

A scenario for:

# Danish Climate Neutrality by 2040

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**CONCITO**

DENMARK'S GREEN THINK TANK

# COLOPHON

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**Danish Climate Neutrality 2040**

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**About the sender:**

CONCITO is Denmark's green think tank. Our purpose is to contribute to a reduction in greenhouse gas emissions and to limit the impacts of global warming. We pursue this purpose as a knowledge partner for everyone who wants to accelerate the green transition and create the sustainable societies of the future. We are one of Denmark's largest green networks with around 100 members, including businesses, researchers, organizations, and individuals. CONCITO means "I set in motion" in Latin, and that is what we want to do to the climate agenda.



# Preface

Denmark's Climate Act has set a target of Danish climate neutrality (net-zero) no later than 2050, meaning that the residual greenhouse gas emissions at that point must be compensated by an equal amount of uptake.

The new Danish government wants to set a target of climate neutrality by 2045 and a target of 110% reduction by 2050, at which point Denmark will need to take up more CO<sub>2</sub> than is emitted.

In light of the latest climate science, there is a need to increase ambitions everywhere - also in Denmark - if the world is to reach the target of the Paris Agreement.

If we do not reach the target, the risk of immense consequences of climate change will increase drastically.

Signing the Paris Agreement, the rich countries have committed to take leadership in the fight against climate change.

As a green frontrunner, Denmark must take part in this leadership and show the way on a

global scale. At the same time, we can reap the potential business advantages of being a green frontrunner.

It is therefore necessary and natural that Denmark becomes climate neutral significantly earlier than 2050, which also aligns with comparable countries around us; Sweden and Germany have set a target of becoming climate neutral by 2045, and Finland by 2035.

Many of the efforts and measures that will bring us on track to climate neutrality before 2050 require clear strategies, prioritization, and decisions already in the coming years.

A number of sectors and transitional elements are entirely dependent on us making ambitious and correct decisions here and now, in order to keep the target within reach, and if we simultaneously are to avoid wrong, expensive and/or delaying choices. At the same time, long-term targets are only relevant if there is confidence in the willingness and abilities to live up to them.

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Therefore, it is important that a climate neutrality target is integrated with existing Danish climate targets.

Denmark is not on track to reach the climate target of 50-54% reduction by 2025 compared to 1990<sup>1</sup>, and a number of big decisions still remain to be made in order to make reaching the target of 70% reduction by 2030 probable, including decisions regarding the agricultural sector. Achieving both the 2025 and 2030 targets requires decisions in relation to reductions here and now, and clear priorities and measures that can ensure that we reach the 2030 target and make it possible to reach even higher ambitions.

Through the imagined futures, CONCITO makes a possible path to climate neutrality probable already by 2040 – particularly by highlighting the requirements to get there.

The path to achieving climate neutrality is illustrated as imagined futures in four different sectors in the Danish economy. Each scenario is deemed achievable technically and in terms of regulations, but it will require major political

decisions here and now to realise them.

Together, the four imagined futures form a vision for Denmark in 2040 where no more CO<sub>2</sub> is emitted than is absorbed.

The year 2040 is chosen because this year that has been mentioned by a number of stakeholders in the debate and because Denmark in principle will be able to achieve climate neutrality by 2040 if we do not slow down the pace of the green transition after 2030.

Regardless of which year the target of climate neutrality is moved forward to, the efforts and measures described in this report will still be relevant.

The imagined futures only cover emissions within Denmark's borders. They do not cover consumption-based emissions or emissions from international shipping and international aviation.

Denmark can become climate neutral already by 2040, but it requires that long term decisions are made with immediate effect.

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<sup>1</sup> Analysis: How Denmark will reach the 2025 climate target: <https://concito.dk/files/media/document/Sådan%20når%20Danmark%20klimamålet%20i%202025.pdf>



# Main messages

## **Denmark can become climate neutral already by 2040**

The combined imagined futures show that Denmark can become climate neutral by 2040. It can be achieved through significant reductions in all sectors, bringing Denmark from emissions of 78 million tons of CO<sub>2</sub>e in 1990 to residual emissions of 9.5 million tons in 2040. The remaining emissions will come mainly from agriculture and land use, which will be compensated for by negative emissions from CCS through biogenic sources, biochar, forest sequestration, and DACCS.

