



September
2023

Analysis of the emissions
reduction contributions of
Danish municipalities towards
meeting the 70% target by
2030

DK2020 municipalities

Wind turbines Photo: Morsø

Prepared for the DK2020 Partnership

Prepared by:

Ea Energianalyse
Gammeltorv 8, 6 tv.
1457 Copenhagen K, Denmark
www.eaea.dk

In collaboration with CONCITO – Denmark’s green think tank

In May 2022, Ea Energianalyse prepared an analysis of the climate action plans of the 20 pilot municipalities in the DK2020 project and, in April 2023 the consultants prepared a corresponding analysis of the 39 first-round municipalities in the project.

The analysis in this report will be updated by the end of 2023 with data on an additional four climate action plans.



Contents

Preface	5
1. Summary	6
2. Introduction	12
3. Baseline emissions and targets of DK2020 municipalities	14
<hr/>	
Data used for the analysis	16
The targets set by DK2020 municipalities	16
<hr/>	
4. Reduction contributions by DK2020 municipalities	20
<hr/>	
Sector emissions reductions	24
Comparison with Climate Programme 2022 and Denmark's Climate Status and Outlook 2022	25
Reduction initiatives	27
Initiatives characteristic for different types of municipalities	31
Transition indicators	34
Initiatives cutting across municipal borders (Scope 3)	36
<hr/>	
5. Residual emissions	38
<hr/>	
Emissions from agriculture, land use and transport	40

Glossary

BaU: Business as usual. A scenario in which the municipality leads a passive energy and climate policy.

CAPF: Climate Action Planning Framework (CAPF) is a comprehensive framework for planning local climate initiatives developed by C40 Cities.

CCS: Carbon capture and storage.

CCU: Carbon capture and utilisation. The process of capturing CO₂ to be used later for a specific use, such as the production of PtX fuels.

Climate action scenario: A scenario in which the municipality and local partners lead a proactive energy and climate policy.

CO₂e: The climate impact of other greenhouse gases (methane, nitrous oxide and F gases) is converted into CO₂ equivalents using specific conversion factors. In this report, CO₂ (and carbon) is used to designate all greenhouse gases.

CSO21 and CSO22: Denmark's Climate Status and Outlook reports for the years 2021 and 2022.

GHG-inventory: Greenhouse Gas inventory. GHG inventory reporting under the Kyoto Protocol includes carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆), and nitrogen trifluoride (NF₃).

GPC: Greenhouse Gas Protocol for Cities (full title: Global Protocol for Community-Scale Greenhouse Gas Emission Inventories). A standard for calculating and reporting greenhouse gas emissions.

Municipalities: 'Municipalities' and 'the municipalities' refer to the 92 (out of a total of 98 municipalities in Denmark) that are covered by the analysis.

PtX: PtX. The production of liquid or gaseous fuels from electricity.

RE: Renewable energy.

Scope 1, Scope 2 and Scope 3 emissions: Scope 1 emissions include direct greenhouse gas emissions within municipal boundaries. Scope 2 emissions are indirect greenhouse gas emissions from using energy from the district heating network and the electricity grid. Scope 3 includes indirect greenhouse gas emissions embedded in the products and services consumed by the city's residents, companies and public administration but produced outside the city limits.

Disclaimers

CO₂/CO₂e: When CO₂ is written in this analysis, it refers to CO₂ equivalent.



Preface

The extreme weather that Denmark experienced last summer is a reminder of the climate changes that await in decades to come. Despite this, greenhouse gas emissions continue to rise, and 2022 was another record year for global CO₂ emissions.

Climate change is inevitable, but if we can reverse the trend and rapidly bring down emissions of greenhouse gases, we can still potentially mitigate the most severe consequences. This requires a concerted and massive effort by governments, businesses, local decision-makers, and citizens.

As many as 97 of the 98 municipalities in Denmark have developed, or are developing, a C40-approved climate action plan compatible with the Paris Agreement. In this report, Ea Energianalyse analyses the 92 climate action plans so far developed by the municipalities, and the results are encouraging. The goal of the municipalities is to reduce their emissions by a combined 76% by 2030 relative to the 1990 level. This is six percentage points more than the national target of 70%.

The coming years will show whether the municipalities can deliver on their targets.

The climate action plans were developed under the DK2020 project. The project requires municipalities to regularly monitor and evaluate their climate actions, and to review their climate action plans every five years. The Danish Climate Act has proved to be effective in putting pressure on the Minister for Climate, Energy and Utilities. Hopefully, DK2020 will have the same effect on city and municipal councils across Denmark.

If the municipalities are to deliver on their targets, making space for wind turbines and solar installations will be crucial, as will phasing out natural gas-fired and oil-fired boilers and ensuring an adequate EV charging infrastructure. But this is not all that is needed. Municipalities must integrate climate as a criterion in all major decisions, whether the decisions pertain to waste management, investing in nursing homes for the elderly or establishing new infrastructure. If the municipalities succeed in all of this, their ambitious goals will be within reach.

Anders Kofoed-Wiuff

Partner at Ea Energianalyse

1



Lake Esrum, Gribskov. Photo: Gribskov Municipality

1. Summary

DK2020 is a partnership between Local Government Denmark, the five Danish regions and Realdania. CONCITO serves as project manager and knowledge partner in the project. C40 Cities, a network of the world's largest and most climate-ambitious cities, is also a knowledge partner in the project. The objective of the partnership is to establish a common framework and to support Danish municipalities in developing climate action plans compatible with the Paris Agreement.

By the end of 2023, 96 Danish municipalities will have prepared C40-approved climate action plans. This includes the 95 municipalities under the DK2020 project and the City of Copenhagen, whose climate action plan was previously certified by C40 as compatible with the Paris Agreement. One more municipality is expected to have its plan approved during 2024.

This report analyses the CO₂ emissions reductions of the 92 municipalities that had developed climate action plans up to and including August 2023. The 92 municipalities represent 98% of the Danish population and 98% of the area of Denmark.

What targets have the DK2020 municipalities set?

Inspired by the national climate target, around 65% of Danish municipalities have set a goal to reduce greenhouse gas emissions by 70% by 2030 compared with the 1990 level. A total of 28 of these municipalities have set higher targets than the national target, and six of these municipalities have set a target of net-zero emissions by 2030 or earlier. Municipalities with a greater share of emissions from agriculture have generally set targets that are lower than the national 70% emissions reduction target, while urban municipalities have generally set higher reduction targets. Together, the municipalities have a target to reduce emissions of 48.5 million tonnes CO₂ in the baseline year (usually 2018 or 2019¹) to 18.3 million tonnes CO₂ in 2030. This corresponds to a reduction of 62%. If the target is met, this corresponds to a reduction of 76% in 2030 relative to emissions in 1990. The municipalities have also set targets for when they want to achieve carbon neutrality. A total of 73 of the municipalities have set a target to achieve carbon neutrality by 2050, eight have set a target of carbon neutrality by 2045, and five by 2040, while six municipalities aim for carbon neutrality by 2030 or earlier.

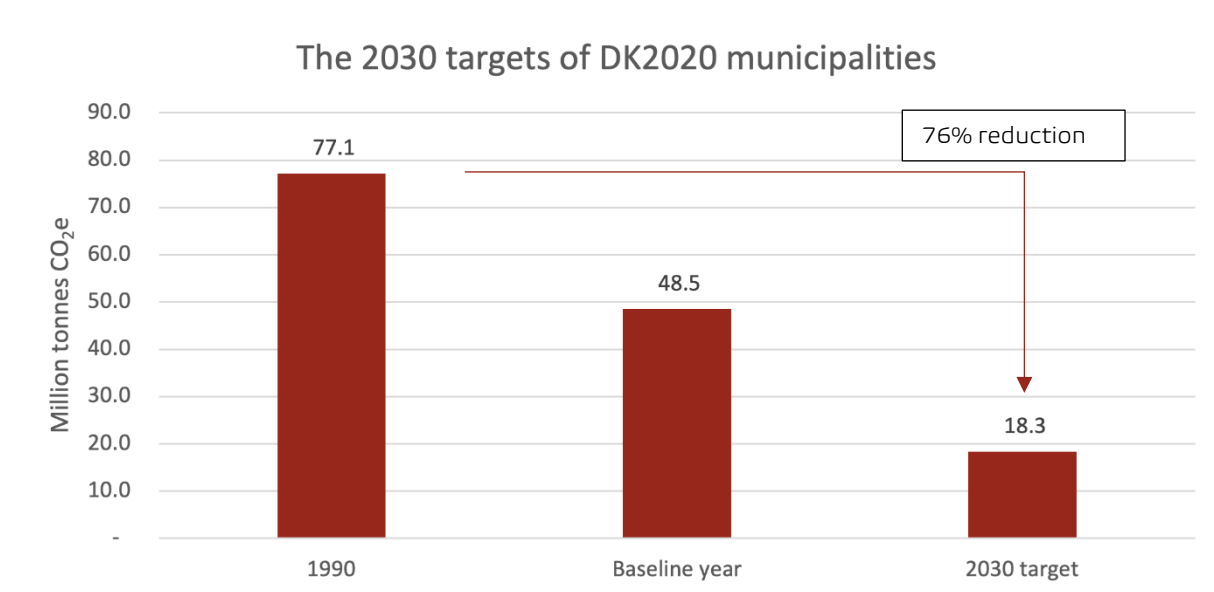


Figure 1: The combined 2030 targets of all DK2020 municipalities

What emissions reductions do the DK2020 municipalities achieve in the climate action scenarios?

The municipalities have set up scenarios showing how they will meet their climate targets.

As each municipality has the autonomy to determine the methodology for preparing their climate action plans, there is some variation in both the number of scenarios and the methodologies used across different municipalities. See figure 6 for a description of methods.

¹ A total of 9 of the DK2020 municipalities use 2017 as the baseline year, 44 use 2018, 32 use 2019, and 7 use 2020. The difference is due to differences in accessibility of data and in when the plans were prepared.



