or other agreed energy performance criteria, such as financial savings.

Transport

- **Better coordination of urban and traffic planning.** Transport infrastructures, cycleways and public transport sustainability guidelines are depicted. The strategy proposes to regulate parking standards according to public transportation availability in different areas, to promote the use of public transport, electric vehicles and cycling.
- **Joint planning for major road users.** A great number of displacements and daily commuting occur in traffic corridors. The new traffic management strategy focuses on helping to quit private vehicle mobility. A body in charge of cross-border and overall traffic coordination among different transport options is envisaged. Parking facilities will be created at the entrance of corridors. Taxes will be used to promote sustainable fuels as electricity, hydrogen and gas. The charging network will be deployed. To reduce the amount of mileage telework will be promoted. Measures such as mileage charges for road use, increased total weight for freight transport or lanes reserved for transportation will be assessed.
- **Transport and transportation of companies and workplaces.** IT opportunities for home workplaces and virtual meetings to avoid driving are promoted. Company bikes and company cars that make the commuters independent of using their own car for work are recommended. Run Green Courses for private and work-related driving are favoured as well as promoting cycling by ensuring good switch conditions and parking for bicycles. Service and repair of bicycles during the working day at the workplace are to be provided. Chargers for electric cars that allow employees and guests to use electric cars are to be deployed. The role of public authorities must be to encourage, advise and coordinate the different business initiatives, together with the improvement of collective transport systems. Several logistic projects are now being coordinated by the Danish Transport Agency (Trafikstyrelsen): digitalised freight exchanges, city logistic terminals and distribution in alternatives time schedules (evening and nights). Common to these instruments is to ensure that freight transports, especially for smaller deliveries, can be grouped together into fewer larger transports.
- **Freight transport and services.** Changing the tax structure and legislation for electric vehicles and increasing taxes on fossil fuels are prepared. Support for switching to electric vehicles and possibly biogas for the slightly heavier distribution vehicles is suggested. There may also be a need for information and behaviour campaigns on electric cars and small electric vehicles for small and medium-sized enterprises, where there may be no resources for analysing and investigating the market. Also, optimisation of the delivery services to private persons and workplaces is to be done.

Highlights

The objectives of the Capital Region of Denmark regarding building heating and energy production are comparable to the Helsinki-Uusimaa Region case since they have already stated carbon-neutral objectives by 2035.

Although there are no specific measures described, the transition paths are very oriented to the specific situation of the region. For instance, how individual heating systems are important and must be transformed to district heating or, at least, renewable sources. This is positive since on most occasions, the roadmaps state objectives which are quite general and not very tailored or well justified for the regions.

The plan to address heating systems is one of the most detailed in the strategies analysed and is a good comparison to the Helsinki-Uusimaa region since the region of Capital Denmark also starts with a coal or natural gas as main power mix for heating systems.

The energy efficiency measures highlight the financing issues, which is the key obstacle in the sector but is not addressed in most of the public strategies analysed. This is positive. The different ownerships are considered when proposing measures, something very pertinent, too.

3.5. NORTH HOLLAND, INCLUDING AMSTERDAM (NETHERLANDS)

North Holland has a population over 2.7 million and occupies an area of 2670 km^2. The largest city is Amsterdam. The province is pledged to the national objective of achieving a carbon-neutral economy by 2050. The current regional policy framework focuses on the energy transition in the short-term (Energy Policy Agenda 2016–2021) with the long-term 2050 carbon neutral goal in mind. The roadmap from 2020 to 2050 was released in 2018.

The document State of the Energy[34] is the last complete analysis of the carbon-related emissions in the region, made public in 2017 and corresponding to 2016 emissions. Transport is the main contributor to emissions (near half of them), followed by households (near 25%) and then lower shares from farming, industries and services.

Quality of the strategy

- All the documents are available at the regional North-Holland administration energy transition website[35]. This website is comprehensive when explaining the regional objectives, the current means used and future plans.
- The 2050 roadmap of the North-Holland region is among the best documents analysed: each sector is sized and described. Tailored insights are described, also mentioning which are the uncertainties, the opportunities, the

34 *ECN. Staat van de energietransitie Noord-Holland. Referentie: 5.4979 (2017). Available at: https://www.ecn.nl/publications/PdfFetch.aspx?nr=ECN-E--18-015*

35 *Provincie Noord-Holland website for Energieneutraal. Available at: https://www.noord-holland.nl/Onderwerpen/Duurzaamheid_Milieu/Energieneutraal#Gebouwde%20omgeving Last visited: October 8th 2018*