## **Danish climate neutrality by 2040 requires immediate decisions with long term effect**

A climate neutral Denmark already by 2040 requires that long term decisions are made with immediate effect. Many of the measures and instruments that will bring us on the path of climate neutrality requires decisions within the term of the current government.

## **Danish climate neutrality by 2040 can additionally contribute significantly to the transition in neighbouring countries**

The measures necessary to achieve Danish climate neutrality will additionally contribute to the transition in our neighbouring countries in several areas. Several of the measures chosen in the imagined futures have been so from a European and/or global perspective. Particularly important examples are:

- Export of green electricity, hydrogen, and green gas
- Stop for our net import of biomass
- Provision of infrastructure for storage of CO<sub>2</sub> from abroad
- Export of climate-friendly foods

The most central measures that need to be in place already in the coming years to achieve Danish climate neutrality by 2040 within the sectors of energy, industry, transport, as well as agriculture and land use, are described in the box below.

# Key measures for achieving Danish climate neutrality by 2040



## Energy sector

1. Regulatory frameworks that enable an expansion of the entire Danish potential for wind power and solar panels before 2040. This includes new models that promote local acceptance of renewable energy plants on land, new supply models for off-shore wind, and increased expansion of the electricity grid.
2. Expansion of infrastructure for transport and export of electricity and hydrogen as well as transport and storage of CO<sub>2</sub>.
3. Incentives for negative emissions to ensure that CO<sub>2</sub> from waste incineration, industry, and biogas upgrades is stored. This can be achieved, for example, through a fixed subsidy at the same level as the CO<sub>2</sub> tax, which is expected to be 750 DKK/ton in 2030, increasing towards 2040.



## Industry sector

1. Political guarantee of a high CO<sub>2</sub> tax, which will assure the industry that investments in the transition will pay off.
2. Frameworks for the expansion of the electricity grid to ensure that companies wanting to electrify can get connected fast.
3. Subsidies for storage of biogenic CO<sub>2</sub> from companies to create an incentive to switch to green fuels and use CCS.



## Transport sector

1. A cap on the number of cars with internal combustion engines (ICE cars) on the roads after 2040. As cars have an average lifespan of about 15 years, it will require regulation that de facto puts a stop to the sale of ICE cars from 2025.
2. A higher CO<sub>2</sub> tax on road transport, i.e., on diesel and gasoline. This will make it more expensive to drive in the remaining ICE cars. Thus, they will end up primarily being owned by people who drive very little.
3. A decision to work towards a more resource-efficient transport system, supported, among other things, by road pricing.



## Agriculture and land use sector

1. An agreement on a climate tax on agriculture, where multiple measures can be utilised, including management of livestock manure, rapid withdrawal of carbon-rich soils from agricultural production, reduced emissions from cow digestion and reduced emissions of nitrogen fertiliser for the fields.
2. Allocation of funds to improve knowledge of emissions from farms as well as a public entity for rapid verification of the effect of measures.
3. Strategy for prioritisation of residual biomass in the agricultural sector in order to identify and plan how much should be used for biochar, biogas, and combustion, while taking soil fertility into consideration.
4. The regulatory framework for companies producing alternative proteins must be improved.



# Summary

The scenario for Danish climate neutrality by 2040 consists of imagined futures for four sectors: 1) Energy, 2) Industry, 3) Transport, and 4) Agriculture and land use, which, when combined, results in a climate neutral Denmark. For each sector, it is described how the emissions can be reduced and how CO<sub>2</sub> can be sequestered in order to achieve a balance between emissions and uptake. The four imagined futures are not predictions of development in the sectors in the coming years, but instead CONCITO's professional assessment of a sustainable path to climate neutrality, which is deemed achievable both technically and in terms of regulation.

The four imagined futures depict just one possible path to climate neutrality. This choice has been made to reduce the complexity of the report. Other important paths containing e.g. greater behavioural changes are thus not included in this

project but hold the potential to make significant contributions.