In this analysis, we focus on two types of scenarios prepared by all of the municipalities:

- **Business-as-Usual (BaU) scenario:** A scenario in which the municipality leads a **passive** energy and climate policy. This scenario typically follows the expected national development in the Danish Energy Agency's Climate Status and Outlook report from either 2021 (CSO21) or 2022 (CSO22), taking into account local conditions.
- **Climate action scenario:** A scenario in which the municipality and local partners lead a **proactive** energy and climate policy. In this scenario, some of the municipalities assume changed national framework conditions that support the local initiatives. If a municipality has set up more than one reduction scenario, we have included their most ambitious scenario in the analysis.

Together, the municipalities' BaU scenarios reduce emissions to 34.2 million tonnes CO₂ in 2030 and 29.8 million tonnes CO₂ in 2050. In their climate action scenarios, in which the climate action and initiatives in the DK2020 climate action plans are implemented, the municipalities reduce emissions to 21.0 million tonnes CO₂ in 2030 and 12.3 million tonnes CO₂ in 2050. Figure 2 shows the municipalities' targets and their total expected emissions in the BaU scenarios and in the climate action scenarios.

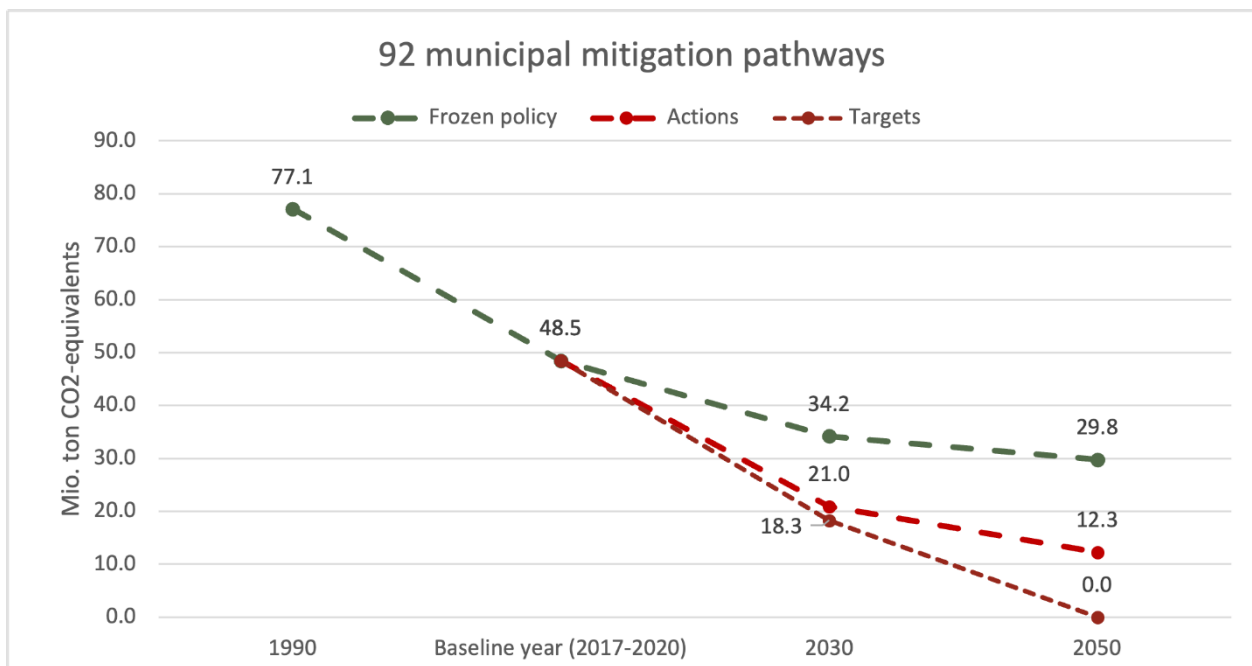


Figure 1: Targets and reductions by DK2020 municipalities, in total. Most municipalities have 2018 or 2019 as their baseline year.



Figure 3 shows emissions up to 2030 in the BaU scenarios and in the climate action scenarios.

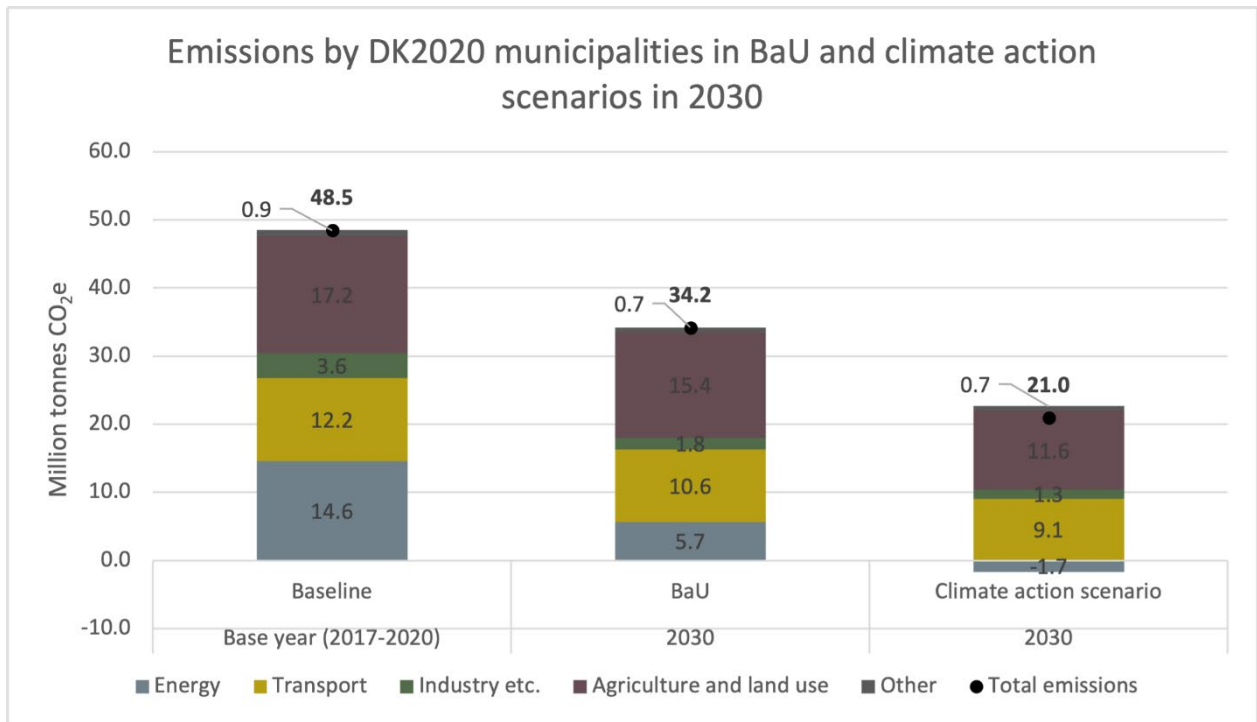


Figure 2: Greenhouse gas emissions by municipalities in the baseline year and up to 2030 in the BaU scenarios and in the climate action scenarios.

The municipalities' climate action scenarios together achieve a total reduction of 73% compared with the level in 1990, and this is slightly under the goal of 76%. Table 1 shows the reduction percentages, scenarios and targets of DK2020 municipalities.



The scenarios set by DK2020 municipalities	2030			2050		
	2030 Million tonnes CO ₂	2030 % reduction relative to 1990	2030 % reduction relative to the baseline year	2050 Million tonnes CO ₂	2050 % reduction relative to 1990	2050 % reduction relative to the baseline year
BaU scenario	34.2	56%	29%	29.8	61%	39%
Climate action scenario	21.0	73%	57%	12.3	84%	75%
Targets	18.3	76%	62%	0	100%	100%
<i>Emissions gap*</i>	2.7	3 percentage points	5 percentage points	12.3	16 percentage points	25 percentage points

Table 1: Emissions by DK2020 municipalities in BaU and climate action scenarios in 2030 and 2050, respectively. *The emissions gap indicates the difference between the climate action scenarios and the targets set by the municipalities.

What initiatives do municipalities focus on?

Within the energy sector, almost all the municipalities are focusing on phasing out individual oil-fired and natural gas-fired boilers, either by promoting the use of heat pumps or by expanding the district heating network. Many municipalities are focusing on establishing wind and solar installations and on phasing out fossil fuels in district heating production. About one-third of the municipalities are focusing on PtX or on CCS.

Within transport, the municipalities are focusing on electrification of public transport, deployment of EV charging infrastructure and changing transport habits, for example initiatives to promote cycling and carpooling among citizens and municipal employees. Furthermore, around two-thirds of municipalities are focusing on converting their municipal car fleet to electric/plug-in hybrid or other green fuels by making changes to supply contracts.

Within the agriculture and land-use sector, the municipalities are focusing on afforestation and on set-aside of carbon rich soils. Furthermore, municipalities are making use of initiatives such as gasification of livestock manure, improved livestock housing system technology, biochar, feed technology, conversion of crops, etc., and almost half of municipalities have either already launched climate partnerships with agriculture or are planning to do so by 2030.

Within industry, the municipalities are focusing in particular on establishing climate partnerships with local companies to encourage transitioning to green energy or production efficiency improvement.

The municipalities expect to see the largest emissions reduction from transitioning the energy sector, with emissions reductions of 112% in 2030 compared to the baseline year, according to the climate action scenario. This includes a 92% reduction in the use of fossil fuels, a 5% reduction from exports of green fuels and a 14% reduction from CCS. The transport sector is expected to reduce emissions by 25%, industry by 63%, agriculture and land use by 33%, and the sector 'Other' by 23%.

The energy sector is able to reduce emissions by more than 100% because CCS at waste incineration and bioenergy plants contributes negative emissions. Furthermore, some municipalities include CO₂ emissions reductions from production and exports of green fuels. If these green fuels are used in international shipping or aviation, the emissions reductions will not count towards Denmark's GHG inventory according to the rules under the Kyoto Protocol. Therefore, the climate action plans of the municipalities may include reductions from PtX production that do not contribute to the national 70% target but that are nonetheless included in the municipalities' climate action scenarios.

Where do the residual emissions come from?