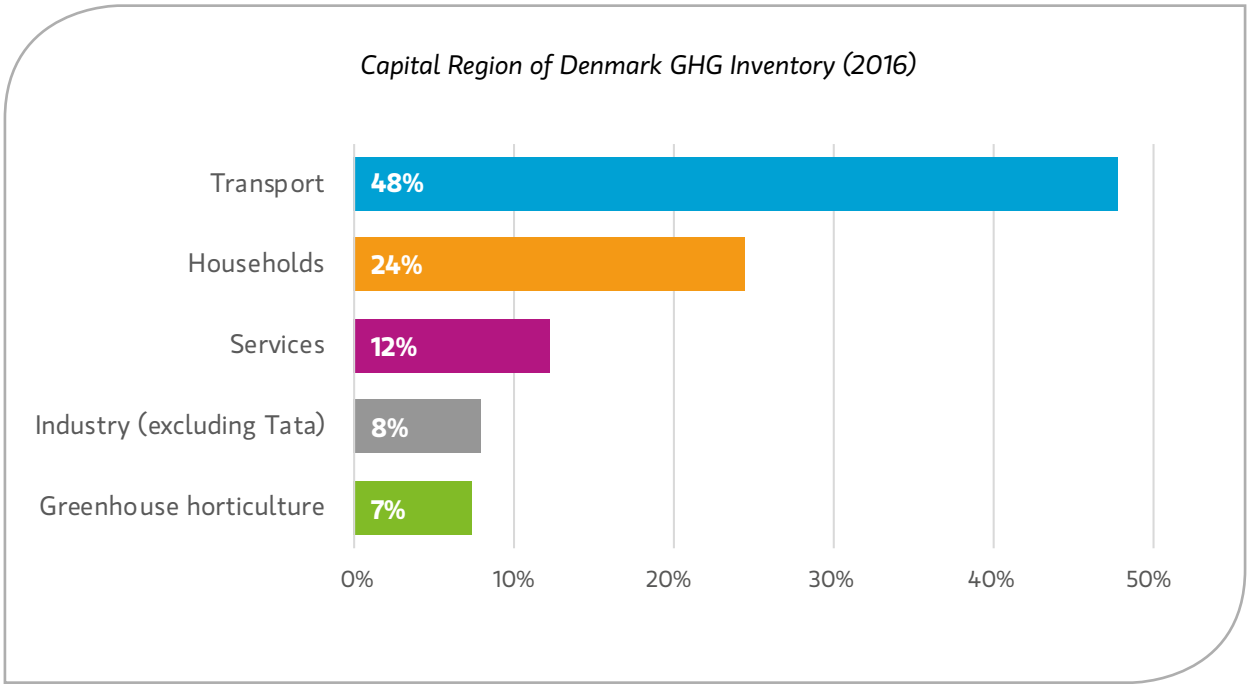


Figure 8 . North Holland Province domestic GHG emissions inventory in 2016

specific measures that the region can execute and a brief description of the timing and the stakeholders involved.

- The measures are very oriented towards the specific competencies of the regional government. The mandate from the Provincial Council of North Holland for this roadmap was to make clear which are the regional tasks to tackle, the possibilities to meet the challenge and what contribution can make the province Government by using its competencies.
- The roadmap is supported by public participation, based on several surveys and studies of different stakeholders.
- The roadmap sub-studies per sector offer further details about all the measures. They are all available in the energy transition website.

The carbon neutral objective

There is no specific objective in the plan apart from the carbon neutrality in 2050. Nevertheless, the Policy Agenda 2016–2020 mentions objectives for 2020 (21% share of renewable energy production) and 2030 (40% reduction of GHG with respect to 1990).

Measures envisaged

The 2020–2050 energy transition route map provided by the region is a very thorough document which is divided into several sectoral documents. This is the only strategy analysed which uses energy consumption (in joules) and not GHG emissions as the main reference. Actions are focused on the scope of influence of the North-Holland Government. Illustrations of the sectorial roadmaps are attached, although not explained.

Agriculture

The agriculture sector in North Holland in characterised by the predominance of greenhouses facilities. The creation of clusters is encouraged. A set of measures to use sustainable heat sources instead of CHP are envisaged: mapping current and future heat sources, make use of geothermal and residual heat and spatial policies. The greenhouses use pure CO_2. Consequently, it is recommended to investigate pipelines, co-finance the distribution, capture and purification of the CO_2, match suppliers and buyers as wells as support testing innovation projects. In Figure 9, the general transition path is illustrated.

