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Klimarådet.

Known paths and new tracks to 70 per cent reduction

Direction and measures for the next 10 years climate action in Denmark

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1. Introduction, conclusions and recommendations

On 6 December 2019, a broad majority of the Danish Parliament (Folketing) signed an agreement on a new Climate Act for Denmark to replace the existing Climate Act from 2014. The new Climate Act sets a framework for Danish climate policy based on binding intermediate targets every five years towards the target of climate neutrality by 2050.[1] The Act is expected to be passed in spring 2020.

Denmark has a new climate target for 2030

By 2030, Denmark has to reduce its greenhouse gas emissions by 70 per cent compared to the level in 1990. The 70 per cent target and the 2050 climate neutrality target mark the first time Denmark has stipulated by law targets for total Danish greenhouse gas emissions. Thus, the targets represent a new direction for Danish climate policy. Achieving the 70 per cent target by 2030, which is the subject of this report, will require substantial effort. In the 30 years after 1990, Denmark is estimated to have reduced emissions by approximately 38 per cent. This means, that almost half of the task has to be solved in the next ten years. We are therefore expecting considerable reduction efforts in the new decade, and these will impact most parts of the Danish society.

The 70 per cent target is to ensure that Denmark becomes a frontrunner in the international climate mitigation efforts. Even though the target is demanding, previous calculations by the Danish Council on Climate Change indicate that 70 per cent in 2030 and climate neutrality by 2050 are not more ambitious than necessary. The target 70 per cent target corresponds to what is needed if Denmark is to contribute to limiting the global temperature rise to 1.5 degrees Celsius. The agreement on the new Climate Act emphasises the political priority for Denmark to work actively to meet this target.

One of the most important tasks of the Danish Council on Climate Change in regards to the new Climate Act is to advise the government, on how Denmark can best meet its national climate targets and international climate commitments. For this reason, in the years to come, the Danish Council on Climate Change will focus on how Denmark can achieve the 70 per cent target in 2030. This report is the first step in that process. However, the 2030 target should not be seen in isolation, and advice from the Danish Council on Climate Change will also consider the long term perspectives for climate neutrality by 2050. In the years to come, the upcoming Climate Act will commit the Danish Council on Climate Change to make recommendations for future climate efforts at least once a year, and to establish a catalogue of possible policy instruments over time.

This report illustrates a way to achieve the 70 per cent target, taking into account that Denmark will have to adjust the course along the way, as we learn more about costs and potentials. The road to 2030 must be cost-effective, but it should also lead us towards the long-term target of climate neutrality and it should consider so-called carbon leakage, where reductions in emissions from Danish territories lead to increased emissions in other countries. This report focuses on the transition elements which are the specific changes in production and behaviour that will lead the transition towards a society with fewer greenhouse gas emissions. The report also focuses on the political instruments that will realise the various transition elements.

The costs of achieving the 2030 target

There is no doubt that achieving the 70 per cent target will entail costs for Danish society, but it is unlikely that it will have severe impacts on the Danish Economy, if measures are implemented sensibly. A rough estimate by the Danish Council on Climate Change shows that the annual socio-economic cost of achieving the target will gradually increase through the 2020s and by 2030 reach DKK 15-20 billionn compared to a scenario in which Denmark does not introduce further initiatives than those already adopted. This cost corresponds to less than one per cent of Danish gross domestic product.

Estimating the costs of such a major change in society as the 70 per cent target will always be associated with considerable uncertainty. The estimate by the Danish Council on Climate Change must therefore be considered with this general reservation. Similarly, not all positive and negative socio-economic aspects have been included in the estimate. For example, the possible distortionary costs associated with specific instruments such as taxes and subsidies have not been included. Conversely, the potential gains associated with the instruments, such as Danish businesses obtaining a leading position in the growing world market for green products have also not been included.

Up to one per cent of GDP is a large sum of money that requires ongoing political prioritization, but it does not threaten Danish prosperity. However, it is important, that we organize the climate mitigation effort towards 70 per cent and later climate neutrality as cost-effectively for the society as possible, ensuring that Denmark can be an example for other countries to follow. By showing that it is possible to carry out a well-planned transition without unduly large costs, Denmark could encourage other countries to raise their levels of ambition.