Residual emissions in 2030 primarily stem from agriculture and land use, as well as from the transport sector. In the municipalities' climate action scenarios, these sectors are expected to account for as much as 98% of net emissions in 2030. Table 2 below compares the breakdown of residual emissions with the projected development in the Danish Energy Agency's Climate Status and Outlook report for 2023 (CSO23).

	2030 climate action scenario, DK2020 municipalities % of total emissions	Adjusted CSO23 projection, 2030 % of total emissions
Energy	-8%	-12%
- of which, fossil fuels	2%	5%
- of which, exports of green fuels	-4%	N/A
- of which, CCS	-10%	-12%
Transport	43%	38%
Industry	6%	11%
Agriculture and land use	55%	54%
Other*	3%	3%
Total	100%	100%

Table 2: Emissions by DK2020 municipalities, percentage shares of total net emissions, by sector. Emissions are from climate action scenarios in 2030. Column to the right: CSO23 emissions, percentage shares of total net emissions, by sector. Note that the projection from CSO23 has been adjusted to make it comparable with the GHG inventories of DK2020 municipalities. *Other emissions include F gases and emissions from landfills and wastewater, for example.

The share of residual emissions originating from agriculture and land use is expected to be even higher in 2050. The energy sector, including CCS, is expected to account for -23% of net emissions in 2050, whereas transport is expected to account for 38%, industry 9%, agriculture and land use 72%, and 'Other' 5%.



MEC-Biogás, biogas plants and lorry. Photo: Jens Bach.

2. Introduction

The consequences of decades of significant emissions of greenhouse gases are now being felt globally in the form of increased temperatures, elevated water levels and deteriorating biodiversity, etc. In 2015, 196 countries, including Denmark, signed the UNFCCC Paris Agreement. The Paris Agreement obligates the parties to the convention to limit global warming by keeping the global temperature rise below 2°C, and preferably below 1.5°C, compared to pre-industrial levels. If Denmark is to meet the targets set and contribute its share to mitigating climate change, initiatives are needed at national, regional as well as municipal level.

The objective of the Climate Act is to ensure Denmark reduces its greenhouse gas emissions by 70% by 2030 compared to the 1990 level and becomes climate neutral no later than 2050. The Climate Act has since been followed up by several political agreements on energy, waste, CCS and PtX fuels, and more. The political platform of the current Danish government includes a target of cutting greenhouse gas emissions by 110% by 2050 relative to 1990 and also brings forward the climate neutrality target to 2045.

Danish municipalities are working to advance the energy and climate agenda through the project DK2020. DK2020 is a partnership between Local Government Denmark, the five Danish regions and Realdania. CONCITO serves as the overall project manager and knowledge partner in the project together with the international network of cities called C40 Cities. The objective of DK2020 is to provide a common framework for Danish municipalities to develop

climate action plans compatible with the Paris Agreement. The end goal of DK2020 climate action plans is carbon neutrality by no later than 2050. As part of DK2020, the municipalities must also set ambitious sub-targets to underpin the long-term goal of carbon neutrality. The majority of the municipalities have set 2030 targets following the national Climate Act.

As many as 96 out of the total 98 Danish municipalities have joined DK2020. Once they have completed the project, they will have climate action plans with Paris Agreement compatibility. In addition to this, the City of Copenhagen's climate action plan has previously been certified by C40 as compatible with the Paris Agreement. This means that a total of 97 municipalities in Denmark will have climate action plans compatible with the Paris Agreement once the project has been completed.

DK2020 started as a pilot project in 2019 and the first 20 municipalities (the pilot municipalities) completed their climate action plans during 2020 (some by the beginning of 2021). Concurrently with this, the project was expanded by an additional 75 municipalities, and 39 of the municipalities in the first round (first-round municipalities) had their climate action plans approved in early 2023. The remaining 36 municipalities are expected to have their plans approved by no later than the end of 2023.

This report consists of analysis of the DK2020 climate action plans of the 92 municipalities that submitted their climate action plans up to and including August 2023.² In the following, these 92 municipalities will be referred to simply as '(the) municipalities'.

The report addresses the following questions:

- What emissions reduction targets have the municipalities set?
- What reductions in CO₂ emissions do the municipalities anticipate achieving within their climate action scenarios?
- What type of climate initiatives are included in the municipalities' climate action plans?
- What are the projected residual emissions in 2030 and 2050 as a result of these plans?

The objective of the analysis is to map the targets and climate action initiatives planned by the municipalities, and how their combined contributions will help realise the national 70% target for 2030.

² Note that, as of mid-September 2023, two of the climate action plans were still pending political consultation.





3. Baseline emissions and targets of DK2020 municipalities

The municipalities participating in the DK2020 project can be categorised into three groups depending on when they began their work on climate action plans: The pilot municipalities, first-round municipalities, and second-round municipalities. Table 3 shows the three phases of the DK2020 project with an indication of the proportion of Danish municipalities in each phase, including the proportion of the Danish population, land area, agricultural land area, and of total Danish greenhouse gas emissions. The greenhouse gas emissions of DK2020 municipalities have been summed for the baseline year and are compared against the total Danish emissions in 2019. The national emissions estimates have

DK2020	Pilot	First round	Second round
Number of municipalities	20%	40%	38%
Population	24%	40%	36%
Area	18%	43%	39%
Agricultural land	18%	44%	38%
Greenhouse gas emissions*	20%	49%	32%

*Table 3: DK2020 municipalities compared with Denmark as a whole. The table shows the municipalities' shares on various parameters relative to all of Denmark. *Note that greenhouse gas emissions are compared with national emissions in 2019, and therefore do not necessarily add up 100%. Note that adjusted estimates from CSO22 have been used for reasons of comparability.*

been adjusted for comparability. For example, emissions from the North Sea have been deducted because the municipalities do not include these emissions in their GHG inventories.

Greenhouse gas emissions by municipalities amounted to around 48.5 million tonnes CO₂e in the baseline year. Nine municipalities use 2017 as the baseline year, 44 use 2018, 32 use 2019, and 7 use 2020. The difference is due to differences in when the plans were prepared.

Figure 4 shows sector-wise emissions in DK2020 municipalities and all of Denmark in 2019. There is good alignment between the national GHG inventory and the GHG inventories of the municipalities when comparing total greenhouse gas emissions. However, at sector level, there are somewhat larger differences, and this is partly due to different sector boundaries. In some municipalities, energy consumption by industry is attributed to the energy sector resulting in a relatively higher proportion of emissions within the energy sector. When combining industry and energy sectors the difference is smaller. Note also that the municipalities have applied different baseline years.

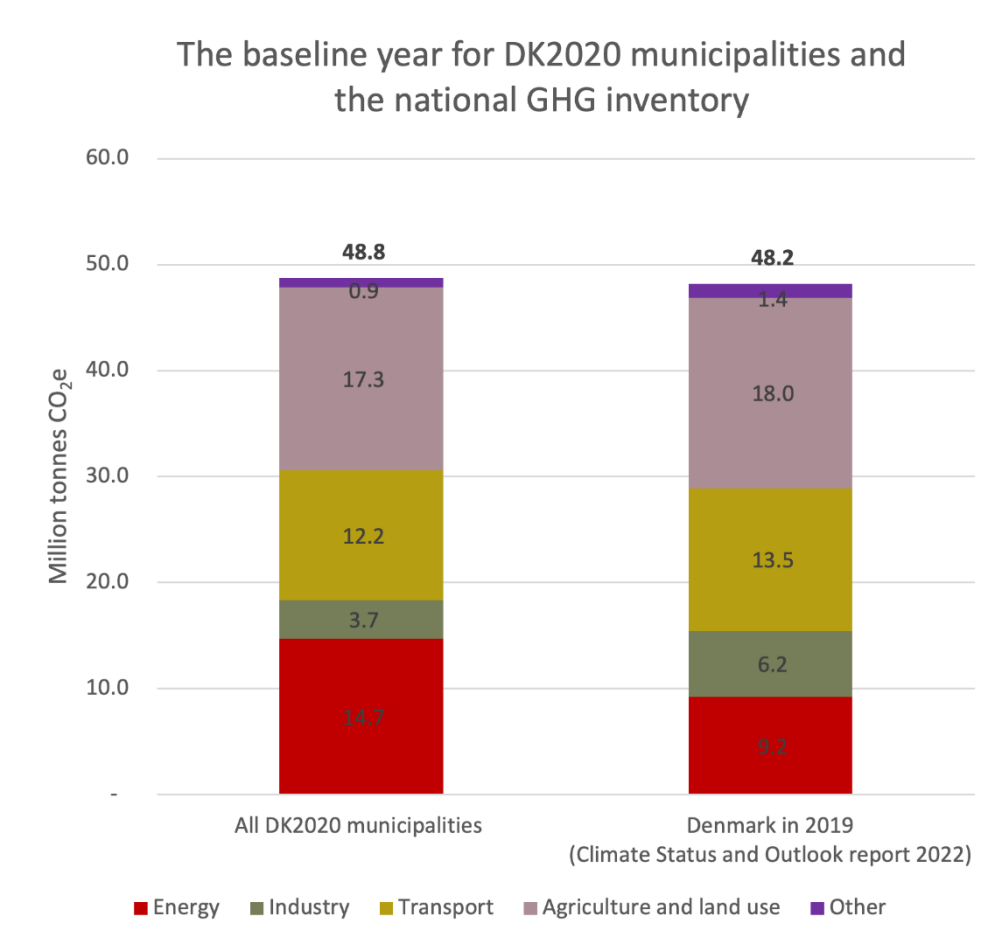


Figure 3: Total emissions by sector for DK2020 municipalities and for the whole of Denmark. Note that the national inventory has been adjusted to make it comparable with the inventories of DK2020 municipalities.



Data used for the analysis

This analysis has been prepared using data from the climate action plans, initiatives and underlying scenarios of the municipalities. DK2020 allows the municipalities a high degree of autonomy with regard to methods and calculation procedures. However, the municipalities must complete the same documentation form - the Climate Action Planning Framework (CAPF) - which ensures a common framework for approving the climate action plans. This freedom of methodology allows municipalities to include their own context, resources and desired action areas, but it also means that there may be methodological differences that make direct comparisons between municipalities difficult.

