Denmark's Climate Targets

Evaluating the current targets and upcoming revision of the targets in a global perspective

English summary

Introducing the Danish Council on Climate Change

The Danish Council on Climate Change is an independent body of experts who advise the Danish government on how to transition to a climate-neutral society, thereby ensuring that, in the future, we can live in a country with very low emissions of greenhouse gases while retaining our level of welfare and development. Each year, the Danish Council on Climate Change assesses whether the government's climate efforts have demonstrated that Danish climate targets are likely to be met. The Council also contributes to the public debate and regularly prepares analyses and recommendations for climate efforts.

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1 Main conclusions

The Danish Council on Climate Change has an official advisory role in setting climate targets
The 2020 Danish Climate Act sets the framework for Danish climate policy. Among other things, the Act governs how and when national climate targets are to be decided, and it describes the institutional setup and tasks of the Danish Council on Climate Change. One of the tasks of the council is to assist the government and Parliament in setting future climate targets, and this report is the council's first input to the discussions on updating current targets and formulating a new 2035 target.

The Climate Act makes climate targets highly topical. Every five years, the government must present a new climate target with a 10-year horizon. The next climate target needs to be agreed in 2025, and it will set the ambition for 2035. In addition to this, the Act states that, after a general election, the incoming government must review the existing 2030 target. The current 2030 target is a 70% reduction in all domestic greenhouse gas emissions compared to emissions in 1990.

Box 1: This is an abbreviated version

This report is an abbreviated version of the original Danish report. The original report was published in December 2022.

This English version aims to bring the council's conclusions and methodology to a broader audience, and it explains the Danish context in greater detail, since the international reader may not be so familiar with Danish climate policy.

For further information or details related to conclusions, assumptions or methodology, please contact the secretariat of the Danish Council on Climate Change at mail@klimaraadet.dk.

This report investigates whether Danish climate targets align with the Paris Agreement
The main objective of this report is to present an analytical framework to answer the following question: Are the current or potential future Danish climate targets aligned with the Paris Agreement's ambition: "*holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels*"?

Since the Paris Agreement's ambition is open to interpretation, there is no single definitive answer to this question. According to our report, the answer depends on three questions:

- How do you interpret the temperature goal of the Paris Agreement?
- What level of certainty for keeping temperatures below a given threshold do you aim for?
- What is a fair contribution from Denmark to reaching the global temperature goal?

Only under certain conditions can the Danish climate targets be considered to align with the Paris Agreement
The table below shows different combinations of answers to the three questions above. As shown, only in two of the total 12 combinations can Denmark's climate targets be said to align with the temperature goal in the Paris Agreement. Put simply, the Danish targets are only Paris-aligned if you allow a 1.5°C overshoot, grant the same emissions per capita to Denmark as the rest of the world, and use the median temperature estimate of the climate model applied.

Table 1 Are Denmark's climate targets aligned with the Paris Agreement's temperature goal?

		Certainty	Temperature goal		
			1.5°C	*Overshoot 1.5°C*	*Well below 2°C*
Ethical principle for Denmark's contribution	*Equal emissions per capita*	*50%*	No	Yes	Yes
		67%	No	No*	No*
	"Fair share" calculation	*50%*	No	No	No
		67%	No	No	No

Note 1: "*1.5°C*" is defined as the maximum peak temperature increase allowed. "*Overshoot 1.5°C*" is defined as having a maximum temperature increase in 2100 of 1.5°C. "*Well below 2°C*" is defined as a maximum peak temperature increase of 1.8°C.

Note 2: "No*" means that the limits described in note 1 are only marginally exceeded.

Note. 3: "*Fair share" calculation* is based on a study by Rajamani *et al.* (2021).

Source: Danish Council on Climate Change

Conclusions are based on a new methodology

The literature on how different entities are aligned with the Paris Agreement is large and primarily employs the same methodology based on the IPCC's carbon budgets. The Danish Council on Climate Change has also applied the carbon budget approach in a previous analysis.[1] However, the budget methodology has some weaknesses, in that it uses a somewhat inaccurate translation of greenhouse gasses into CO_2 equivalents and because it neglects the timing effect of emissions. To remedy these weaknesses, the council has applied a pioneering approach using a climate model that translates a global emissions trajectory into a global temperature trajectory. Scaling projected Danish emissions to global level reveals the temperature trajectory Denmark is contributing to. This alleviates the weaknesses of the budget methodology and clearly illustrates any potential overshoot of the climate target. The methodology is described in greater detail in chapter 3.

Higher targets for methane reductions will increase Denmark's contribution to the global temperature goal

Given the current situation, in which existing targets are under revision and new targets are to be formulated, it is interesting to see how raising the Danish climate targets could contribute to the global temperature goal.

The current target of a 70% reduction in 2030 could be raised to e.g. 75% or 80% compared to 1990. The upcoming 2035 target could be more ambitious than a linear reduction path to the net zero target in 2050 would imply, and/or the net zero target could be brought forward. Since the Danish version of this report came out, the latter option has actually been brought into play, as the new government that came into power in December 2022 has proposed a net zero target for 2045 and a 110% reduction target for 2050. However, at present these targets have not been written into the Climate Act.

Higher targets are not the only way to increase a country's climate contribution. This analysis shows that reducing short-lived potent greenhouse gasses such as methane can have a disproportionate effect on warming. More specifically, reducing methane can reduce the peak temperature more than the same CO_2 reductions, when measured in CO_2 equivalents (CO_2e). This insight is especially relevant for countries with large agriculture sectors and/or countries with a large production of fossil fuels.

2 The global temperature goal

The UNFCCC sets the global climate goal

In 1992 the United Nations (UN) formulated its overall climate change objective. The objective is that greenhouse gas concentrations should be stabilized at a level that will prevent dangerous anthropogenic interference with the climate system. What was considered dangerous anthropogenic interference with the climate system was not well defined at the time.

Prior to the climate negotiations in Paris in 2015 (COP21), the United Nations Framework Convention on Climate Change (UNFCCC) carried out a review of climate science literature. The review concluded that 2°C warming could not be considered a safe level of warming and thus was not in line with the UNFCCC goal from 1992 of avoiding dangerous anthropogenic interference with the climate system. This influenced the negotiations at COP21, where the temperature goal in the Paris Agreement was formulated as "*holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels*".