Climate neutrality can be achieved with other combinations of measures and technologies than the ones that are described in imagined futures. The purpose of this report is to illustrate what it will require if we wish to achieve Danish climate neutrality by 2040.

The imagined futures are based on existing data and other stakeholders' scenarios and analyses as well as CONCITO's own professional assessments. For each sector, we describe the most important measures for realizing the imagined futures, as well as the technical prerequisites and dilemmas that the imagined future entails. Socio-economic analyses have not been carried out in relation to the costs of the transition, but arguments for the most optimal path from a societal point of view are pointed out.

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## Why 2040?

2040 as a target year is a natural and necessary baseline for a country like Denmark. There are several reasons for this, including:

- The climate science shows that we need to increase the pace of the green transition. A 2040 target will support the necessary climate action now, whereas a 2045 target will allow us to slow down the pace, as it does not require further action in several sectors in the short run.
- The climate science shows that at the current level of global warming of around 1.1 degrees, there are already significant negative consequences as a result of climate change. The risk of transgressing more critical tipping points increases if global emissions are not drastically reduced. This emphasises the need for the world to keep warming at a limited level. Denmark can contribute to this through ambitious climate targets and corresponding concrete action<sup>1</sup>. Partly through Denmark's own reductions, and partly by inspiring other countries to set more ambitious targets as well.
- As indicated by the latest burden-sharing agreement<sup>2</sup>, Denmark should expect to take on a faster reduction than other European countries. This points to the need for Denmark to become climate neutral as soon as possible. The distribution principle in the burden-sharing agreement is GDP per capita. According to the agreement, Denmark is among the European countries that must reduce the most, alongside countries like Sweden and Germany.
- Moving forward the target of climate neutrality will require significant economic investments, but the more long-term the planning perspective, the greater investment security we have as a society, and the better opportunity Danish companies have for harnessing the commercial potential of the transition. Historically, Denmark has reaped business

advantages from being a first mover.

- The earlier Denmark achieves climate neutrality, the smaller the challenge will be for future generations. By setting a less ambitious target, big costs are passed onto the next generations.

Therefore, 2040 is the baseline for the imagined futures.

### The imagined futures are limited to national emissions

The imagined futures only cover emissions within Denmark's borders. They do not include consumption-based emissions, where Denmark's consumption leads to emissions in other countries. Consumption-based emissions are relevant and crucial to address but are outside the scope of this report. Consumption-based emissions are addressed in other publications and events by CONCITO, such as in the white paper: Omstilling på vippen<sup>3</sup>.

Likewise, the significant emissions from international shipping and international aviation<sup>4</sup> are not included in the imagined futures, although one could argue that our share of these emissions should also be addressed for Denmark to contribute with its share to the global green transition. Addressing these emissions will require increased energy consumption and thus less net export of green energy, lower national emissions (e.g. through reduced agricultural production), and/or additional negative emissions.

In the imagined futures, Denmark's export of green energy to other countries is magnitudes greater than the energy consumption necessary to produce green fuels for international transport. Exporting green energy to other countries is prioritised because the benefit for the climate is deemed higher than when using it for ship and aircraft fuels.

The issue of leakage is addressed in the section on agriculture and land use. Calculations of potential leakage have not been made, but minimising leakage and biomass imports have been considered when developing the imagined

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1 The Danish Council on Climate Change: Denmark's Climate Targets 2022.