The municipalities' GHG inventories include the emissions that take place inside the geographical boundaries of the municipality as well as emissions from electricity and district heating supply where such emissions occur outside the municipal boundaries. Some municipalities also include international aviation, while others do not. In addition to inventories based on geographical boundaries, some municipalities also calculate their consumption-based emissions, and this may result considerably higher emissions.

This report, however, focuses on inventories based on geographical boundaries.

The targets set by DK2020 municipalities

To satisfy the requirements of the DK2020 project, the climate action plans of the municipalities must include climate action scenarios showing pathways towards climate neutrality by no later than 2050. The municipalities set their own sub-targets in their climate action plans, including the size of emissions reductions they want to achieve in a given year. However, they are required to set ambitious sub-targets and to demonstrate Paris Agreement compatibility, which, among other things, means that emissions must be at net-zero by no later than 2050.

The emissions reduction targets of DK2020 municipalities by 2030, relative to 1990	Number of municipalities
55%	1
59%	1
60%	1
66%	2
70%	59
72%	1
75%	3
78%	1
80%	6
82%	1
85%	6
88%	1
90%	1
95%	1
100%	*6

*Table 4: The emissions reduction targets for 2030 set by DK2020 municipalities, relative to 1990. A total of 11 municipalities have only set targets relative to their baseline year, and these have therefore been converted to targets relative to 1990 in the table. Note that a small number of municipalities do not use 2030 but 2025 or 2029, for example. *Furthermore, in one municipality, the goal of carbon neutrality is only for the energy sector, including energy for industry and transport.*

The majority of municipalities align with the national target to cut emissions by 70% by 2030 compared to the 1990 level. A number of municipalities go further than the 70% target, aiming for higher emissions reduction targets. Table 4 shows the emissions reduction targets of municipalities by 2030 relative to 1990. A total of 59 municipalities have set emissions reduction targets that align with the national target of a 70% reduction in emissions by 2030 compared to the 1990 level. A total of 27 municipalities have set targets higher than the national target. The majority of municipalities have set a target for carbon neutrality by 2050. Some municipalities, however, are more ambitious and have set targets for carbon neutrality before 2050. Among these municipalities, 19 have set targets for carbon neutrality before 2050, of which six municipalities aim for carbon neutrality by 2030 or earlier.

The carbon neutrality targets of DK2020 municipalities	Number of municipalities
2025	*1
2030	5
2040	5
2045	8
2050	73

*Table 5: The targets set by DK2020 municipalities for achieving carbon neutrality.
* The City of Copenhagen realised in December 2022 that they will not be able to achieve full carbon neutrality by 2025.*

The City of Copenhagen's climate action plan and goal of carbon neutrality by 2025 have been included in the analysis. This is despite the City of Copenhagen not being a part of the DK2020 project and despite the city's Technical and Environmental Committee having announced in December 2022 that the city will not be able to achieve full carbon neutrality by 2025. However, the city has also announced that they are working on a new climate action plan with new targets for 2035.

The DK2020 project does not advise a clear method for the best way to transfer the 70% target to a municipal context. A challenge in this regard is that emissions in the individual municipality distribute differently across sectors than at national level, which means the leeway and possibilities for achieving reductions differ from municipality to municipality. For example, an urban municipality, in which the majority of emissions come from energy and transport, is likely to achieve far greater reductions than a rural municipality with large emissions from agriculture. Thus, due to diverse circumstances and sectoral differences, there is no simple way to decide whether a given, individual municipality's target is more or less ambitious than the national 70% target.



By converting the municipalities' emissions reduction targets to a single, combined emissions reduction target, taking into account the emissions of each municipality, we get a weighted target of 76% by 2030 compared to the 1990 level. This means that the municipalities' combined target is more ambitious than the national target. In terms of emissions, this means the municipalities aim to reduce emissions from a level of 77.1 million tonnes CO₂ in 1990 to a level below 18.3 million tonnes CO₂ in 2030. This corresponds to an emissions reduction target of 62% compared to the baseline year (2018-2020). Figure 5 illustrates the combined targets of all DK2020 municipalities.

The average target of DK2020 municipalities, by type of municipality	Emissions reduction target (1990 to 2030)
Capital municipalities	80%
Rural municipalities	71%
Commuter municipalities	71%
Provincial municipalities	76%
Metropolitan municipalities	90%

Table 6: The emissions reduction targets of DK2020 municipalities by type of municipality. The target has been calculated as a simple average of the municipalities' individual targets.

Some municipalities have not estimated their CO₂ emissions for 1990. In these situations, a simple conversion has been made to arrive at 1990 emissions.

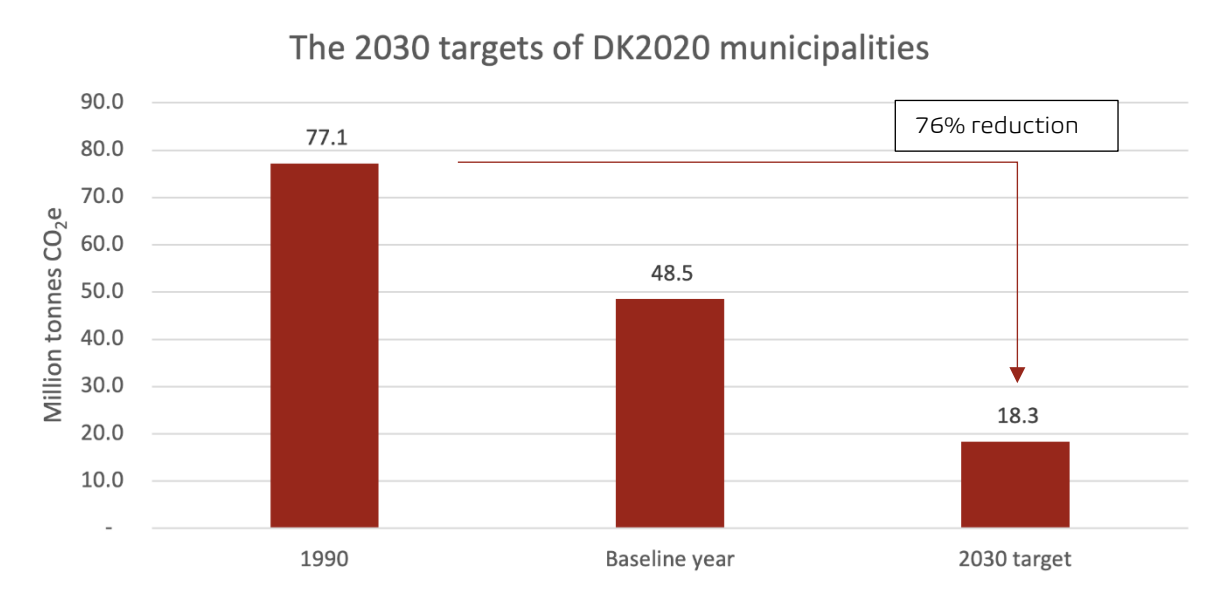


Figure 4: The combined 2030 targets of all DK2020 municipalities.



The targets of DK2020 municipalities relative to global reduction needs

Almost all Danish municipalities have now adopted climate action plans that aim to be compatible with the Paris Agreement's goal to keep the global temperature rise below 2°C, and preferably below 1.5°C. Since the first municipalities embarked on this journey in 2019, climate science has become clearer on the global emissions reductions needed to meet the Paris Agreement. It is therefore necessary to assess whether the municipalities' reduction targets are still adequate.

In March 2023, the IPCC published the Synthesis Report of their Sixth Assessment Report (AR6) summarising the state of knowledge of climate change. The report stresses the need for further accelerated climate action if the goals of the Paris Agreement are to stay within reach. In their Synthesis Report, the IPCC assesses the global reduction pathways (mitigation pathways) to keep the global temperature rise below 1.5°C (50% probability) or 2°C (67% probability). These pathways will require cutting emissions by 43% (34-60) and 21% (1-42), respectively, by 2030 relative to 2019. The combined target of the municipalities is to reduce emissions by about 62% by 2030 compared to their baseline year, and this is in line with the average global reduction requirement to meet the 1.5°C goal.

In 2022, the High-Level Expert Group on the Net Zero Emissions Commitments of Non-State Entities published a report with recommendations for the emissions reduction targets of non-state entities (for example municipalities). The expert group recommends that all local governments aim for a 50% reduction by 2030, relative to 2020. The municipalities also meet this recommended target.

An important element of the C40 Climate Action Planning Framework (CAPF) is to ensure equitable and fair effort sharing with regard to climate action. The C40 Cities network includes cities from across the world. The possibilities of these cities to rapidly reduce their emissions differ widely, just as the degree to which they are responsible for having contributed to historical emissions also differs. Because Denmark, and with it, Danish municipalities has a relatively large historical responsibility, and generally has good possibilities for reducing future emissions, municipalities' emissions reduction targets should reflect the principle of global burden sharing. The Danish Climate and Transition Council (KOR) has assessed whether Denmark's 70% target will be enough to fulfil Denmark's responsibility with regard to driving down global greenhouse gas emissions. The Council concludes that Denmark's contribution to emissions reductions is inadequate, regardless of the burden-sharing principle applied. Whether considering historical responsibility or financial capacity, Denmark's reduction targets are far from what is needed for Denmark to take on its share of the burden. With regard to its historical responsibility, Denmark must contribute net-negative emissions in the period 2020 to 2030, according to the Council.

In this context, the municipalities' reduction targets fully and completely meet average global reduction needs. In fact, the Danish targets lie somewhat higher than the global average, as they probably should if Denmark is to set an example and demonstrate climate leadership globally. However, to meet equitable burden-sharing principles, there may be a need for Denmark to raise its ambitions even further, and this is where Danish municipalities can support central government in achieving rapid decarbonisation.

4



Biogas plant in Solrød Municipality. Photo: Solrød Municipality

4. Reduction contributions by DK2020 municipalities

As part of the DK2020 project, municipalities have carried out scenario analyses of developments in CO₂ emissions within their respective municipal boundaries. Furthermore, they have set up climate action scenarios to demonstrate how they plan to meet their climate targets. Due to the municipalities' autonomy to choose methodologies for their climate action plans, the number of scenarios and methodologies used for the scenarios vary from municipality to municipality. See the text box for a description of methods (see figure 6).