The temperature goal of the Paris Agreement is ambiguous

When evaluating whether or not a country or other entity is aligned with the Paris Agreement, it is necessary to look closer at the actual wording of the temperature goal in the Paris Agreement. The goal is not unambiguous and leaves room for interpretation. The two main questions that arise from the Paris Agreement goal are:

- Can the goal be temporarily exceeded, i.e. is 'overshooting' allowed?
- What temperature goal is considered, 1.5°C or "well below" 2°C?

This gives rise to the four different interpretations outlined in Figure 1. Besides these two questions, there is also the question of certainty and risk mentioned previously.

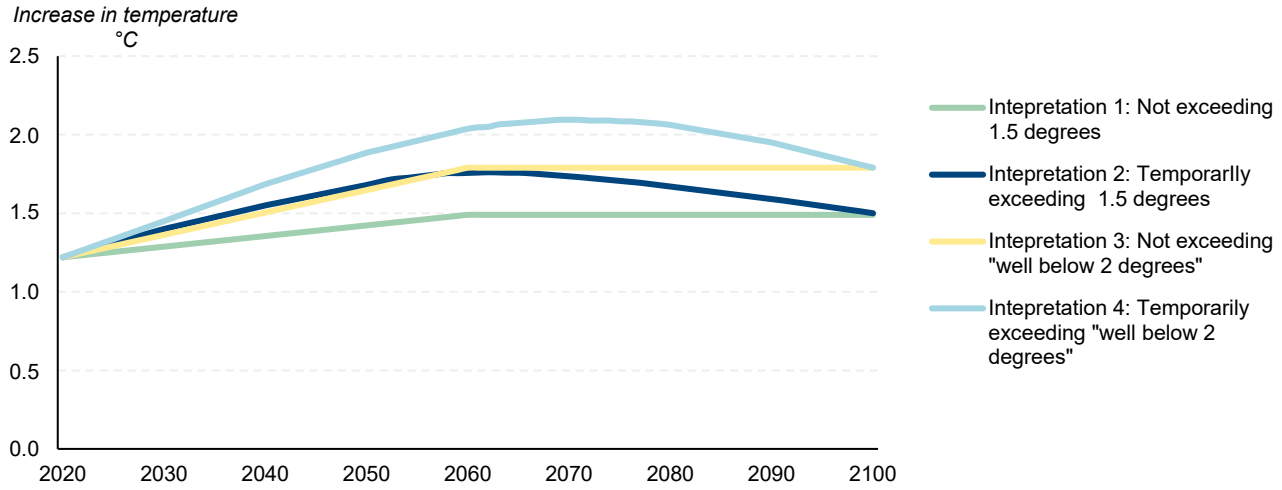

Figure 1 Stylized temperature trajectories following different interpretations of the Paris Agreement's temperature goal

Source: Danish Council on Climate Change .

Every increment of warming matters

Different temperature trajectories have different consequences. The 2018 IPCC 1.5°C report showed that a world in which the global average temperature was limited to 1.5°C would experience significantly fewer heatwaves, lower sea level rise, less coral bleaching, less extreme weather events and decreased risk of poverty compared to a 2°C world.[2]

Unfortunately, the world is not headed towards 1.5°C. With the current national pledges for 2030, the world is heading towards 2.2-2.4°C warming in 2100 (50% likelihood).[3] Even at today's level of warming of about 1.1°C, we see significant consequences of a changing climate in all parts of the world.[4] The IPCC's latest report shows that temporarily overshooting the 1.5°C target would increase the risk of irreversible changes in the climate system.[5]

Tipping points can accelerate climate change

There are thresholds in the climate system that, if crossed, could trigger abrupt, self-reinforcing, and potentially irreversible changes in particular parts of the climate system. These thresholds are also called *tipping points*. If a tipping point is exceeded, it can result in the melting of the Greenland and Antarctica ice sheet, loss of the Amazon rainforest, permafrost melting, and changes in ocean currents.

Exceeding certain tipping points also results in increased warming. Exceeding one tipping point will increase the risk that another tipping point, which is exceeded at a higher level of warming, will also be exceeded. In a worst-case scenario, this could trigger a domino effect, with one tipping point setting off another and resulting in a trajectory of increased warming and accelerating climate impacts. A recent article estimates that several tipping points might already have been crossed at the current level of warming, and that the risk of crossing more tipping points will increase as the global temperature increases. [6]

The existence of tipping points warrants precaution

The uncertainty surrounding tipping points and other self-reinforcing processes in the climate system means that the projections of climate models should be interpreted with caution. The future scenarios of the models may superficially give the impression that humans have a high degree of control over future temperature developments and the associated climate impacts. The current climate models show that, if we manage to stop global emissions, the temperature will stabilize. And if we later start removing CO_2 from the atmosphere, we can even achieve global cooling. This impression of control encourages a mindset that it doesn't matter much if the temperature becomes slightly higher than desired, as we can always lower it again. It is currently likely that we do still have control over temperature developments, but increasing understanding of tipping points shows that we risk losing this control.

The original goal of the Climate Convention was to prevent dangerous climate change. Despite the ambiguity of the temperature goal in the Paris Agreement, climate science shows that there are already significant negative consequences due to climate change at the current warming level of approximately 1.1 degrees. At the same time, some scientists believe that there is a risk of crossing multiple tipping points. This means that the world should exercise caution and aim to keep warming at a limited level. Even seemingly small reductions in the temperature increase will reduce the risk of dangerous and uncontrollable climate change. Denmark can contribute to this through ambitious climate targets and accompanying concrete actions.

3 A framework for evaluating climate targets in a global perspective

This analysis examines whether the Danish climate targets are aligned with the temperature goal of the Paris Agreement. The Danish climate targets cover the territorial emissions of Denmark, which makes these emissions the main focus of this analysis. However, territorial emissions are not the only relevant emissions to consider when conducting climate policy. For instance, in recent years the public debate has started to include the element of consumption-based emissions. The consumption-based emissions of many developed countries remain high, even though their territorial-based emissions have declined.[7]

The budget methodology has significant drawbacks

CO_2 budgets are commonly used to assess a country's climate targets. This method involves comparing the expected cumulative CO_2 emissions of a country over a specific future time horizon with a global CO_2 budget, usually based on the IPCC's CO_2 budget.

The CO_2 budget method has some disadvantages. An important disadvantage is that it only takes into account CO_2 emissions and *not* other greenhouse gases such as methane and nitrous oxide. This matters very much for a country like Denmark, which has relatively high emissions of methane and nitrous oxide compared to world averages. In 2021, at global level, CO_2 amounted to approximately 70% of greenhouse gas emissions, with methane and nitrous oxide making up the majority of the remaining 30%. At national level for Denmark, CO_2 emissions accounted for a little less than 70% in 2021, but CO_2 emissions are projected to be about 50% of emissions in 2030, with methane and nitrous oxide making up almost all the remaining 50%.[8] Using the CO_2 budget method to evaluate Danish targets can thus provide misleading results.