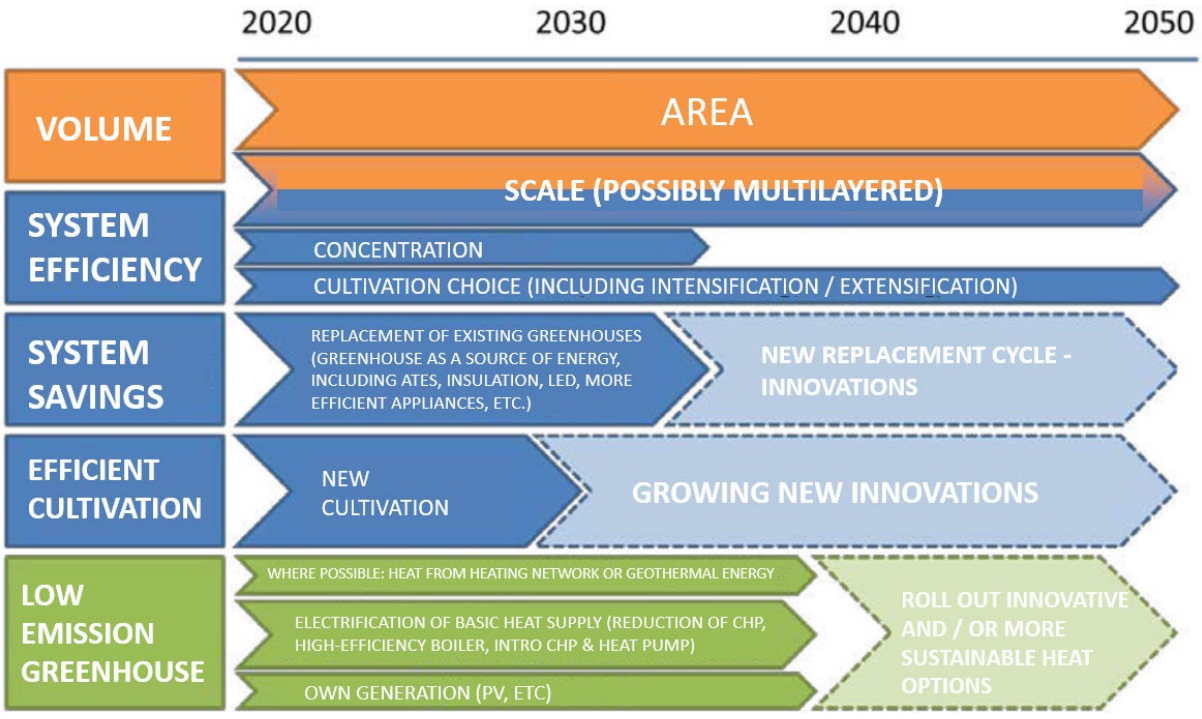


Figure 9. Expected transition path for agriculture

Transport

The regional government wants all new vehicles sold by 2035 to be zero emission, been the rest of the ICE[36] fleet gradually substituted in the years following. By 2030, the sustainable options should be economically attractive, a diversity of zero emissions fuels such as H_2, electric and bio-LNG[37] should be already available in the market and the new infrastructures ready. The main controversial point could be the use of less carbon-intensive fuels as a technology bridge. See Figure 10 with the illustrated general transition path.

The strategy debriefs a number of measures structured around reduction of traffic volume, increased transport efficiency through higher occupancy and load rates, vehicle efficiency, drivers' behaviour and reduction of CO_2 emissions. Some of the specific notions are: compact urbanisation with all city needs close in each district, environmental zoning and parking policies, modal shifts facilitated, better logistic planning and optimisation of distribution window times and efficient driving techniques supported by ICT.

36 Internal Combustion Engine (ICE) fleet is referred to all the vehicles which use the combustion of fuels to work.

37 Liquefied Natural Gas (LNG) is natural gas that hat has been cooled down to liquid form for ease and safety of non-pressurized storage or transport. Bio-LNG refers to LNG obtained from renewable biomass sources instead of fossil ones.