In this analysis, the focus is on two types of scenarios prepared by all municipalities:

- **Business-as-Usual (BaU) scenarios:** Although there may be differences in their methodological approach to BaU scenarios, the municipalities generally assume a BaU scenario in which they lead a *passive* energy and climate policy. This scenario typically follows the expected national development in the Danish Energy Agency's Climate Status and Outlook report from either 2021 (CSO21) or 2022 (CSO22), taking into account local conditions. CO₂ emissions reductions will therefore be a result of expected sector-specific trends considering national policies and initiatives adopted at the time.

- **Climate action scenarios:** A scenario in which the municipality and local partners lead a **proactive** energy and climate policy. In this scenario, some of the municipalities assume changed national framework conditions that support the local initiatives. If a municipality has set up more than one reduction scenario, we have included their most ambitious scenario in the analysis.

The pilot municipalities in the DK2020 project prepared their climate action plans with BaU scenarios based on CSO21. However, since they prepared their plans, the national framework conditions have changed. Amongst other things, CSO22 includes the *Agreement on a green transition of the agricultural sector* and Denmark's National CAP Strategic Plan³, the *Infrastructure plan 2035 agreement*, the *Charging infrastructure market regulation agreement*, the *Green transport pool realisation agreement*, as well as the 2 GW offshore wind deployment and the technology-neutral tendering procedure for negative emissions agreed as part of the 2022 Finance Act. Therefore, generally speaking, a BaU scenario using CSO22 will achieve greater reductions than one using CSO21. Furthermore, the improved national framework conditions will allow municipalities to achieve greater reductions in their climate action scenarios. The Danish Energy Agency's most recent climate status and outlook report, CSO23, was published after the municipalities had drawn up their climate action plans and climate action scenarios.

³ National plan for implementation of the EU common agricultural policy, including for implementation of funding from the European Agricultural Fund for Rural Development (EAFRD).



Methods for calculating greenhouse gas emissions

Within the DK2020 project, there exists a flexibility of approach regarding choice of methodology, as long as they align with the CAPF guidelines. This requires high standards with regard to the transparency of GHG inventories, including documentation of and reference to data and methods used. For this reason, it is not a separate requirement under the DK2020 project for GHG inventories to fully meet the guidelines under the GPC accounting standard. However, the municipalities are encouraged to prepare GHG inventories in accordance with the GPC accounting standard, although deviations within individual sectors are allowed, for example renewable energy crediting.

The majority of municipalities follow the methodological guidelines that form the basis for the Danish Energy Agency's energy and GHG estimates.

All municipalities have assumed that the national electricity system will be green by 2030. Therefore, in accounting terms, there are no emissions reductions to be gained from deploying solar and wind in 2030. On the other hand, the municipalities generally assume that the marginal gas in the gas system in 2030 will be fossil. Therefore, some of the municipalities that export biogas have recognised the effect of the natural gas displaced in other municipalities.

Production of green fuels, such as hydrogen or other PtX products intended for use in the transport sector are included under the energy sector in this report. This is because, there is no way to guarantee, at municipal level, that PtX fuels produced in one municipality are also used in this municipality. Some municipalities recognise the effect of PtX production when the fuels displace petrol and diesel fuel. Furthermore, some municipalities expect to host PtX plants in the future, but do not recognise the reduction effect from this in their climate action scenario.

Figure 5: Description of methods for calculating greenhouse gas emissions in the climate action scenarios of municipalities.

If all reductions in the BaU scenarios are aggregated, the municipalities stand to reduce emissions to around 34.2 million tonnes CO₂ by 2030 and 29.8 million tonnes CO₂ by 2050.

In the municipalities' climate action scenarios, in which the climate action and initiatives in the DK2020 climate action plans are implemented, the municipalities' emissions are estimated to reach 21.0 million tonnes CO₂ by 2030, leaving a 2.7-million-tonne CO₂ emissions gap towards meeting the municipalities' own targets for 2030. In

percentage terms, the municipalities achieve a reduction of 73% compared with the level in 1990, corresponding to 21.0 million tonnes CO₂ in the climate action scenarios. This result is slightly below the target of 76%, corresponding to 18.3 million tonnes CO₂. It therefore seems that, in their climate action scenarios, the municipalities have identified the better half of the measures and initiatives needed to attain their own targets.

The scenarios set by DK2020 municipalities	2030			2050		
	Million tonnes CO ₂	% reduction relative to 1990	% reduction relative to the baseline year	Million tonnes CO ₂	% reduction relative to 1990	% reduction relative to the baseline year
BaU scenario	34.2	56%	29%	29.8	61%	39%
Climate action scenario	21.0	73%	57%	12.3	84%	75%
Targets	18.3	76%	62%	0	100%	100%
Emissions gap*	2.7	3 percentage points	5 percentage points	12.3	16 percentage points	25 percentage points

Table 7: CO₂ emissions by DK2020 municipalities in BaU and climate action scenarios in 2030 and 2050, respectively. *The emissions gap describes the difference between the climate action scenarios and the targets set by the municipalities.

As depicted in the table above, the municipalities demonstrate a reduction of 73% in their climate action scenarios, surpassing the national 70% target.

In these climate action scenarios, emissions by the municipalities amount to 12.3 million tonnes CO₂ in 2050. This corresponds to a reduction of 84% relative to 1990 and 75% relative to the baseline year. The results in 2050 in the climate action scenarios should take into account that the municipalities currently do not know which initiatives will be prioritised at national level after 2030, and it is therefore difficult for them to identify long-term reduction pathways towards net-zero emissions.



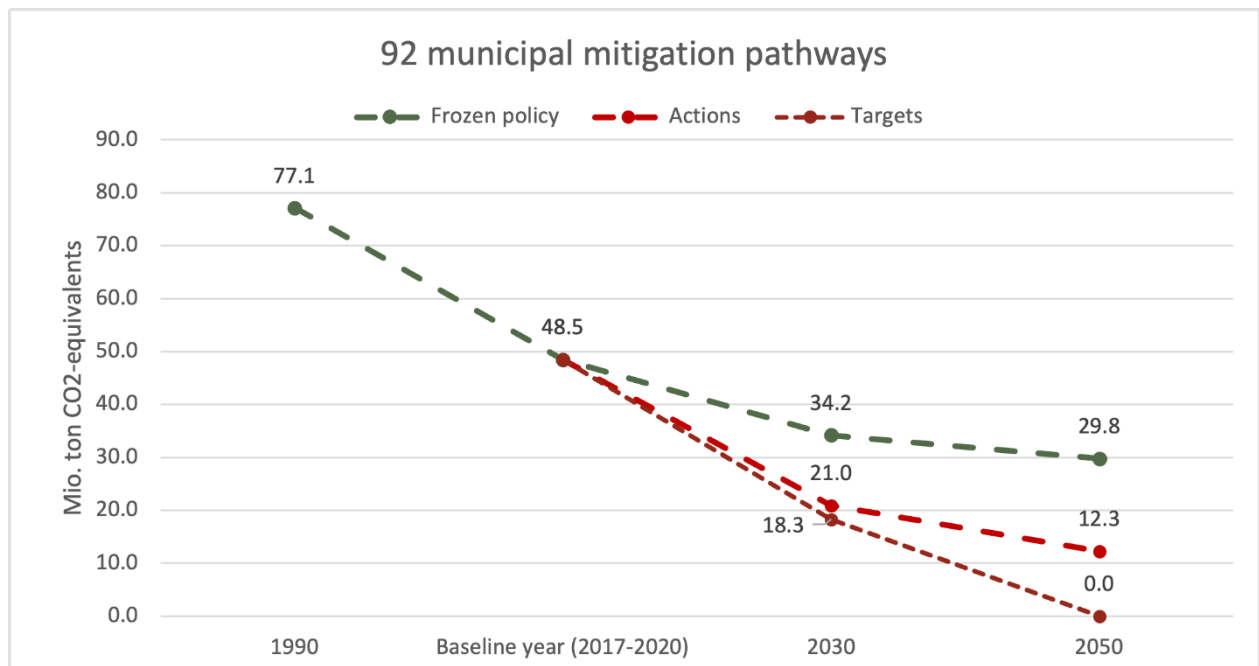


Figure 6: Targets and reductions by DK2020 municipalities, in total.
Most municipalities have 2018 or 2019 as their baseline year.

Sector emissions reductions

In the municipalities' climate action scenarios, they expect to reduce their combined greenhouse gas emissions by 27.5 million tonnes CO₂ in 2030 relative to the baseline year. Table 8 below shows the breakdown of these 27.5 million tonnes CO₂ reduction in 2030 across various sectors. Within this reduction, the energy sector is anticipated to make a substantial contribution of 16.3 million tonnes CO₂, leading to a projection of negative emissions in 2030. This significant development is primarily due to near-complete phase out of fossil fuels in electricity and heat production, as well as PtX production and exports of green fuels and CCS/CCU. If exports of green fuels and CCS are not included under the energy sector, there will be emissions of 0.5 million tonnes CO₂ in 2030. Agriculture and land use contributes a reduction of 5.6 million tonnes CO₂ in 2030, and the transport sector and industry are expected to contribute reductions of 3.1 and 2.3 million tonnes CO₂, respectively, by 2030.

	Baseline year	2030	Reduction	Reduction relative to the baseline year
	(million tonnes CO ₂)	(million tonnes CO ₂)	(million tonnes CO ₂)	(%)
Energy	14.6	-1.7	16.3	112%
- of which, reduction in fossil fuels	-	0.5	13.5	92%
- of which, exports of green fuels	-	-0.8	0.8	5%
- of which, CCS	-	-2.1	2.1	14%
Transport	12.2	9.1	3.1	25%
Industry	3.6	1.3	2.3	63%
Agriculture and land	17.2	11.6	5.6	33%
Other	0.9	0.7	0.2	23%
Total	48.5	21.0	27.5	57%

Table 8: Total sector reductions by DK2020 municipalities in 2030, according to their climate action scenarios.