In addition to assessing the overall socio-economic costs, the challenge of carrying out a major transition should also be measured on other parameters. For example, the size of the substantial investments in new technology that have to be implemented over a short period of time, the impact on public finances or the extent of disparate economic burdens across businesses and citizens. These other aspects of the transition have not been analysed in depth in this report, which focuses more on pointing to cost-effective reduction potentials and policy instruments and thus on limiting the overall cost for Denmark for meeting the 2030 target.

The specific choices of instruments and funding will influence who is directly affected by the transition. Therefore, additional initiatives may be necessary to ensure the social balance mentioned in the proposal for the new Climate Act. However, cost-effective greenhouse gas reduction instruments should still be the basis to ensuring an appropriate and necessary transition. Furthermore, Denmark should also work towards the European Union as a whole adopting as ambitious common climate targets as possible, with accompanying instruments, as this will contribute to lower global emissions and it will reduce the costs for Danish companies and Denmark as a whole on the way to the 70 per cent reduction in 2030.

Two tracks towards the 70 per cent reduction

The report divides the transition and target achievement into two tracks. The first track entails intensified efforts within what Denmark as a society is already doing. This includes increased use of well-known transition elements focusing on technical reductions of greenhouse gas emissions, where green technology replaces or limits the use of black technology, but where we basically consume and produce more or less the same things as usual. This applies, for example, to replacing a petrol-powered car with an electric car or an oil-fired boiler with an electric heat pump. In this track, the emissions reductions have to accelerate now. This requires political implementation of specific policy instruments, such as changes in tax levels, and the track in this report is therefore referred to as the *implementation track*.

Parallel with this is another track that requires the development of new and less well-known transition elements, where untested technologies have to be brought into play and where the habits and consumption patterns of Danes will have to change more radically in a climate-friendly direction. This track is referred to as the *development track*, which emphasizes that short-term political focus should be on investing in strategic development and planning of how these transition elements can make the necessary contribution by 2030. Until 2030 and further toward 2050 the individual transition elements of the development track must continuously transition to the implementation track as the adjustment elements are developed, tested and commercialised, and as new instruments are applied to realise them. Both tracks are urgent and require a large number of political initiatives. We only have ten years to reach the 70 per cent target, and efforts must also lead to climate neutrality by 2050. We have to implement and develop now.

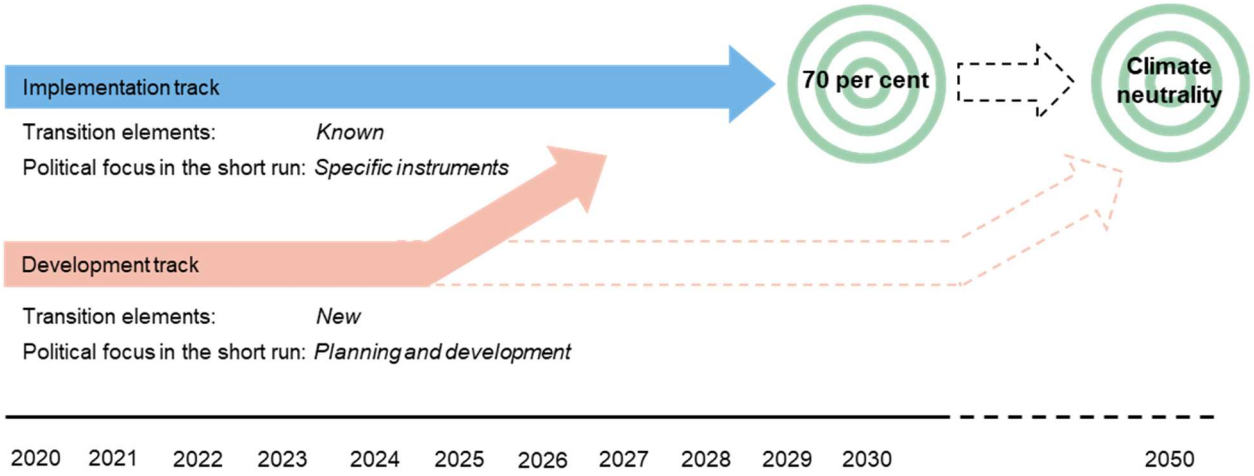

Figure 1.1 Illustration of the implementation and development track

Notes: The dashed black arrow indicates that the transition elements of the implementation track should continue and be scaled up from 2030 and onwards to 2050, while the dashed red arrow illustrates that the development track should continue toward 2050, and that some elements in this track might not be implementable by 2030, although they may become so in later years.