Using a greenhouse gas budget (CO_2e budget) can alleviate some of the disadvantages of the CO_2 budget method. A greenhouse gas budget based on CO_2e includes all greenhouse gases, but the method still has some important drawbacks:

- Translating greenhouse gases via the standardized global warming potential framework (GWP 100) is inaccurate, especially given the expectedly short time horizon before the temperature goal of the Paris Agreement will be exceeded.
- The budget methodology does not reflect that the timing of emissions is important.
- Overshooting the budget can be difficult to identify since later negative emissions can neutralize the overshoot. Thus, the budget method might overlook the degree of overshoot that a given emissions trajectory will produce.

This analysis employs a new method: the climate model method

The current report uses a climate model to evaluate Denmark's contribution to reaching the temperature goals in the Paris Agreement. This approach involves firstly determining Danish emissions of the individual greenhouse gasses given the relevant climate targets. These emissions can then be scaled up to global level by applying a similar procedure to the budget method. The emissions are then analyzed by using the climate emulator MAGICC,[9] and the result is a trajectory for the global temperature which then can be compared to the goal in the Paris Agreement. Figure 2 illustrates and compares the two methods. MAGICC is described further in Box 2.

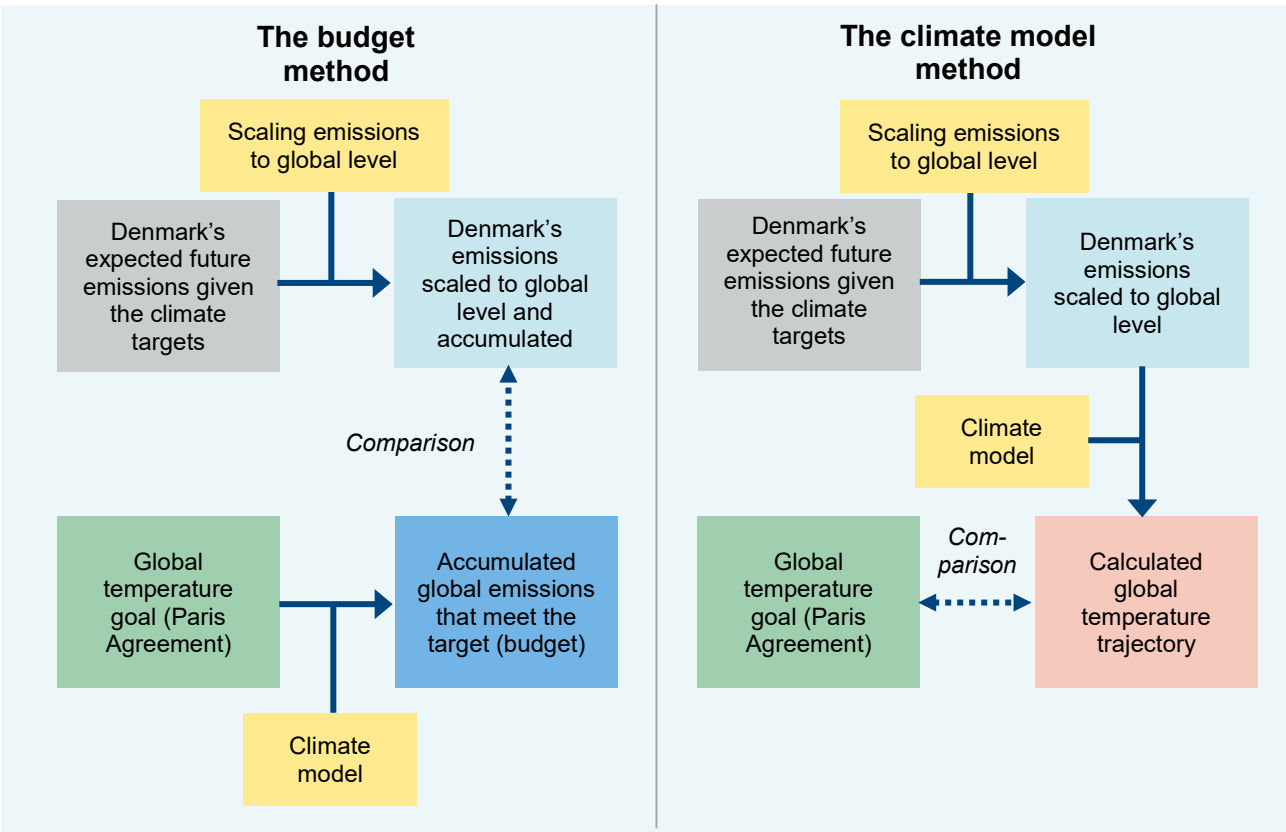

Figure 2 Comparing the budget method with the climate model method

Source: Danish Council on Climate Change.

The climate model method has similarities with the budget method. Both methods are based on a hypothetical scenario in which Denmark is assumed to represent the entire world. This means that the starting point for both methods is to scale up Danish emissions to global level. Scaling up Danish emissions reveals the global temperature trajectory Denmark contributes to. In analyses using the budget method, the scaling is often described as distributing the CO_2 or CO_2e budget to countries based on their size. However, this is mathematically the same as scaling up a country's emissions to global size.

In many instances, scaling is based on the country's share of the global population. However, the choice of scaling principle is based on ethical considerations about the distribution of global emissions, even if this is not stated explicitly. For instance, scaling up emissions on the basis of population share reflects an underlying ethical principle that all people are allowed to emit the same amount of greenhouse gasses in the future. However, there is no single, commonly accepted principle of fairness, and arguments for developed countries having to contribute more to the fight against climate change than developing countries are common. The choice of scaling principle is discussed further in chapter 4.

Box 2: What is a climate emulator?

Climate models are an essential tool in climate science. Climate models give us an understanding of the climate system in the past, present and future. The models work via a series of equations that represent processes in the atmosphere, oceans, land areas, biosphere and cryosphere, as well as interactions between the various systems. The complexity of the climate system means that climate models often become so complicated that they require supercomputers and specialists to run them, making them both time-consuming and resource-intensive to use. Models are therefore not used when analyzing a large number of different scenarios or for analyzing the same scenario with different variations in the model's assumptions.