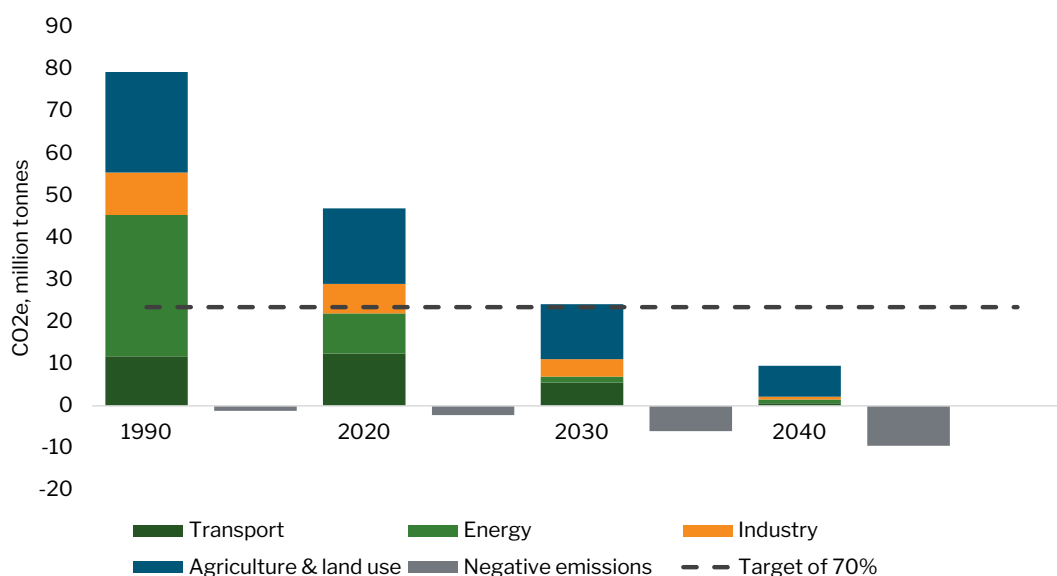
2 KOM (2021) 555.

3 <https://concito.dk/nyheder/ny-hvidbog-klimaaftrykket-fra-danskernes-forbrug-skal-mindskes-markant>

4 In 2019, shipping and aviation emitted 2.2 million tons and 3.1 million tons of CO<sub>2</sub>, respectively (DCE, 2019). 2-3 times higher, if the so-called "non- CO<sub>2</sub>" effects (such as contrails) are included



Figure 1: Emissions and uptake in CONCITO's scenario towards climate neutrality by 2040.



Source: CONCITO's own scenarios based on the report from the Danish Council on Climate: Climate Status and Projection 2022.

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### A climate-neutral Denmark by 2040

The imagined futures show that Denmark can become climate neutral already by 2040 and what it requires. In 2020, Denmark's emissions were 45.5 million tons CO<sub>2</sub>e<sup>5</sup>.

CONCITO's imagined futures show a possibility for achieving climate neutrality with residual emissions of around 9.5 million tons of CO<sub>2</sub>e in 2040, which are offset by negative emissions. This means that we can reduce emissions to less than a quarter of what they are today.

It also means that reductions of more than 10 million tons of CO<sub>2</sub>e are needed between 2030 and 2040 – assuming that Denmark achieves its 70% target in 2030.

Emissions and uptake of greenhouse gasses in the four sectors are illustrated in Figure 1 below. As the figure shows, emissions in all sectors will almost reach zero towards 2040 – except for agriculture and land use, where the residual emissions are offset by 9.5 million tons of additional negative emissions annually, primarily coming from CCS of biogenic CO<sub>2</sub> from waste, biogas upgrading and industry, biochar, and a smaller contribution from forest uptake.

The emissions from the industry and energy

sectors will be reduced so much that there will be very limited residual emissions left in 2040.

If the imagined future for the energy sector is realised, all coal, oil, and natural gas will be phased out of the production of electricity and district heating by 2030, and the burning of biomass in 2040 will be reduced to one-quarter of the current level. Denmark will produce nearly 10 times more green electricity than today and thus become a major exporter to Germany, among other countries. Denmark can hereby help our neighbouring countries become independent of fossil fuels. The cheap, green electricity will also benefit Danish companies.

Additionally, Denmark will have a climate-positive industry that contributes with net-negative emissions. The industry will be electrified where it is technically possible. The remaining processes will shift to green fuels, especially pyrolysis gas, combined with capture and storage of CO<sub>2</sub>.