Source: The Danish Council on Climate Change.

The division of climate efforts into two separate tracks is an overarching feature of this report and is illustrated in figure 1.1. In practice, the distinction cannot be drawn this sharply, as there will be transition elements in the development track, where specific policy instruments can be implemented in the short term, for example with regards to consumer behaviour, while others require long-term, strategic development. Many of the instruments will similarly promote both the implementation and development track. However, the two tracks provide a good model for how we should approach the forthcoming work on achieving the 70 per cent target as well as the long-term target.

We have to think innovatively to reach 70 per cent

The implementation track does not immediately require us to use completely untested technologies or significantly change our habits. Therefore, it is natural to commence by asking the question: How far can we get along the implementation track by doing more of what we are already doing? The answer is that we will come some way towards the 70 per cent target, but not all the way to the finish line. The calculations by the Danish Council on Climate Change show that we will reach a reduction of approximately 60 per cent, if we use well-known transition elements, and the average cost per reduced tonne of CO_2e is kept below DKK 1,000 for most elements. Thus, there is a shortfall of about 10 percentage points to the 70 per cent target, as can be seen in figure 1.2.

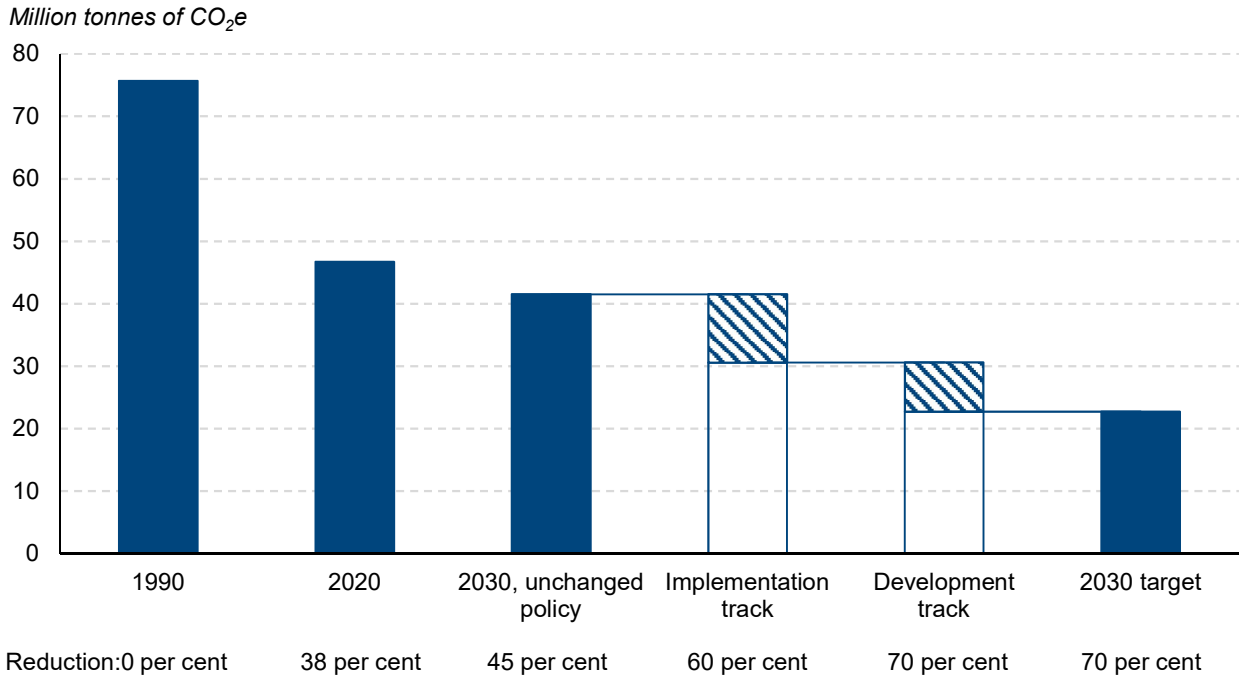

Figure 1.2 Danish net emissions of greenhouse gases from 1990 to the 2030 target

Notes: The 2020 bar shows the expected emissions according to *Denmark's Energy and Climate Outlook*.