Comparison with Climate Programme 2022 and Denmark's Climate Status and Outlook 2022

We have yet to fully identify the pathway to achieving the national 70% target. We therefore do not know the precise reduction requirements and reduction targets needed in individual sectors. The government's Climate Programme 2022 presents a proposal for how Denmark as a whole could realise the target. For the programme, the Danish Energy Agency analysed four pathways to realising the 70% target in 2030 and the long-term goal of carbon neutrality by 2050. The Climate Programme is updated each year, and 2022 is the most recent version. The four technical scenarios are:

1. Bio & CCS scenario
 - This scenario focusses on bioenergy and CO₂ storage. Focusses on technologies to achieve negative emissions rather than on emissions reductions.
2. Electricity scenario
 - Extensive electrification, including both direct and indirect electrification.
3. Behavioural scenario
 - Focuses on climate-conscious behavioural change, as well as extensive energy efficiency improvements and electrification.
4. New markets scenario
 - Focuses on transitioning Danish agriculture to meet the demand for plant-based food and proteins in international markets. Concurrent major transitioning of the building and construction sector, electrification, energy-efficiency improvements and behavioural change.

The government's Climate Programme provides a perspective on the total national contributions needed by the individual sectors, and it is therefore relevant to compare these contributions to the DK2020 municipalities' expected contributions. The scenarios in the government's Climate Programme contribute a reduction of 50% relative to 2019, corresponding to 70% relative to 1990.⁴ Figure 8 illustrates sector reductions by municipalities (red columns), in CSO22 (blue columns), and in the government's Climate Programme (green columns).

The governments climate program 2022 & DK2020 municipal reductions

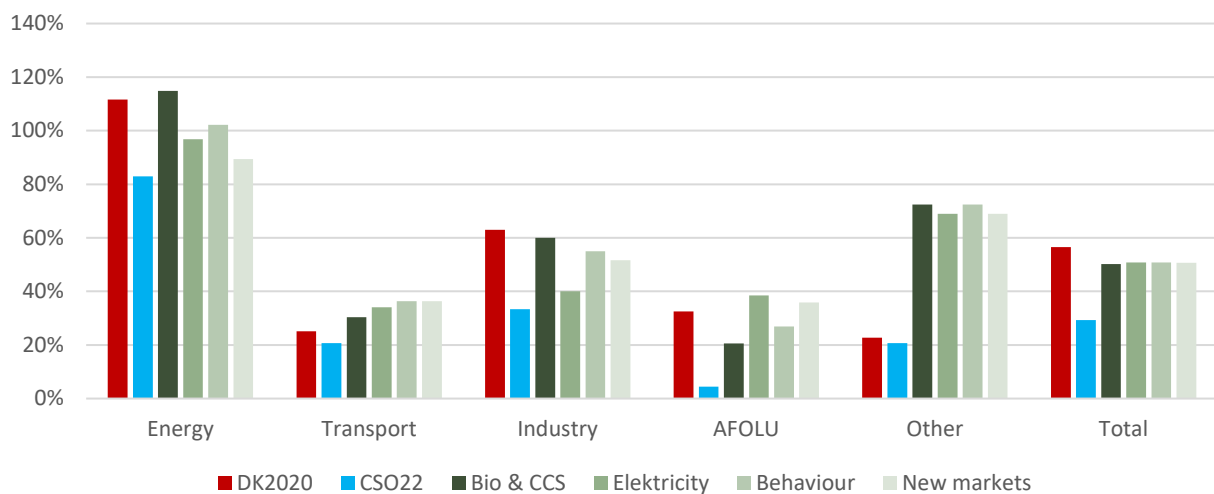


Figure 7: Reduction percentages by sector in 2030 relative to 2019 in the four pathways presented in the government's Climate Programme 2022 (green columns), and sector reductions by DK2020 municipalities (red columns). Denmark's Climate Status and Outlook 2022 (CSO22) is illustrated in blue columns.

The DK2020 municipalities' climate action scenarios show the pathway to a 57% reduction by 2030, relative to the baseline year (2017-2020). As can be seen from figure 8:

- DK2020 municipalities achieve greater reductions than CSO22 in all sectors.
- In the energy sector, DK2020 municipalities reduce emissions as much as in the Bio & CCS scenario; i.e., the scenario leading to the greatest reductions in the energy sector.
- In the transport sector, DK2020 municipalities lag behind the scenarios in the government's Climate Programme, but only slightly so with regard to the Bio & CCS scenario.
- In the industry sector, DK2020 municipalities achieve larger reductions than any of the Climate Programme scenarios. However, note that several municipalities include industry under the energy sector, and this makes the comparison difficult.
- With regard to agriculture and land use, DK2020 municipalities achieve emissions reductions of 32%, which places them somewhere in between the scenarios in the government's Climate Programme 2022.



- Reductions in the category 'Other' are not as significant as in the Climate Programme's scenarios, but they still exceed expectations in CSO22. 'Other' covers all emissions not included in other sectors, for example emissions from landfills and F gases. They account for only a small share of DK2020 municipalities' emissions in the baseline year and the municipalities generally have had difficulty identifying reduction instruments, because these are primarily regulated by national framework conditions.
- The climate action scenarios of DK2020 municipalities include CCS of 2.1 million tonnes of CO₂ by 2030. Comparatively, the Climate Programme's scenarios include 2.8 million tonnes CO₂ in the Bio & CCS scenario, 1.6 million tonnes CO₂ in the electricity scenario, 1.5 million tonnes CO₂ in the behavioural scenario and 0.3 million tonnes CO₂ in the new markets scenario. CSO22 involves CCS of 1.4 million tonnes of CO₂. This indicates that, with regard to CCS, DK2020 municipalities align closely with the scenarios in the government's Climate Programme 2022 and with CSO22.

Reduction initiatives

The municipalities focus on initiatives they can influence directly, as well as on initiatives the implementation of which they can only influence indirectly.

The municipality as a company
•Municipal operations, buildings, vehicles, etc.
The municipality as a public authority
•The municipal authority that manages heating supply projects, plans infrastructure and that designates and decides the use of land areas in municipal and local development plans.
Owner of utility companies
•As the owner of utility companies, the municipality can directly influence operations.
Partnerships, facilitation and information to citizens
•The municipality can influence industry, business, everyday life and habits of citizens, etc.

Figure 9: The municipality's various roles in climate action.

Figure 9 shows the various roles played by municipalities in local climate action. At the top of the figure is 'the municipality as a company'. Here, the municipality operates institutions like nursing homes, daycare centres, libraries, home care services, etc. which use heat, electricity, transport and similar. Typically, municipal operations account for a relatively small share of the total climate impact (<5%). However, this is an area where the municipality has extensive influence. Municipalities are the primary planning authority pursuant to the Planning Act, and they are responsible for determining and regulating land use in the municipality, including authorising solar, wind and biogas plants. Municipalities are also heat supply planning authorities, and with the utility companies and other stakeholders, they are responsible for planning heat supply and processing project proposals. Municipalities also have large influence as the local heat supply authority, and, today, for example, they can choose to ignore fossil scenarios in district heating projects. Similarly, municipalities can be the owner of a

utility company, such as a waterworks or a district heating plant, and they can influence the climate impact of these through active ownership. Finally, municipalities can try to influence the climate impact of the private sector through partnerships, facilitation of collaboration projects, and through information to citizens and businesses. The private sector is typically responsible for the largest share of the climate impact, and the municipality's possibilities for influencing CO₂ emissions in this sector are mostly indirect.

The analysis of energy and climate action initiatives by DK2020 municipalities includes an analysis of the number of municipalities focussing on different types of initiative. Only municipalities that are in the process of implementing the initiative or planning concrete action have been counted as focusing on the initiative in question. If a municipality mentions an initiative without describing whether it is in the process of implementing the initiative or fails to describe the actions it will carry out to implement the initiative, the municipality will not be assessed to be 'focussing on' the initiative and the municipality will not have been included in the count.

Initiatives in the energy sector	Share of DK2020 municipalities focussing on the initiative
Conversions of individual oil-fired and natural-gas-fired boilers to district heating or heat pumps	99%
Heat savings	88%
Installation of photovoltaic solar modules in open terrain	76%
Installation of photovoltaic solar modules on rooftops	68%
Installation of onshore wind turbines	64%
Construction of biogas plants/increased production at biogas plants	53%
Phase out of fossil fuels in district heating production	46%
Increased exploitation of surplus heat in district heating production	44%
Production of green fuels (PtX)	39%
Separation and removal of plastic waste in waste incineration	39%
CO ₂ capture	35%

Table 9: DK2020 municipalities' initiatives in the energy sector The eleven most popular initiatives have been included.

Within the energy sector, all municipalities are focusing on heat planning and on phasing out individual oil-fired and natural-gas-fired boilers. According to their climate action plans, 82% of municipalities are focusing on expanding the district heating network, while 63% have initiatives to promote conversion to individual heat pumps. The municipalities are also focusing extensively on phasing out fossil fuels in district heating production. Furthermore, the municipalities are focusing on heat savings, as well as initiatives to install wind, solar and biogas plants, for example. About one-third of municipalities are focussing on CO₂ capture or PtX.



Initiatives in the transport sector	Share of DK2020 municipalities focussing on the initiative
Gas-powered public transport or electrification of public transport	89%
Supporting charging infrastructure and parking options for electric cars	86%
Promoting cycling (electric bikes and ordinary bikes)	82%
The municipal vehicle fleet: Procurement of electric vehicles and requirements for this in tendering procedures	72%
Electrification of passenger cars and vans	69%
Changing transport habits	63%
Carpooling (private citizens and businesses) and green transport for businesses (including share cars)	61%
Promoting public transport	58%
Conversion of lorries/refuse collectors to non-fossil fuels or electricity	56%
Improved fuel economy of vehicles and reduction of transport needs	40%

Table 10: DK2020 municipalities' initiatives in the transport sector. The ten most popular initiatives have been included.

Within transport, the municipalities are in particular focusing on electrification. The initiatives include areas where the municipality has direct influence, i.e. their own car fleet and machinery, refuse collectors and busses in public transport. The municipalities are also focusing on supporting charging infrastructure and parking options for electric cars, so that electric cars become a realistic alternative for citizens with no option to park on their own property.