Instead of large climate models, researchers often use climate emulators for scenario work. Climate emulators are simpler models programmed to mimic the results of the major climate models, but with focus on a few key aspects of the climate system. The climate emulator used in this analysis, MAGICC, calculates a global, annual temperature, defined as an average for the globe, but it does not have the spatial granularity required for estimating the temperature or the amount of precipitation in a particular region. MAGICC calculates the temperature based on emissions of greenhouse gases, which the user sets as an input.

Climate emulators are especially useful for analyzing:

- **Scenarios.** When integrated assessment models create scenarios for greenhouse gas emissions, a climate emulator such as MAGICC can be used to estimate the mean global temperature increase. For the IPCC's 5th assessment report, more than 1,000 different scenarios were analyzed, and for the 1.5 degree report more than 400 scenarios. This is really only possible in climate emulators, as it would be far too expensive to use the large climate models for this many scenarios.
- **Uncertainty.** Climate emulators are less complex and easy to run, so it is possible to analyze the same greenhouse gas emissions trajectory with varying parameters in the emulator. This is useful since there is uncertainty about the parameters. Climate emulators can illustrate the impact of this uncertainty. For MAGICC, 600 different combinations of central parameters have been defined, and these combinations have been used in the IPCC's reports to provide an uncertainty range for the temperature development.

4 Evaluation of Denmark's current targets

This chapter applies the methodology described in chapter 3 and analyzes to what extent Denmark's current climate targets are aligned with the temperature goal in the Paris Agreement. First a reference scenario is described, and subsequently the most important assumptions in the reference scenario are analyzed.

Denmark's current targets will most likely not limit the temperature increase to 1.5°C

The reference scenario assumes that Denmark fulfils its current climate targets. The current targets are reduction of greenhouse gas emissions of 50-54% in 2025, 70% in 2030, and to achieve climate neutrality by 2050. Since the publication of the Danish version of this analysis in December 2022, a new Danish government has proposed to bring forward the year for climate neutrality to 2045 and achieve 110% reduction in 2050, but these proposals have not yet been adopted in the Climate Act.

The climate emulator, MAGICC, calculates the global temperature increase resulting from the emissions scenario that these targets represent. The median estimate for the global peak temperature increase is about 1.7°C. This is shown by the green curve in Figure 3. The curve represents the median estimate for the global temperature increase that Denmark's current climate targets can be translated into if the emissions are scaled up to global level. As Figure 3 shows, the temperature clearly rises above 1.5°C. However, after 2050, the temperature decreases again, and by the end of the century, the increase in temperature is below 1.5°C. The median temperature increase does not exceed 2°C at any point.

There is significant uncertainty about a number of parameters in the climate system. This translates into significant uncertainty about the global temperature increase that Denmark's current climate targets translate to if emissions are scaled up to global level. Figure 3 illustrates this uncertainty by including the 17%, 33%, 67% and 83% percentiles. Thus, whether or not Denmark's climate goals match the temperature goals in the Paris Agreement depends not only on how these temperature goals are interpreted, but also on the degree of risk aversion.

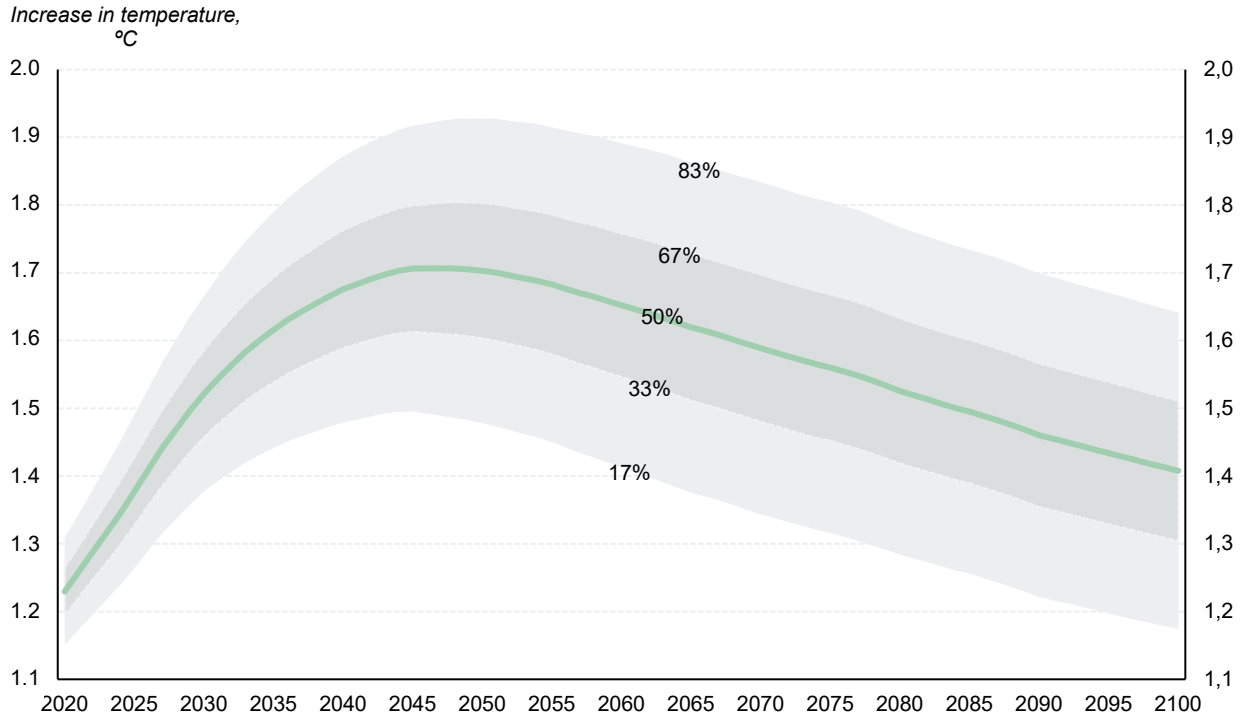

Figure 3 Temperature trajectory based on scaling up Denmark's current climate targets to global level

Note 1: The figure shows the calculated increase in the global temperature when Denmark's emissions are scaled up to global level.

Note 2: The percentages indicate the probability of the temperature staying below the given temperature trajectory.

Note 3: The uncertainty ranges around the median are estimates based on the uncertainty ranges of the IPCC's SSP1-1.9 scenario in the sub-report by Working Group 1 in the 6th Assessment Report.