Source: Danish Energy Agency, *Denmark's Energy and Climate Outlook 2019* and the Danish Council on Climate Change.

If the Council's recommendation for the transition in the implementation track is realised, coal will be completely phased out in electricity and district heating production by 2030, 1 million electric cars will be on the Danish roads, significant energy efficiency measures will have been made in industrial energy consumption, gas consumption in housing and industrial processes will almost entirely be covered by green gas, and agriculture will be using the most obvious instruments to reduce emissions from farmland, livestock and fertilizer. A list of all the transition elements is in table 1.1.

Table 1.1 Transition elements and reductions in the implementation track

Sectors		Transition elements			
Gas	1.1	More biogas in the natural gas network (0.8)	Upgrade instead of electricity generation (0.3)		
Transport	2.3	Electric cars (1.5)	Electric vans (0.5)	CO_2-neutral trucks (0.2)	CO_2-neutral busses (0.1)
Agriculture	2.3	Conversion of organogenic soils (1.4)	Better slurry handling (0.4)	Altered feed to dairy cattle (0.2)	Reallocation of production areas (0.4)
Buildings	1.5	Energy-related renovations of buildings (0.2)	Heat pumps (0.7)	Connection to district heating (0.5)	
Electricity and district heating	1.7	Separation of plastics (0.7)	Phasing out of coal (0.7)	Phasing out of oil and gas (0.3)	
Industry	1.9	Energy savings (0.4)	Electrification, including heat pumps (0.5)	Biomass to process (0.3)	Green cement and conversion from coal and coke to gas (0.7)
Environment	0.2	Reduction of leakage from biogas plants (0.2)			
Total	**10.9**				

Note 1: The figures in the table show the 2030 reduction in million tonnes of CO_2e relative to *Denmark's Energy and Climate Outlook*.

Note. 2: Due to rounding, the total reduction potential deviates in some places from the sum of individual elements.

Source: The Danish Council on Climate Change.

The Danish Council on Climate Change proposes a wide package of instruments carried by a tax on greenhouse gas emissions

Political instruments are required to realise the reduction potential in the transition elements. Initially, instruments are required to lead the transition in the implementation track, and this is the focus of this report. However, it should be stressed that the development track also requires specific efforts now, but these will be of a strategic nature in the form of various types of investments in technical development at both long-term and short-term implementation levels.

The Danish Council on Climate Change proposes a wide package of instruments, and a main element is a general tax on greenhouse gas emissions based on the polluter-pays principle. The tax should cover not only CO_2 but all greenhouse gas emissions and should be phased in gradually up to 2030, when the tax rate should be at a significantly higher level than the current CO_2 tax. The Danish Council on Climate Change estimates that a tax of approximately DKK 1,500 per tonne of CO_2e in 2030 will be sufficient to reach the 70 per cent target.

A general tax like this is a cost-effective instrument, and it also underpins the polluter-pays principle. The current tax system in the energy field is a cacophony of different taxes and subsidies. The Danish Council on Climate Change proposes that the entire system be reformed with CO_2 equivalents (CO_2e) as the focal point, with uniform tax rates across sectors, although with deductions corresponding to the carbon price in sectors covered by the EU ETS. CO_2 equivalents are a way of converting various greenhouse gasses like CO_2, methane and dinitrogen oxide to the same scale. Greater uniformity in greenhouse gas emissions payments is a prerequisite for reducing these emissions cost-effectively. A tax on greenhouse gas emissions will have derived reduction effects through a changed consumption mix. This will probably affect car transport in particular with fewer kilometres driven, depending on how taxes in the transport sector are restructured during the period.

In principle, the tax also covers farming, land use and forestry, which are collectively referred to as the agricultural sector. Today, this sector pays almost nothing for greenhouse gas emissions. What makes agriculture special is that it is difficult to calculate the emissions for each farm accurately, and it is therefore necessary to develop true and fair farm accounts before the sector can be included in the general tax system. However, farmers should already be

encouraged to limit their emissions. This can be done with a simpler tax based on observable measures such as number of livestock and amounts of fertilizer, and with an allowance for verifiable climate initiatives. It could also be through actual requirements or subsidies to encourage farmers to use climate-friendly technology.