Furthermore, the majority of municipalities are focusing on promoting public transport, cycling and walking instead of driving. These initiatives include improving departure times and the transport experience, the location of stops, establishing cycle paths, bicycle parking, etc.

Finally, many municipalities want to reduce traffic growth by promoting car sharing through apps and reserved parking spaces for share cars, etc.. Additionally, some municipalities want to carry out measures to limit the driving requirement for heavy transport, such as strategically locating distribution centres.

Initiatives in the agriculture and land-use sector	Share of municipalities focussing on the initiative
Afforestation	81%
Set-aside of carbon-rich soils	72%
Climate action plan or climate collaboration for agriculture	51%
Gasification of livestock manure or use hereof	42%
Biochar / pyrolysis	36%
Improved livestock housing system technology, rapid flushing of livestock manure	33%
Climate and nature restoration	28%
Improved feed technology	25%
Eelgrass and blue biomass in general	25%
Conversion to other crops (e.g. grass)	21%

Table 11: DK2020 municipalities' initiatives in the agriculture and land-use sector. The ten most popular initiatives have been included.

In the agriculture area and land-use sector, the two most popular initiatives are afforestation and set-aside of carbon-rich soils. Presumably, this is because these initiatives have a potentially large impact and because the municipalities can plan the initiatives by entering into dialogue with landowners or through afforestation projects on municipal land. Furthermore, DK2020 municipalities are focusing on gasification of manure at biogas plants, rapid slushing and cooling of the manure, or improved feed technology. However, feed technology is often only described at a more generalised level.

The municipalities are also focusing on crop conversion to grass, for example, and some municipalities are also examining the possibility to establish facilities for the production of grass protein. Biochar/pyrolysis is another initiative used by a good share of rural municipalities, who expect these initiatives will contribute important reductions.

Some of the municipalities also plan for nature restoration, where the focus is on both CO₂ reduction and on improving the state of nature and biodiversity.

Finally, almost a quarter of municipalities are focusing on blue biomass, and many of these municipalities are planning to contribute by planting eelgrass.

Industry and 'Other' have not been included in the table because the municipalities only describe very few initiatives in these two sectors. Municipalities focusing on initiatives in industry often do so through dialogue and collaboration projects that aim to improve production efficiency or transition to green fuels or to electricity. 'Other' covers the remaining emissions, such as solvents, refrigerants and chemical processes, and it is a sector in which the municipalities have only limited influence, resulting in fewer initiatives within their climate action plans.

Initiatives characteristic for different types of municipalities

Fulfilment of the targets set by municipalities requires a very broad range of initiatives and instruments. Therefore, the municipalities are typically focussing on a diversity of initiatives. However, it can be interesting to see if certain types of municipalities focus specifically on certain initiatives. Statistics Denmark operates with five types of municipalities: rural municipalities, commuter municipalities, provincial municipalities, metropolitan municipalities, and capital municipalities (see figure 10).



Figure 8: All Danish municipalities divided into five municipal groups. This grouping is used by Statistics Denmark, for example. *: Not covered by this report. The climate action plan is expected to be completed by the end of 2023 at the latest. Dragør Municipality's plan, however, will not be completed until sometime during 2024. **: Not part of the DK2020 project.

Table 12 shows the initiatives that are particularly popular among the various municipalities. The list includes initiatives that municipalities *are focusing on*, meaning that they are in the process of implementing the initiative or that they are planning specific actions according to their climate action plan.

The focus of municipalities often reflects their physical circumstances. Afforestation and set-aside of carbon-rich soils are among the most popular initiatives among rural municipalities, commuter municipalities and provincial municipalities, but not among capital municipalities. Similarly, almost all rural and provincial municipalities describe initiatives concerning open-terrain solar PV, while capital municipalities have rooftop solar PV among their top initiatives. A similar relationship is seen with regard to installation of wind turbines, which is a popular initiative among all types of municipalities except for the capital municipalities.

Initiatives to improve the municipal charging infrastructure and for electrification of the municipal vehicle fleet and public transport are priority initiatives in all types of municipalities. In metropolitan and capital municipalities in particular, focus is on structural changes to promote cycling, public transport and to change transport habits in general.

Deployment of district heating has high priority in commuter municipalities, provincial municipalities and, in particular, in capital municipalities, whereas this initiative is not among the most popular initiatives in rural and metropolitan municipalities. The lower focus among rural municipalities can be explained by inadequate energy density in the housing stock, while metropolitan municipalities, on the other hand, already have extensive district heating networks. The metropolitan municipalities have a unique challenge with managing large fossil-fuel-based power plants, and this is reflected in CCS initiatives and initiatives to phase-out coal.



Table 12: Common climate action initiatives in various types of municipalities, broken down by *electricity from renewable energy sources*, *heating and energy-efficiency improvements*, *transport and mobility*, and *agriculture and land use*.

	<i>Initiatives applied by all or almost all municipalities</i>	<i>Initiatives applied by the majority of municipalities (>75%)</i>
<i>Rural municipalities</i>	<ul style="list-style-type: none"> • Photovoltaic solar modules in open terrain 	<ul style="list-style-type: none"> • Green public transport • Supporting electric vehicles • Afforestation • Setting aside carbon-rich soils • Wind turbines
<i>Commuter municipalities</i>	<ul style="list-style-type: none"> • Green public transport • Afforestation • Setting aside carbon-rich soils • Photovoltaic solar modules in open terrain • Energy efficiency improvements and energy savings in the building stock 	<ul style="list-style-type: none"> • Promoting cycling • Supporting electric vehicles • Wind turbines • District heating deployment • Phasing out individual oil-fired and natural-gas-fired boilers
<i>Provincial municipalities</i>	<ul style="list-style-type: none"> • Promoting cycling • Energy efficiency improvements and energy savings in the building stock • Phasing out individual oil-fired and natural-gas-fired boilers 	<ul style="list-style-type: none"> • Supporting electric vehicles • Green public transport • Green municipal vehicle fleet • Afforestation • Setting aside carbon-rich soils • Wind turbines • Photovoltaic solar modules on rooftops • Photovoltaic solar modules in open terrain • District heating deployment • Phasing out fossil fuels from district heating, replacing with RE or electricity
<i>Metropolitan municipalities</i>	<ul style="list-style-type: none"> • Supporting electric vehicles • Green public transport • Changing transport habits • Promoting cycling • Promoting public transport • Afforestation • Wind turbines • Photovoltaic solar modules in open terrain • Photovoltaic solar modules on rooftops • Phasing out coal at power plants • CCS 	
<i>Capital municipalities</i>	<ul style="list-style-type: none"> • Supporting electric vehicles • Green municipal vehicle fleet • Photovoltaic solar modules on rooftops • Energy efficiency improvements and energy savings in the building stock • District heating deployment 	<ul style="list-style-type: none"> • Promoting cycling • Changing transport habits • Green public transport • Promoting public transport



Transition indicators

Table 13 shows the transition indicators for municipalities in 2030. The table contains transition indicators from the municipalities' DK2020 climate action plans⁵ and the national target or expectation. The right-hand column describes the national target or expectation and compares this with the municipalities' transition indicators.

For many of the transition indicators, the municipalities come close to the national targets and expectations. However, only in a few cases, for example with regard to deployment of electric cars and phase-out of natural gas, boilers do the municipalities exceed the national targets or expectations. Considering the municipalities' ambitious CO₂ reduction targets, it seems surprising that the municipalities do not perform better on their transition indicators.

This could be a reflection of the challenges associated with identifying the concrete reductions initiatives needed to realise the climate action plans. If this is the case, it may nurture concerns as to whether the plans are feasible. Another explanation could be that the municipalities plans are still in process and that they were prepared while the national framework conditions for the transition were being developed. For example, the national targets for onshore solar and wind deployment were decided after many of the municipalities had already completed their climate action plans, and the regulatory framework for the deployment, including the designation of onshore areas for energy farms, has not yet to be finalised (as of September 2023). The same applies for CO₂ capture and PtX. With regard to these technologies, the municipal plans were prepared as the national framework and targets were being determined.

CONCITO will conduct a survey of municipalities in the autumn of 2023 to examine whether their expectations and targets for individual transition indicators have changed since completion of their DK2020 plans.

⁵ In a few cases, the municipalities' expectations have been updated on the basis of revised plans made available after completion of DK2020.

Indicator	DK2020 municipalities (2030)	DK target/expectation	Remarks
Phasing out natural gas for space heating	94%	100% in 2035	<p>The reduction indicates the reduction in total natural gas consumption – not just natural gas. In its <i>Denmark can do more II</i> strategy, the government has set targets for 100% renewable gas by 2030, full phase-out of natural gas-fired boilers by 2035, and accelerated deployment of district heating, so that deployment will be completed by 2028.</p> <p>Phasing out by DK2020 municipalities and the national target are not directly comparable, but the DK2020 municipalities are doing a good job and expect to come close to full phase out already in 2030.</p>
Phasing in electric cars	32%	23% in 2030 31% in 2030 (including plug-in hybrids)	<p>More or less at par with Danish Energy Agency expectations in CSO22, which projects just under 1 million green cars (electric and plug-in hybrids) by 2030. This corresponds to 31% green cars (electric and plug-in hybrids) and to 23% electric cars (excluding plug-in hybrid cars).</p> <p>Phasing in of electric cars by municipalities has been estimated for electric cars only. Thus, DK2020 municipalities overperform on 'number of electric cars' compared to expectations in CSO22.</p>
Electricity production from solar PV	21,800 GWh	Approx. 27,000 GWh	<p><i>Denmark can do more II</i> includes a target of 10-times more electricity production based on solar PV. This corresponds to around 27,000 GWh annually.⁶</p> <p>DK2020 municipalities expect to realise 81% of the target.</p>
Electricity production from onshore and nearshore wind turbines	15,700 GWh (19,400 GWh including nearshore wind)	Approx. 23,000 GWh	<p><i>Denmark can do more II</i> includes a target of doubling electricity production from onshore wind by 2030. This corresponds to around 23,000 GWh annually.⁷</p> <p>DK2020 municipalities expect to realise approx. 68% of the target.</p>
Setting aside carbon-rich soils	62,100 ha	80,000 ha	<p>The target of 80,000 ha is from the <i>agreement on a green transition of the agricultural sector</i>.⁸</p> <p>DK2020 municipalities expect to realise around 80% of the target.</p>
Afforestation	50,300 ha	60,000 ha	<p>National ambition for the forested area of Denmark to total 20-25% within one tree generation (80-100 years from the time of the decision in 2002, i.e. 2100). This requires planting around 60,000 ha new forest by 2030.</p> <p>DK2020 municipalities expect to realise more than 80% of the target.</p>
Biogas	12,300 GWh	14,500 GWh	<p>The expected biogas production in CSO22 is slightly more than 14,500 GWh.</p> <p>DK2020 municipalities expect to realise around 85% of the target.</p>