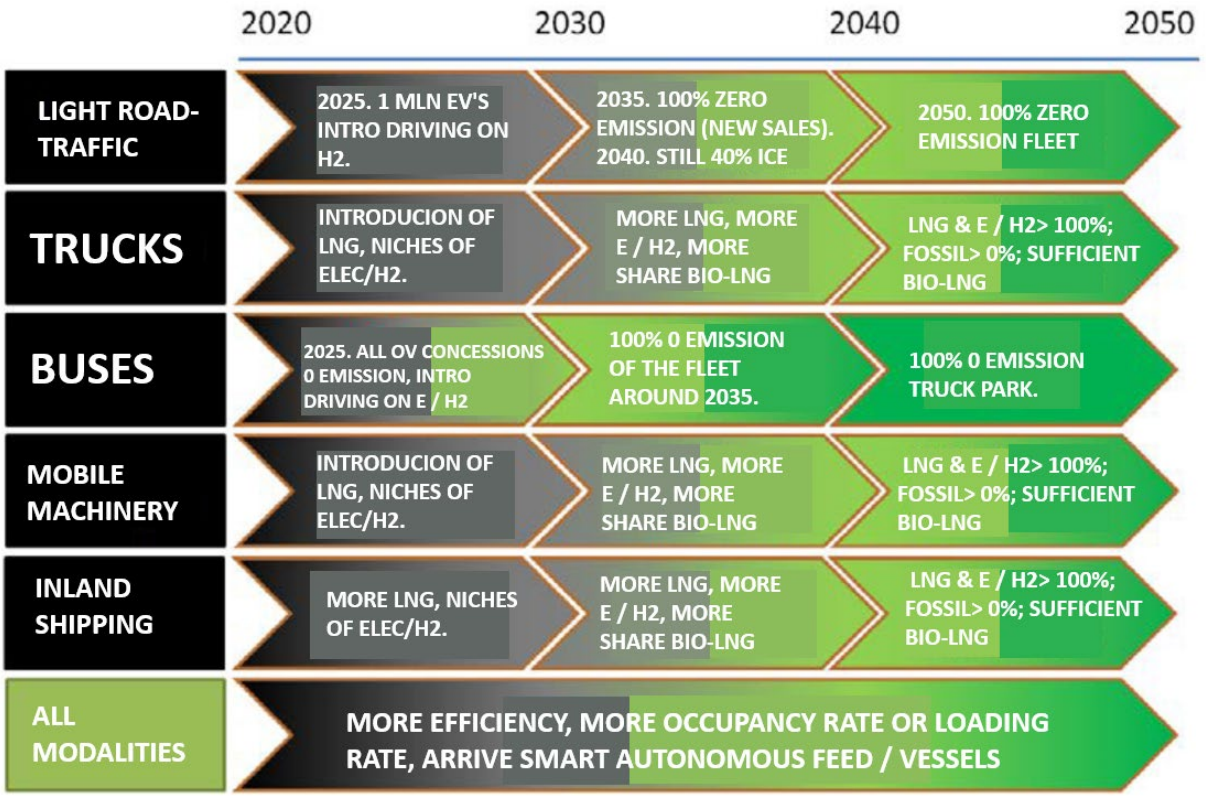


Figure 10. Expected transition path for transport

Built environment (households, services)

In this analysis, the built environment sector comprises households and services (non-residential construction). They orient the actions to the ownership since owners will be the actors responsible. They also distinguish between new and existing buildings. The main focus is on building heating, which currently uses mainly natural gas. Regarding the role of the province, since municipalities have the control of heat supply and the province cannot act on regulation and standard issues, it is envisaged mainly to facilitate and encourage to take action to the rest of the stakeholders. The province is currently doing this through the Service Point for Renewable Energy[38].

It provides advise, sets up pilot projects, approaches actively stakeholders and shares best practices. The Service Point will direct its activities towards natural gas free buildings in the coming next years.

The strategy also describes steps to be undertaken by municipalities with the support of the regional government in order to establish heating networks and the corresponding technologies. It is not known which the specific roles will be. For private household owners, the option of ESCOs to ensure energy savings and overcome funding barriers. For instance, in the city of Deventer "The Housing Plan"[39] is offering advice and services in this sense. See Figure 11 with the illustrated general transition path.