Source: Calculations by the Danish Council on Climate Change based on MAGICC7 and IPCC, 6th Assessment Report (Working Group 1), 2021

Important assumptions regarding the reference scenario

The temperature trajectory of the reference scenario shown in Figure 3 relies on a set of assumptions. The main assumptions are:

- **The scaling principle.** In the reference scenario, Denmark's emissions are scaled up to global level based on the Danish population's share of the total global population.
- **Share of different greenhouse gases.** The shares of the different greenhouse gases are based on the Danish Energy Agency's annual frozen policy projection of Denmark's greenhouse gas emissions, *Denmark's Climate Status and Outlook 2022*. Based on this projection, we have added the expected effect of political agreements adopted after the latest of the agency's projections as well as the government's strategy for fulfilling the Danish 2030 target.
- **International shipping and aviation.** Emissions from shipping and air transport are included in the reference scenario, even though the international share of these emissions is not part of the Danish climate target. Emissions from international shipping and aviation are assumed to be reduced to zero in 2050, similar to other emissions.
- **Emissions after 2050.** Since Denmark currently does not have climate targets after 2050, it is assumed that Denmark's emissions converge to the emissions in the IPCC's SSP1-1.9 scenario in 2100, which has global net negative emissions of about 10 billion tonnes of CO_2e.
- **Emissions in the years between targets.** The reduction trajectories between the targets in 2025, 2030 and 2050 are assumed to be linear.

Denmark's temperature contribution is lower than the world average

Figure 4 shows the median estimate from the reference scenario of the scaled up Danish emissions (green curve) compared with the temperature trajectory of the world (yellow curve) and the EU (blue curve) respectively. The trajectory of the world shows the expected temperature trajectory if all countries fulfill their climate targets including net zero targets they declared at COP27. The EU's trajectory has been created in the same way as the trajectory for Denmark, i.e. by scaling up to global level the emissions of the EU aligned with the present European climate goals (55% in 2030 and net zero in 2050). As seen in Figure 4, the temperature trajectory based on the present Danish climate targets is lower than the world average, with peak temperature around 1.9°C in 50 years, after which the temperature is expected to decrease moderately until 2100.

Denmark's contribution to global warming is on par with the EU average, when scaled up to global level. Because emissions of methane and nitrous oxide account for a significantly smaller share of total emissions from the EU compared to Denmark, the climate effect of the EU's climate goals is not significantly worse than the equivalent effect of Denmark's climate targets, even though the per capita CO_2e emissions are higher in the EU than in Denmark.

When comparing Denmark's contribution toward the goals to the rest of the world, the temperature trajectory is significantly lower, as indicated by the gap between the green and yellow curves. Note, however, that representations such as Figure 4 have limitations. For example, the model does not take into account that Denmark has higher consumption-based emissions compared to the rest of the world. A different scaling principle could also have been applied, which might have yielded different results. Lastly, the figure looks at the different goals of the countries and not their actual implemented policies. Reports that have analyzed the current policies show that the world is headed towards 2.5 °C of warming.[10].

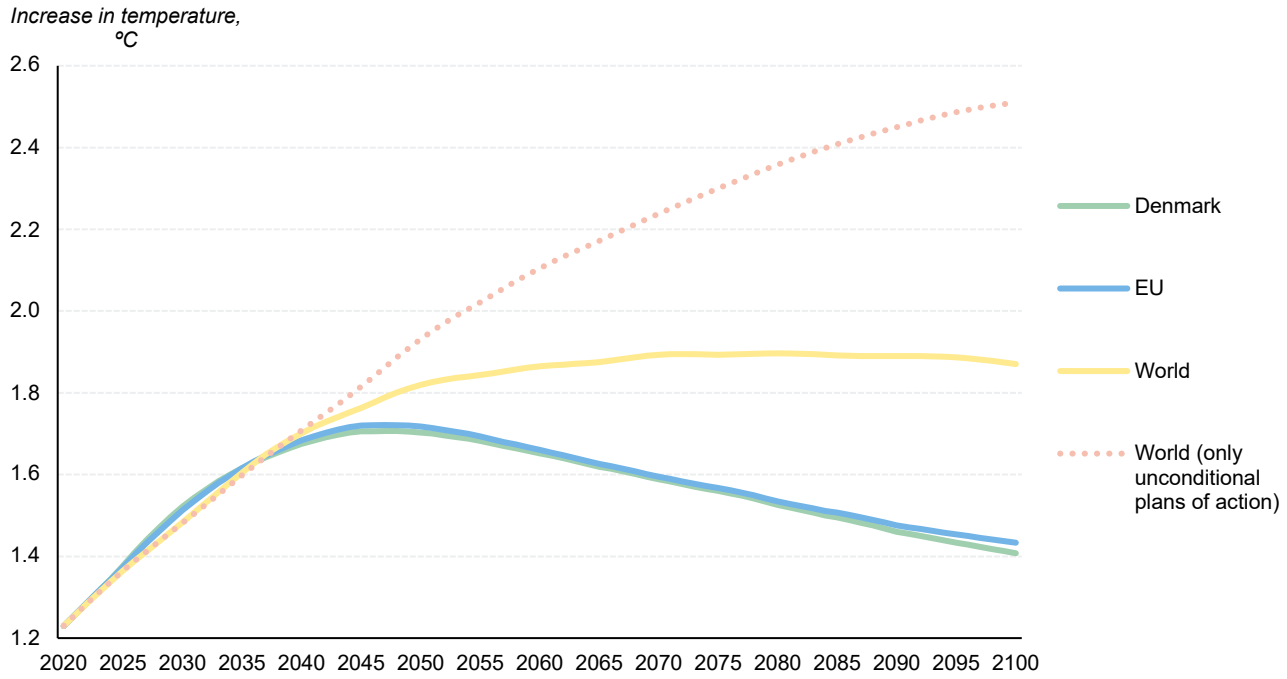

Figure 4 Comparing Denmark's climate targets to the world and EU average

Note 1: The figure shows the estimates of the median with 50% probability of the stated temperature being either higher or lower.

Note 2: The world's temperature trajectory was calculated by Meinshausen *et al.* based on the countries' nationally determined contributions (NDCs) stated prior to COP27.

Source: Calculations by the Danish Council on Climate Change based on MAGICC7 and Meinshausen *et al.*[11]

The scaling principle heavily impacts the results

As previously mentioned, the reference scenario in this analysis is based on a principle of scaling emissions according to population share. This corresponds to the hypothetical scenario in which the emissions per capita at global level equal the per capita emissions in Denmark. This is based on an ethical principle of equality where everyone has the right to emit the same amount of greenhouse gases, regardless of their past emissions. This principle of scaling is often used in similar analyses and is widely used in the literature.[12] However, other principles could be used when scaling Denmark's emissions, depending on whether focus is on, for example, *equality, redistribution* or *historical emissions,* with some scaling principles being more in line with the principle in the Paris Agreement of common but differentiated responsibility, than others.