PtX	9,200 GWh	17,500 GWh	<p>The 17,500 GWh have been calculated from the lower limit in the former government's PtX strategy of 4-6 GW electrolysis capacity and assuming 50% full load.</p> <p>The DK2020 municipalities' plans for PtX are not directly comparable with the previous government's PtX strategy, as some municipalities do focus on specific projects but have actively chosen not to include these in their energy and climate action plans. For example, this applies for the HØST PtX Esbjerg project in Esbjerg Municipality.</p>
CCS	2,100 kt CO ₂	3,200 kt CO₂	CSO23 includes CCS of 3.2 million tonnes of CO ₂ ⁹

Table 13: Transition indicators for DK2020 municipalities compared with the national expectations or politically determined targets.

Initiatives cutting across municipal borders (Scope 3)

Greenhouse gas emissions can be estimated on the basis of the source of emissions, referred to as 'scopes'. There are the following scopes:

- Scope 1 - direct emissions from energy consumption by buildings, transport, industry and agriculture inside municipal borders
- Scope 2 - indirect emissions from use of energy from the supply network (electricity and district heating)
- Scope 3 - indirect emissions from goods and services consumed by the municipalities' citizens and businesses. For example, this includes CO₂ emissions from the production of consumer goods imported from abroad

DK2020 requires all Scopes 1 and 2 emissions to be included in GHG inventories, along with Scopes 1 and 3 emissions from waste generated inside municipal borders. Municipalities are therefore not required to include all Scope 3 emissions in their climate action plans. Similarly, emissions embedded in imported products are not included in the national 70% target. Nonetheless, almost all DK2020 municipalities have Scope 3 initiatives in their climate action plans. These typically pertain to citizens' food habits, procurement policy and initiatives to promote sharing economy, reuse and recycling. Table 14 provides an overview of the Scope 3 initiatives included by municipalities.

⁶Ministry of Climate, Energy and Utilities. Faktark – Firedobling af VE på land. <https://kefm.dk/Media/637917337888630707/Faktaark%20land%20VE.pdf>

⁷ Faktark – Firedobling af VE på land. <https://kefm.dk/Media/637917337888630707/Faktaark%20land%20VE.pdf>

⁸ The ambition in the *agreement on a green transition of the agricultural sector* is to set aside 100,000 ha of carbon-rich soils by 2030. This figure includes peripheral land. We have assumed approx. 20% is peripheral land, which gives an expected set-aside of 80,000 ha carbon-rich soils.

⁹ Danish Energy Agency, January 2023, memorandum on assumptions, CCS https://ens.dk/sites/ens.dk/files/Basisfremskrivning/kf23_ccs_forudsætningsnotat.pdf

Initiatives to reduce Scope 3 emissions	Share of municipalities focussing on the initiative
Green procurement agreements	62%
Climate-friendly diet and ecology (incl. teaching activities in this)	49%
Increased waste separation	49%
Sustainable building materials, CO ₂ requirements on new buildings	44%
Increased food waste recycling and reduced food waste	42%
Sustainable living	39%
Recycling building materials	35%
Circular economy	32%
GHG inventories for businesses or climate collaboration with businesses	28%
The municipality as a company: Reducing resource consumption	27%
Increased recycling or reuse of textiles	16%
Promoting 'sharing economy'	12%
Electronic equipment	6%
Promoting building renovation instead of new building	6%
International flights	5%

Table 14: List of some of the Scope 3 initiatives that DK2020 municipalities are focussing on.

Some municipalities also prepare separate Scope 3 emissions inventories. However, these inventories have a lower level of detail than the inventories of Scope 1 and Scope 2 emissions because the data basis is more uncertain and more difficult to procure.



Photovoltaic solar modules in Egedal. Photo: Egedal Municipality

5. Residual emissions

The municipalities' climate action scenarios show the pathway to a 73% reduction by 2030, compared to the level in 1990. The municipalities therefore expect to achieve reductions beyond the national reduction target of 70% in 2030. The municipalities expect to emit 21.0 million tonnes CO₂ in 2030 according to their climate action scenarios. This chapter estimates the residual emissions in 2030 and the breakdown of these emissions is compared with expectations in the Danish Energy Agency's Climate Status and Outlook report.

Table 15 shows the municipalities' emissions in the baseline year, in the BaU scenario and in the climate action scenario in 2030. The table also shows each sector's share of total emissions in the BaU scenario and the climate action scenario.

	Baseline year	BaU scenario 2030	Climate action scenario 2030	BaU scenario 2030	Climate action scenario 2030
	(million tonnes CO ₂)	(million tonnes CO ₂)	(million tonnes CO ₂)	% of total emissions	% of total emissions
Energy	14.6	5.7	-1.7	17%	-8%
- of which, fossil fuels	-		0.5	0%	2%
- of which, exports of green fuels	-	-0.1	-0.8	0%	-4%
- of which, CCS	-	0.0	-2.1	0%	-10%
Transport	12.2	10.6	9.1	31%	43%
Industry	3.6	1.8	1.3	5%	6%
Agriculture and land	17.2	15.4	11.6	45%	55%
Other	0.9	0.7	0.7	2%	3%
Total	48.5	34.2	21.0	100%	100%

Table 15: Emissions by municipalities in the baseline year, in the BaU scenario in 2030 and in the climate action scenario in 2030. The two right-most columns show each sector's share of net emissions in each scenario.

The table shows that the municipalities expect large reductions in the energy sector, in particular. According to their plans, this sector will contribute with negative emissions in 2030. The negative contribution stems primarily from CCS. However, some municipalities also recognise exports of locally produced green fuels. Residual emissions in 2030 therefore stem primarily from agriculture and land use and from the transport sector, which account for 55% and 43%, respectively, of net emissions.

Compared to national level, the municipalities' emissions show a similar sectoral breakdown. In the most recent projection of Danish emissions by the Danish Energy Agency in CS023, with a frozen-policy approach, agriculture and land use and the transport sector are projected to account for the majority of emissions in 2030. CS023 includes CCS as negative emissions not broken down by sector. This is different from the methodology used in this inventory of emissions by municipalities, which includes CCS under the energy sector, see table 15. Table 16 has estimated and adjusted the expectations in CS023 so that CCS is estimated under the energy sector and the results can be compared with the municipalities' inventories.

	Municipalities' expected CO ₂ emissions in 2030, climate action scenarios	Adjusted CSO23 projection, 2030
	% of total emissions	% of total emissions
Energy	-8%	-12%
- of which, fossil fuels	2%	5%
- of which, exports of green fuels	-4%	N/A
- of which, CCS	-10%	-12%
Transport	43%	38%
Industry	6%	11%
Agriculture and land	55%	54%
Other	3%	3%
Total	100%	100%

Table 16: Emissions by DK2020 municipalities, percentage shares of total net emissions, by sector. Emissions are from climate action scenarios in 2030. Column to the right: CSO23 emissions, percentage shares of total net emissions, by sector. Note that the estimates from CSO23 have been adjusted to make them comparable with the GHG inventories of DK2020 municipalities.

Table 16 shows the breakdown by sector in 2030 for municipalities as well as for CSO23. The table shows that the same sectors are expected to account for the majority of emissions in 2030. The CSO23 projection shows that agriculture and land use and the transport sector will account for 92% of total Danish net emissions in 2030. While as in the municipalities' climate action scenarios, the sectors are estimated to account for 98% of net emissions in 2030. Note that only the breakdown by sector should be compared, as the municipalities' plans indicate significantly larger reductions than CSO23, which projects emissions assuming no changes will be made to framework conditions and assuming no new policy measures will be introduced.

In 2050, it is expected that by far the majority of emissions will come from agriculture, land use and the transport sector. The energy sector, including CCS, is expected to account for -23% of net emissions, transport is expected to account for 38%, industry 9%, agriculture and land use 72%, and 'Other' 5%.

Emissions from agriculture, land use and transport

The municipalities' plans show that the municipalities mainly have difficulties reducing emissions from agriculture, land use and the transport sector. In their climate action scenarios, the municipalities achieve a reduction of 32% relative to the baseline year in the agriculture and land use sector, while emissions from the transport sector are only reduced by 25%. The relatively limited reductions in the transport sector are because the most effective initiatives, such as tax policy, are decided at national level and, to a certain extent, at EU level.

Within agriculture and land use, the municipality generally acts as the facilitator and approver of local development plans, etc. A municipality's influence on livestock populations, for example, is very limited, and livestock is responsible for a large share of emissions. The two initiatives in the municipalities' climate action scenarios that contribute large reductions in the sector are afforestation and set-aside of carbon-rich soils. Both of these initiatives generally rely on agreements with many different local landowners and other players, and this

can be a complex process. The municipality can play a crucial role as facilitator of this process, but it has no direct power to carry out the initiative.

Emissions from the transport sector stem mainly from private transport and heavy transport. The municipalities can improve conditions for electric cars by establishing new charging stations. They can also improve the infrastructure for bikes. Furthermore, municipalities have good opportunities to influence public transport. However, they have only a few direct instruments to reduce emissions from private transport and heavy transport.

Most of the decisions in both sectors are taken at national level. Therefore, municipalities rely particularly on the right national framework conditions for reducing emissions from these sectors.