38 Servicepunt duurzame energie website: https://servicepuntduurzameenergie.nl/

39 Housing Plan of the city of Deventer website: http://www.woningabonnement.nl/

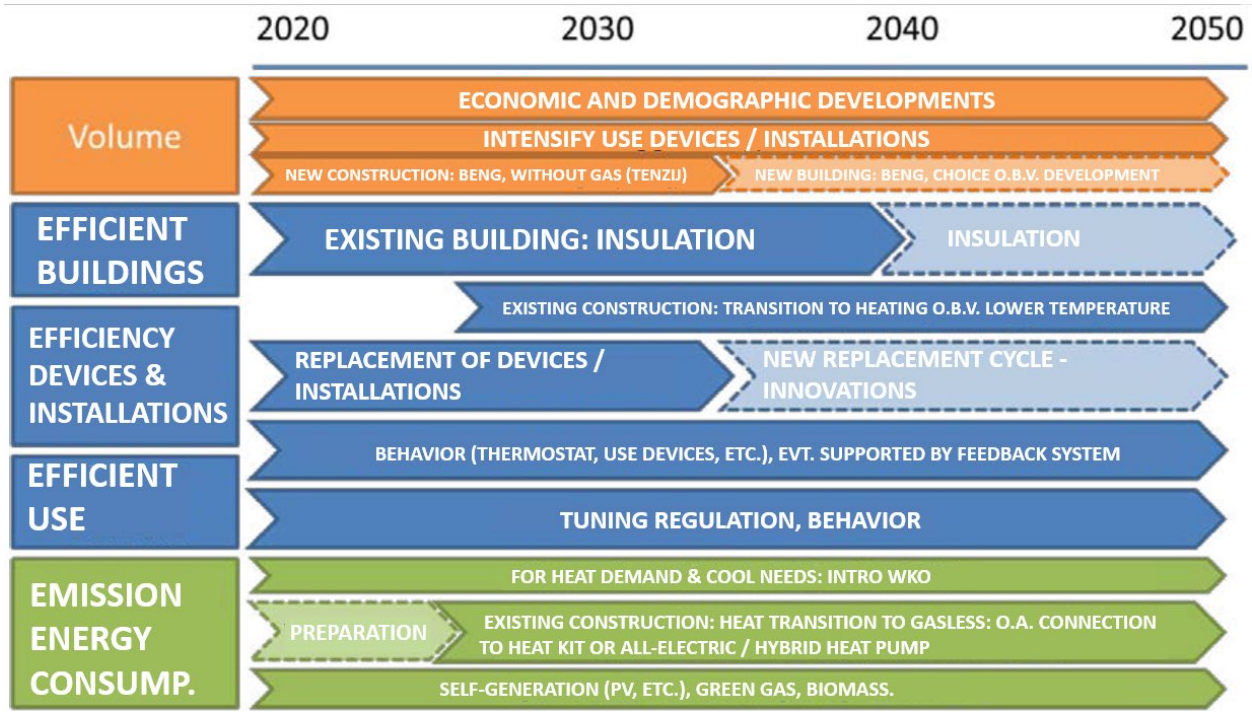


Figure 11. Expected transition path for built environment

Industry

The action envisaged by the region in this field is limited, due to the presence of large international industries whose control lies on the national Dutch government. The actions are structured around energy efficiency (lobbying to achieve more restringing national regulation, individual plans for businesses), renewable sources of energy (obtain permits for off-shore wind energy exploitation, power to gas technologies), circular economy (encourage usage of waste as by-product and innovation activities in companies) and CO_2 capture and storage (public support through campaigns, research spatial integration of the needed infrastructures, influence for achieving national legislative framework). See Figure 12 with the illustrated general transition path.

Energy supply

Regarding renewable energy generation, there are no specific measures from the regional government, apart from help in the adequate land-use planning. This is, for instance, to avoid competition of solar power with cropland use or to assess the impacts of onshore wind energy generation. About the energy infrastructure, the document arises the question of replacing or removing the natural gas network, and the need to implement district heating networks (currently not deployed in the area). The region has developed together with Alliander a Sustainable Area Heaters Card. This map provides a geographical overview of the province and Alliander known heat sources in the Metropolitan Region of Amsterdam and Noord-Holland.