Historical emissions and wealth suggest that Denmark needs to make a large contribution to the fight against climate change and should raise its targets

The Paris Agreement states that countries should contribute to an extent which reflects their *common but differentiated responsibility and respective capabilities*. Even though this statement cannot directly be translated to a specific principle of scaling, it is clear that richer countries are expected to contribute relatively more. The principle stems from the fact that richer countries have a larger share of historical emissions (*responsibility*) and more resources to fund and promote the transition (*capabilities*).

What does the Paris Agreement mean for choice of scaling? On the one hand, using the *same emissions per capita* scaling principle does not necessarily conflict with the statement in the Paris Agreement. Converging to an equally distributed level of per capita emissions will in practice result in richer countries reducing relatively more than poorer countries, while some counties could increase the level of emissions for a period of time. On the other hand, a meta-analysis by Rajamani *et al.* on justice in global climate policy points to Denmark's responsibility being larger than implied by *a same emissions per capita* scaling. Rajamani *et al.* conclude that Denmark should reduce its 2030 emissions by approximately 130% compared to the 1990 level if Denmark is to only emit its *fair share* to reach the 1.5°C goal in the Paris Agreement. [13] In other words, Denmark should reach negative emissions in the next few years.

As this short discussion illustrates, different interpretations of the Paris Agreement or principles of fairness yield different results, and there is a very wide range of targets that could be deemed fair or not fair. Accordingly, there is no single definitive answer to what exactly Denmark's fair contribution is.

The share of the different greenhouse gases impacts the temperature trajectory

Denmark's climate targets are defined as reductions in the total emissions of greenhouse gases as measured in CO_2e. Therefore the targets do not prescribe the amount of individual greenhouse gases, such as CO_2, methane and nitrous oxide, that Denmark is allowed to emit. Nevertheless, the distribution of emissions reductions across the different gases is important. This is because some gases induce more warming per tonne of gas than others.

As a rule of thumb, according to our analysis lower methane and nitrous oxide emissions result in lower temperature trajectories. Figure 6 shows different temperature trajectories resulting from different greenhouse gas distributions when scaling Denmark's emissions to global level. The gas distributions are based on scenarios from the Danish Energy Agency's yearly outlook (Climate Status and Outlook 2022). These emissions vary depending on the amount of electrification, bioenergy, behavior change etc. they employ to reach the long-term targets. Emissions of methane and nitrous oxide are significantly lower in the scenario *new markets* than in the three other scenarios since this scenario assumes a strong shift in diets towards more plant-based food, both in Denmark and in Denmark's agriculture export markets. The blue curve in Figure 6 is based on this scenario and shows that the greater the focus on reducing emissions of methane and nitrous oxide, the lower the temperature increases within this century.

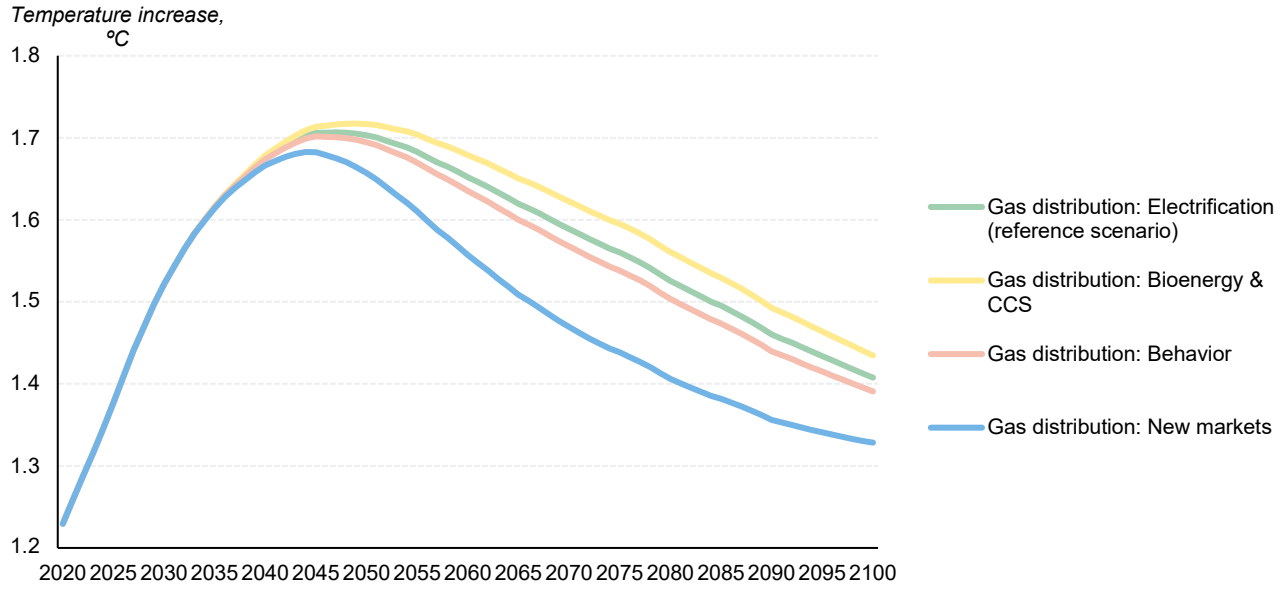

Figure 6 The impact of the distribution of reductions among different greenhouse gases

Note 1: The figure shows the calculated global increase in temperature if Denmark's emissions are scaled up to global level.

Note 2: The figure shows estimates of the median with 50% probability of the temperature being either higher or lower.

Source: Calculations by the Danish Council on Climate Change based on MAGICC7.

When focusing on the short and medium term, emissions of methane and nitrous dioxide have greater impact in the short term than the CO_2e approach would indicate. Therefore, focusing on larger reductions of especially methane emissions in the short term could lower the peak temperature. In the long term, however, emissions of CO_2 today have a greater warming effect than the other gases because of the long lifetime of CO_2.

5 The 2035 target and revision of current targets

The Danish Climate Act requires the government to adopt a 2035 target by 2025 at the latest. Which 2035 target the government chooses to adopt will influence the peak temperature as well as the temperature level in 2100. This is evident from Figure 7. If the 2035-target follows a linear trajectory between the targets in 2030 and 2050 the target would be 77.5% in 2035 compared to 1990. When scaling up the resulting emissions trajectory to global level, the result will be the temperature trajectory depicted of the reference scenario (green curve). A more ambitious 2035 target will lower both peak temperature and the temperature in 2100.