Emissions in the transport sector can also be reduced so substantially that there will only be minor residual emissions left in 2040 from the remaining vehicles with internal combustion engines. This will, however, require a much faster transition to electric vehicles than today, implying that basically no new cars with internal combustion engines are sold from around 2025. Together with increasing fuel taxes, this ensures

<sup>5</sup> The scenario includes all types of greenhouse gasses. Some greenhouse gasses are more potent than others. The climate effect of the greenhouse gasses can be converted to CO<sub>2</sub> equivalents, which is shortened to CO<sub>2</sub>e.

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that almost all passenger and freight transport will be powered by electric vehicles. At the same time, it will provide a possibility to strengthen the mobility with better utilisation of cars and infrastructure.

The last remaining sector that will still have significant greenhouse gas emissions in 2040 is thus agriculture (including land use).

CONCITO recommends that Danish agriculture continues to have a significant export of food in 2040, ensuring that the sector feeds as many people as today. Emissions from agriculture can be significantly reduced, but there will still be significant residual emissions that must be offset by CO<sub>2</sub> uptake of a corresponding size.

The emissions from agriculture and forestry will be reduced to about 69% compared to the 1990 level. At the same time, CO<sub>2</sub> uptake will increase so that it constitutes 4 million tons of CO<sub>2</sub> / year. Although the sector will not reach net-zero, the overall reductions and carbon uptake will lead to a total reduction in the sector's climate impact of about 85% compared to the 1990 level.

The agricultural production will emit significantly fewer greenhouse gases per unit produced as a result of emission-reducing technology, optimisation, and a larger share of the production being based on non-animal proteins than is the case today. The latter is supported by a shift in the demand towards alternative proteins in the export markets.

### **Implications for the 70% target by 2030**

Achieving climate neutrality by 2040 requires that initiatives are put into action in the short term and that several technologies are scaled up. As a result of this, emissions will also be reduced in the short term. If CONCITO's imagined futures for the four sectors are realised, Denmark's emissions will be reduced to 18.6 million tons of CO<sub>2</sub>e in 2030.

This corresponds to a reduction of 77% compared to emissions in 1990 and would in other words exceed the 70% target.

Denmark's latest governmental Climate Program from 2022 showed that with current policies, Danish greenhouse gas emissions are expected, with great uncertainty, to decrease to around 28 million tons of CO<sub>2</sub>e in 2030, which is only a 64% reduction relative to the emissions in 1990. Thus,

there is still a gap between the current policies and the 70% target. Additionally, CONCITO has pointed out that several measures are still missing if Denmark is to achieve the 50-54% reduction target by 2025. The rapid implementation of measures in the imagined futures could have a significant impact on emissions in 2030 and a smaller effect in 2025.

### **Implications for a new 110% target by 2050**

The Danish government's coalition agreement includes a vision to reduce CO<sub>2</sub>e emissions by 110% by 2050. This means Denmark's net emissions should be -7.8 million tons in 2050.

In CONCITO's imagined futures for climate neutrality in 2040, emissions are at 9.5 million tons. These will decrease towards 2050, as, for example, emissions from the North Sea production and the few remaining vehicles with an internal combustion engine cease. Additionally, further reductions should be possible in the agricultural sector. Assuming residual emissions of 6 million tons in 2050, the total need for negative emissions will be just under 14 million tons in order to achieve the 110% reduction target.

The potential for negative emissions from biogenic sources is almost exhausted in CONCITO's imagined futures for 2040, which point to the necessity of scaling up technologies such as DACCS to achieve net uptake of the additional 8 million tons of CO<sub>2</sub> required by a 110% target. This highlights the need for early implementation of these technologies. Additionally, a 110% reduction target entails a need for further reductions in the coming years, so we will have to pay less for removing the CO<sub>2</sub> again in the future.

The number of years and the extent of how much CO<sub>2</sub> Denmark needs to remove from the atmosphere on a large scale will likely depend on our historical emissions and responsibility. This is an argument for faster reductions and for moving forward the climate neutrality target – rather than emitting more for a longer period of time and thereby passing on the bill for future generations to pay.

Already by 2030, all coal, oil, and natural gas will have been removed from the production of electricity and district heating. The central challenge in the energy sector will be to expand green electricity production and the necessary infrastructure quickly enough.