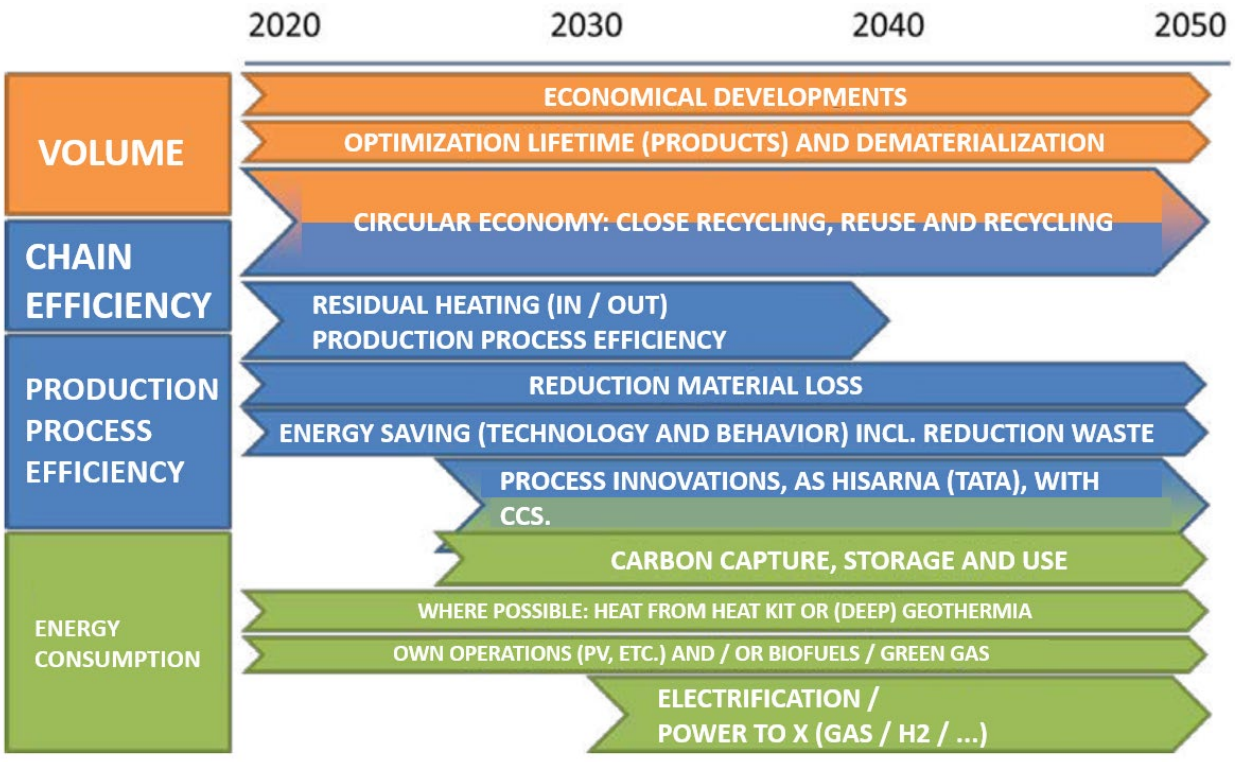


Figure 12. Expected transition path for industry

Highlights

- The quality of the strategy is good in terms of structure, although defined intermediated and/or sectorial goals are missing. The scope of measures could be extended, so the roadmap serves as a guide not just for the Provincial Government but for all stakeholders.
- Regarding the transport fleet, this strategy is the only one which clearly states objectives regarding the ban on ICE vehicles and market share of zero-emission vehicles. This is positive since the more accurate the measures and timing, the greater security for the private sector.
- It is remarkable that the Sustainable Area Heaters Card is used to provide geographical guidance regarding possible heat sources and options.

3.6. OTHER CARBON NEUTRAL STRATEGIES ANALYSIS

According to the Track 0[40] project and the CDP[41] datasets, several regions have stated ambitious carbon neutral goals with earlier dates than Helsinki-Uusimaa. Two facts are to be noticed. First one, 'carbon neutral' is understood in different ways, sometimes it is used to refer to the energy generation systems, in other cases to the whole power consuming sectors but just accounting for domestic emissions, etc. Second, the current status of the renewable share in power production systems can help a lot. For instance, regions as Jämtland County are already exporters of renewable electricity. The following table gives an overview of these regions.

Table 4. Other carbon neutral regions over the world

Region	Country	Objective and time	Do they have already a strategy for this objective?
Australian Capital Territory	Australia	• Net zero emissions by 2045. • 100% renewable electricity supply by 2020	Yes, for the previous objectives (2012). The strategy for new objectives is currently being built.
Region of Burgenland	Austria	• 100% Renewable Energy by 2020	2020 Strategy released and ongoing.
Byron Shire	Australia	• Zero GHG emissions by 2025	The plan was initiated in 2015. Sectorial reports are available on the website.
Lüchow-Dannenberg District	Germany	• 100% Renewable Energy (90% Renewable Electricity Achieved) • 95% emission reduction 2050	Master Plan released in 2017.
Schleswig-Holstein	Germany	• 300% renewable electricity by 2025	As of 2016, the state was already producing 128% of local electricity demand with RES. Many documents supporting energy transition in their website.
Upper Austria	Austria	• 100% Renewable electricity and heat by 2030	2050 strategy already released.
Lower Austria	Austria	• 100% renewable electricity consumption by 2015 • 50% renewable energy consumption by 2020, 100% by 2050.	The strategy for 2030 has been already launched.
Carinthia	Austria	• Heat and electricity supply fossil and nuclear-free by 2025 • Zero emissions transport by 2035	The 2035 roadmap is available.
New Caledonia	France	• Achieve 100% renewable electricity production by 2030	In 2016 the regional government adopted the Energy Transition Scheme.
Quebec	Canada	• Phase-out carbon coal by 2030 • Enhance energy efficiency by 15% in 2030 • Reduce the number of petroleum products consumed by 40% in 2030 • Increase overall renewable energy output by 25% in 2030 • Increase bioenergy production by 50% in 2030	Quebec has released in 2016 a very detailed action plan until 2020. It has one curious target: reduce fossil-based products consumption by 40%, involving indirect emissions. It should be also noticed that the creation of a good governance is within the topics addressed by the measures. It is the first part of the 2030 energy policy of the region, which can be found here.