Once again it is important to highlight the uncertainty linked to the temperature trajectories. However, this uncertainty has a greater effect on the level of the temperature trajectories, while the internal ranking of the different trajectories is less affected by the uncertainty. Thus, a 2035 target of 95% will result in a higher likelihood of a scaled temperature trajectory below 1.5°C than the corresponding trajectory from the reference scenario.

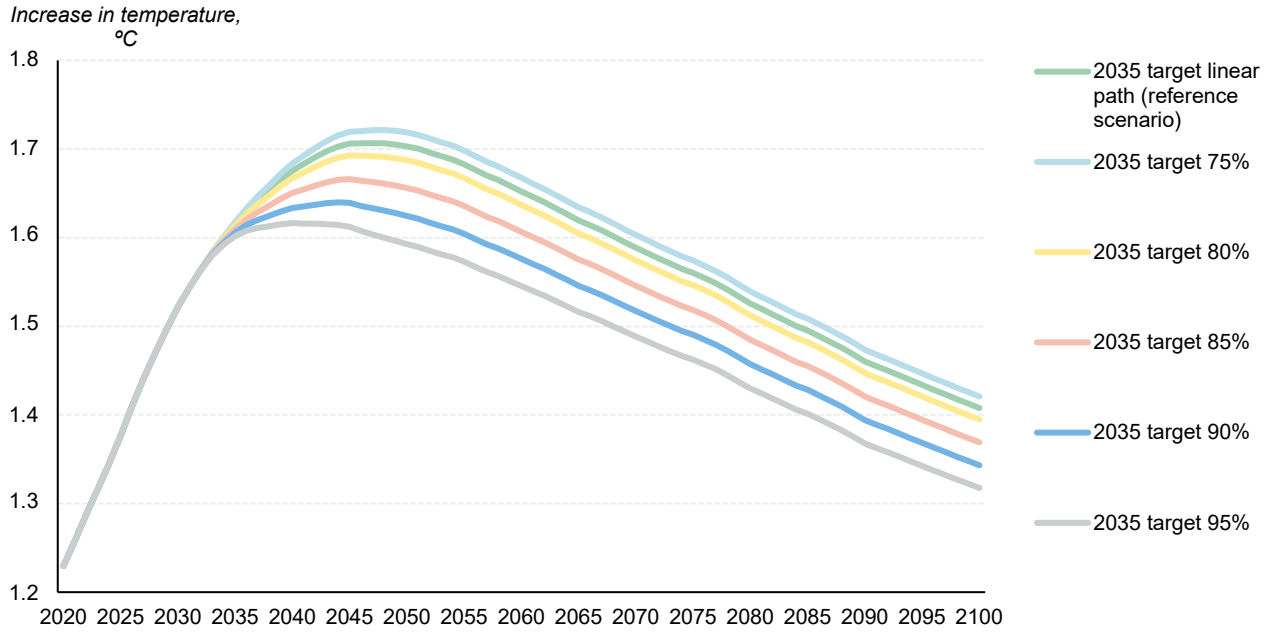

Figure 7 Temperature trajectories based on different Danish 2035 targets (scaled up to global level)

Note 1: The figure shows the calculated global increase in temperature if Denmark's emissions are scaled up to global level.

Note 2: The figure shows estimates of the median with 50% probability of the temperature being either higher or lower.

Note 3: The trajectories with different 2035 targets are based on the Danish Energy Agency's electrification scenario, which is also the case for the reference scenario.

Source: Calculations by the Danish Council on Climate Change based on MAGICC7.

Revisiting existing targets can bring down the peak temperature further

The Danish Climate Act stipulates that after every general election the existing climate targets are to be reviewed by the incoming government. Denmark held a general election in November 2022 and thus the current targets are up for review. Like the 2035 target, a more ambitious target for 2030 or advancing the net zero emissions target by one year will affect both the peak temperature and the long-term temperature. This is shown in Figure 8.

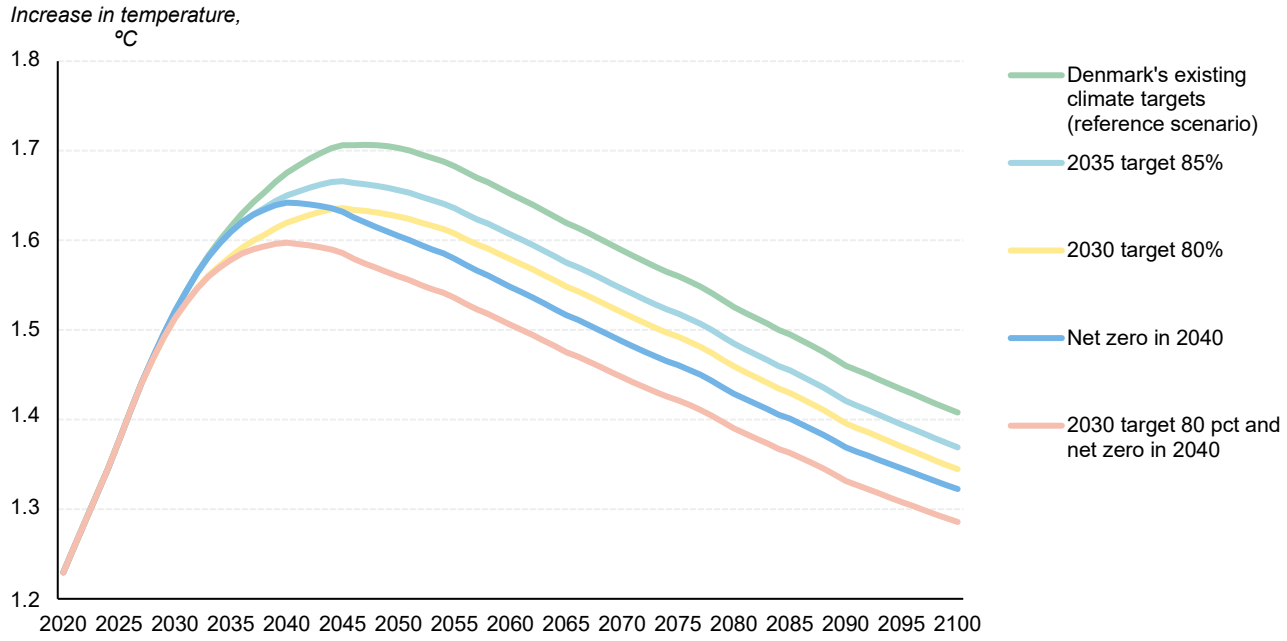

Figure 8 Temperature trajectories for revised existing targets (scaled up to global level)

Note 1: The figure shows the calculated global increase in temperature if Denmark's emissions are scaled up to global level.