40 The Track 0's mission is to translate the globally agreed well below 2°C/1.5°C limit on temperature rise set out in the 2015 Paris Agreement into emissions pathways and metrics that can support transformative solutions implementable by everyone. Information available at: http://track0.org/cities-regions/ Last visited: October 5th 2018

41 The Carbon Disclosure Project (CDP) runs the global disclosure system that enables companies, cities, states and regions to measure and manage their environmental impacts. The dataset consulted is available at: https://data.cdp.net/browse?category=States+and+Regions&sortBy=newest Last visited: October 6th 2018

4. CONCLUSIONS ON THE ANALYSIS OF STRATEGIES

It can be concluded that each one of the strategies analysed have a good quality. Several good practices as well as shortcomings may be found. Using this research as starting point in the collaborative framework of the BIG FIVE initiative may be useful to improve the different carbon neutral strategies. The following remarks can be found:

About the Quality and Characteristics of the Long-Term Climate Strategies

- The Helsinki-Uusimaa 2035 Carbon Neutral Roadmap is part of the Regional Development 2.0 process in the region. Nevertheless, it has to be clear the **horizontal relationship** with other regional policies (locating synergies and also possible contradictory points) and the **vertical integration** of the roadmap with national, European and municipal strategies. The way that the roadmap will be implemented in short-term action plans should be indicated. It should be also clear for the different stakeholders what is the **added value of this document**. For instance, how could this regional roadmap be useful for municipalities such as Helsinki Capital City, with an advanced climate action plan? For the private sector, how can the regional roadmap state more certainties than insecurities?

- Some strategies have developed **measures oriented** to all the stakeholders in the playing field, clarifying who are the main responsibles for the actions. Other strategies, such as North Holland, are quite focused on the role of the Regional Government as land use and regional development planner. The purpose of the measures contained in the Helsinki-Uusimaa Roadmap should be clear, too.

- Most of the strategies are lacking **intermediate time-bounded milestones**, specified per each sector. This, together with **indicators for each measure** described, is essential for a proper monitoring of the strategy in cooperation with the different bodies. For instance, the Jämtland strategy specifies as an indicator the surface of PV panels per person, establishing as objective 1 m^2/person in 2024.

- The regions with similar objectives and timelines as Helsinki-Uusimaa are:
  - Capital Region of Denmark. Carbon neutral district heating and energy supply systems by 2035 (they have a high share of coal and natural gas, too).
  - Jämtland County needs to achieve a carbon-neutral transport sector by 2030.
  - Stockholm County must achieve a 70% reduction in the transport sector from 2010 baseline by 2030.

- The information about the **public consultation process** to enrich the strategies is sometimes missing in the official webpages of the bodies in charge of developing the strategies. The strategies where this info appears are not offering, in general, a good overview of the public process which, in many occasions, is limited to surveys. A strategy which will be changing the socio-economic structure of a region like Helsinki Uusimaa in just 17 years must have a genuine participation process with physical meetings and high-quality participation dynamics.

- Most of the strategies point out the different actors as municipalities, businesses and the regional bodies. The North-Holland strategy goes further and makes a **stakeholder analysis**. The outcomes of performing a thorough stakeholder assessment can be very positive: knowing which the key stakeholders are, their influence, interests, needs, and other characteristics can be one major driver when designing the specific measures. The public consultation process can be used to start analysing and engaging them. The Climate **Council of Jämtland** is a good practice example.

- The Hamburg strategy is pointing out the **public budget and timeline to execute** it in order to carry out the different measures. This is important since the rest of the strategies do not have even a commitment of the overall public budget to be spent.

- **The governance of the transition**. Many of these strategies contain, in greater or lower level of detail, mechanisms to undertake the monitoring and review of the strategies. The regional body that the Capital Region of Denmark is envisaging could be a good example and it is also in line with the idea of the Jämtland Climate Council. Regardless the body in charge of this, it is very important to establish the framework for the execution, monitoring and review of the plan, knowing which will be the main accountants for carrying out the different actions, as well as a consequent budget.

- **Cost-Benefit Analysis, as well as other environmental and social impact assessments**, is missing in all the strategies. Just in one strategy the potential reductions per measure have been estimated, and just in two strategies the potential socioeconomic benefits of climate action have been highlighted. It is important to notice that the climate transition will have also negative consequences, e.g. job losses in some sectors while new ones appear; or the ideal size of the electric vehicle fleet, knowing that their production consumes even more energy than ICE vehicles and that batteries are made with Critical Raw Materials[42] with high environmental and social impact along their life cycle. The negative counterparts of the transition are there, and should not be neglected in the strategy, but rather be treated as risks with the pertinent mitigation plans. Also, how the potential climate measures can have positive social consequences should be highlighted, for instance the positive relationship among decentralised electric and energy self-generation and energy poverty.

42 Critical Raw Materials are those raw materials which are economically and strategically important for the European economy, but have a high-risk associated with their supply.

About the Specific Measures Contained

- The analysis of the specific measures envisioned in the different long-term strategies has not been as fruitful as expected. The **nature of these long-term regional policy-documents** is to orient the regional and municipal level administrations climate work. Knowing that (i) many times the regional bodies have limited competences and the main implementation role lies on the municipalities and (ii) long-term energy and climate strategies are subject to great uncertainties, it is understandable that the measures contained in the strategies are rather vague and general, with a general guiding purpose. It is in the short-term energy and climate strategies, not under the scope of this analysis, where concrete measures are described and implemented.

- **ICT and digital innovations** are mentioned several times. Nevertheless, given the role of digital technologies as an important tool to mainstream solutions and influence in the citizen's behaviour, more attention should be paid in this sense. Which is the ICT strategy of the region, if it exists, and how is going to support the climate strategy? A good example is brought by the Capital Region of Denmark when describing the role of digital technologies in the transport-related measures.

- Some strategies acknowledge the importance of the **indirect emissions** regarding some activities like the consumption of goods, activities such as tourism and procurement, etc. Taking into account the important share of this in the global GHG emissions as well as the fact of the externalisation of GHG emissions when buying products and services, the introduction of measures in the strategy to address indirect emissions is very important. Strategies are mainly focused on public procurement and some education actions. Nevertheless, detailed measures regarding tourism and transport activities associated, food system, zero-kilometre concept, formal and informal education as well as capacity building are lacking, among other issues.

- **R&D activities and innovations** are mentioned in several strategies. However, none of the strategies is depicting any approach regarding a key step in system innovation: the **niche management**[43] in order to mainstream the climate solutions in the society. This is a shortcoming of all these strategies. They are usually focused on the last step of system innovation, which is to prepare the standards, regulation and policies in general, but are not acting on the scaling up process. Generally, just fiscal incentives to interfere in the market could be considered as measures to try to boost the market uptake of innovative solutions.

- Most of the strategies have an **excessive reliance on high technology** solutions when sometimes the simplest option is the most sustainable choice. In many occasions, less intensive and less environmentally harmful process (such as some agroecological practices, or extensive livestock) can have a greater positive impact on the economy, jobs and the environment. They do not require big technological revolutions and they already are systemic innovations. This approach is in contrast with the gradualist options such as keep upgrading the efficiency of current pollutant industrial systems (e.g. intensive monocultive crops or livestock facilities) with technical solutions (improved water systems, drone monitoring, and so). Of course, this type of statements cannot be generalised for all contexts, but an assessment is more than worthy. For instance, the Stockholm strategy proposes to introduce methane capture technologies to reduce GHG emissions on farming, and it does not mention the extensive farming practices which are far more environmentally-friendly than the intensive livestock facilities and provide more employment.

It can be concluded that the quality of the climate strategy as a policy document has a great importance in order to become an effective tool supporting the energy transition, giving guidelines and security for all the stakeholders involved. Therefore, the complex process of the strategy preparation should not be underestimated. Consequently, adequate resources to construct and run the carbon neutral strategy are to be invested if the regional governments want to make sure that the climate targets will be achieved.

43 Niche management is the approach that focuses on investigating the experimental introduction of sustainable technologies using societal experiments (e.g. pilot plants, demonstration plants) in technology introduction in pursuit of improving interactions among the elements of a sociotechnical system and its efficiency in achieving its objectives.

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- The DrawDown project. It assembles and present the best available information on climate solutions in order to describe their beneficial financial, social and environmental impact over the next thirty years. https://www.drawdown.org/
- PPP Lab. This initiative of the Dutch Government offers a great amount of high-quality material regarding the establishment of PPPs. It is of great interest the document "Insight Series 06: Scaling through PPPs". https://ppplab.org/
- H2020 Prospect project. The PROSPECT learning programme enables peer-to-peer learning in regional and local authorities in order to finance and implement their sustainable energy and climate action plans. https://www.h2020prospect.eu/
- The Covenant of Mayors provides lots of documentation in their support section (funding, policy design, etc). https://www.covenantofmayors.eu/support/library.html
- One of the organisations in charge of the Covenant of Mayors is Energy-Cities, which is a network with many useful materials, also with an interesting focus on new way to finance the energy transition (check their projects Infinite Solutions and Neighbourhood Economics.) http://www.energy-cities.eu/
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- The World Business Council for Sustainable Development, https://www.wbcsd.org/

Uudenmaan liitto // Nylands förbund
Helsinki-Uusimaa Regional Council

Esterinportti 2 B • 00240 Helsinki • Finland
+358 9 4767 411 • toimisto@uudenmaanliitto.fi • uudenmaanliitto.fi