Note 2: The figure shows estimates of the median with 50% probability of the temperature being either higher or lower.

Note 3: The scenarios with climate targets are based on the greenhouse gas distribution from the Danish Energy Agency's electrification scenario, which is also the case for the reference scenario.

Note 4: Linear reduction trajectories between the targets are assumed. Thus, a 2035 target of 85% is implicitly assumed both in the scenario with a 2030 target of 80% and in the scenario where net zero is advanced to 2040. In the scenario where both a 2030 target of 80% and net zero in 2040 are assumed, the implicit assumption of the 2035 target is a 90% reduction.

Note 5: The scenarios where net zero is advanced to 2040 assume that Denmark's emissions converge to the IPCC's SSP1-1.9 scenario after 2040.

Source: Calculations by the Danish Council on Climate Change based on MAGICC7.

Setting ambitious targets is important in order to lower the temperature trajectory. But it makes a difference whether the targets are reached by reducing CO_2 or by reducing other greenhouse gases. As mentioned in chapter 4, emissions of methane in particular affect the temperature in the short term. Focusing on methane reductions when closing the reduction gap of the current 2030 target could have approximately the same effect on the peak temperature as setting a more ambitious 2030 target of 80%. Table 2 highlights the scaled up temperature outcome of a number of different targets and greenhouse gas distributions.

Table 2 Overview of results from different scenarios

Scenario	Peak temperature	Temperature increase in 2100	Average temperature 2023-2100	Year of peak tempera ture	Year where temperature increase comes under 1.5°C
Reference scenario (median)	1.71	1.41	1.57	2047	2085
Reference scenario 83% percentile	*1.93*	*1.64*	*1.77*	*2050*	*>1.5ºC in 2100*
Reference scenario 67% percentile	*1.80*	*1.51*	*1.65*	*2048*	*>1.5ºC in 2100*

Reference scenario 33% percentile	*1.61*	*1.30*	*1.46*	*2045*	*2068*
Reference scenario 17% percentile	*1.50*	*1.17*	*1.35*	*2045*	*<1.5°C for all years*
Alternative climate targets*					
2035 target 75%	1.72	1.42	1.58	2048	2087
2035 target 80%	1.69	1.39	1.56	2045	2082
2035 target 85%	1.67	1.37	1.53	2045	2078
2035 target 90%	1.64	1.34	1.51	2044	2074
2035 target 95%	1.62	1.32	1.49	2040	2068
2035 target 85%, gas distribution: New markets	1.64	1.29	1.46	2042	2061
2035 target 85%, gas distribution: Behavior	1.66	1.35	1.52	2045	2074
2035 target 85%, gas distribution: Bio & CCS	1.68	1.40	1.56	2045	2084
2030 target 80%	1.64	1.34	1.51	2045	2074
Net zero in 2040	1.64	1.32	1.49	2040	2068
2030 target 80% and net zero in 2040	1.60	1.29	1.46	2040	2062
Gas distribution: New markets and focus on methane reductions in 2030**	1.64	1.33	1.48	2044	2064
2030 target 80% and net zero in 2040, gas distribution: New markets	1.57	1.22	1.38	2037	2048

Note 1: The percentiles in the reference scenario are calculated estimates based on the uncertainty ranges from the IPCC's SSP1-1.9 scenario in the sub-report of Working Group 1 in the 6th Assessment Report.

Note 2: *The figures are estimates of the median of the temperature trajectories.

Note 3: **The scenario does not include new climate targets but only a change in the gas distribution.

Source: Calculations by the Danish Council on Climate Change based on MAGICC7.

A "no overshoot" scenario requires drastic increases in ambitions

To bring Denmark's climate policy in line with the "no overshoot of 1.5°C" interpretation of the Paris Agreement would require a major effort. However, bringing the targets in line with a target to limit peak temperature increase to under 1.6°C is not out of range. This would significantly limit the period in which the temperature exceeds 1.5°C.

One way to limit Denmark's contribution to the peak temperature to 1.6°C is shown with the red curve in Figure 8. If Denmark's targets were increased to 80% reduction in 2030, 90% in 2035 and 100% in 2040 compared to 1990, the scaled up temperature trajectory would peak at around 1.6°C of warming. To reach these targets, current climate policy measures need to be scaled up significantly. Whether this is practical or economically feasible is beyond the scope of this analysis.

Alignment with the Paris Agreement is a moving target

Denmark's climate policy should be seen as a part of the global effort. If other countries fail to deliver climate action that is consistent with the temperature goal in the Paris Agreement, the global reductions needed for Denmark – or any other country – to align with the Paris Agreement will become increasingly more drastic.

Accordingly, over time, analyses like this will suggest that more and more ambitious climate targets are needed, even if the country analyzed actually sets and meets ambitious targets. The same applies to analyses that utilize the budget methodology.

Ultimately, to what extent Denmark or any other country should contribute to lowering the increase in temperature will always be a political question. Nevertheless, this analysis shows that Denmark can contribute to the fight against global warming by setting ambitious national targets and focusing in particular on reducing methane emissions.

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[3] United Nations Environment Programme, *Emissions Gap Report: The Closing Window - Climate crisis calls for rapid transformation of societies*, 2022; UNFCCC, *2022 NDC synthesis report*, 2022.
[4] IPCC, *AR6 Climate Change 2021: The Physical Science Basis*, 2021; IPCC, *AR6 Climate Change 2022: Impacts, Adaptation and Vulnerability,* 2022.
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[6] Armstrong McKay et. al, *Exceeding 1.5 C global warming could trigger multiple tipping points*, Science, 2022
[7] See for instance, Danish Energy Agency, Global Afrapportering 2022, 2022
[8] UNEP, Gap report 2022, 2022; Danish Energy Agency, Klimastatus og -fremskrivning 2023, 2023
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[11] Meinshausen mfl., *COP27 Briefing paper: One year on: We are still heading for only "just below" 2°C, if all long-term pledges are fulfilled*, 2022.
[12] Rajamani *et al.*, *National "fair shares" in reducing greenhouse gas emissions within the principled framework of international environmental law*, 2021.
[13] Rajamani *et al.*, *National "fair shares" in reducing greenhouse gas emissions within the principled framework of international environmental law*, 2021.