A general and uniform tax on greenhouse gas emissions will immediately mean that many Danish industrial companies and farms have their tax burden significantly increased by an unchanged production pattern. This is the intention, as the tax should encourage more climate-friendly production, but it also presents a significant risk of carbon leakage, where the tax undermines Denmark's competitiveness and to some extent moves production and emissions to other countries. Therefore, the general tax should be supplemented by a possible tax allowance for industries particularly vulnerable to international competition. Considering leakage stresses that the Danish climate efforts must be viewed from a global perspective. At the same time, the Danish Council on Climate Change stresses that the more companies exposed to competition are exempted from contributing to reduction efforts, the more other parts of society will have to contribute, and the more expensive it will be for Denmark as a whole to achieve the 70 per cent target.

The tax proposed by the Danish Council on Climate Change will not affect all citizens and companies equally, and this could raise concerns that increasing greenhouse gas taxes will have a social impact. However, there is much to suggest that the lowest income groups are unlikely to be hit the hardest by the Council's proposal for a green tax reform. The Council's proposal for a greenhouse gas tax will impact ordinary citizens in particular, with the price of gasoline and diesel increasing continuously up to 2030, as a general tax on greenhouse gas will also include fossil-fuels-based motoring. Depending on the level of the tax, the price at the pump may increase by more than DKK 4 by the end of the decade measured in today's prices. For example, this may be particularly problematic for people who need a car for their work and have difficulty switching to an electric car.

According to the Danish Council on Climate Change, distribution effects should not stop the use of taxes as an effective climate instrument. However, the distribution effects should be incorporated in the political debate. This will enable a better framework for redistribution elsewhere in society in order to counter what politically may be seen as unfair consequences of climate policy. Distribution effects can be addressed by repaying some of the tax revenue, for example a green cheque, or by initiating other political or social measures not directly linked to the climate field.

Sector-specific instruments must supplement a general tax on greenhouse gasses

A tax on greenhouse gases is not enough in itself, as there is a number of barriers that a tax will not remove. Certain areas require governmental coordination or regulation that stands in the way of the green transition needs to be rolled back, while in other areas, traditional economic incentives are just not sufficient. This may be due to market imperfections, or because players react inadequately to economic incentives, even though these are beneficial. For these reasons, the Danish Council on Climate Change recommends a number of concrete instruments in specific areas. Overall, the Danish Council on Climate Change presents a wide package of instruments in ten policy areas, as well as a considerable research and development effort to push forward the elements in the development track. A few instruments from key sectors (electricity and heating, industry, transport and agriculture) are highlighted in the following, while the whole package, which also includes initiatives in biogas, waste and public procurement, is listed in box 1.1.

Coal remains one of the primary emissions sources in the Danish economy. However, climate-friendly alternatives in the **electricity and heating field** are so good, that there is no reason to continue using coal for much longer. For that reason, the Danish Council on Climate Change recommends that coal be completely phased out from the remaining coal-fired heat and power plants in Odense and Aalborg as soon as possible and by 2025 at the latest. This might happen automatically because of a higher tax on greenhouse gas emissions, but nonetheless the government should implement parallel initiatives to make sure that it actually does happen. The agreement on a new Climate Act expresses a wish for climate efforts that can be implemented in the short term. Phasing out coal is a low-hanging fruit for such short-term efforts. Phasing out coal makes accelerating the expansion of renewables-based electricity generation even more important, as electrification of transport, heating and industry will lead to increased demand for electricity. This advocates bringing forward planned tenders for offshore wind farms and agreeing new calls for tenders.

Increased electrification of society, along with increased deployment of wind turbines, solar cells and heat pumps, is expected to lead to a gradually reduced consumption of biomass. However, this does not rule out the possibility that certain parts of the transition will demand new biomass in a transitional period. Bringing forward the phase-out of coal does not necessarily lead to increased use of biomass, but if it does, it is important that this biomass, like all other biomass used for energy purposes, meets criteria for climate sustainability. Biomass that does not meet these criteria should be regarded as a fossil fuel on which a CO_2-tax is imposed from an administratively determined CO_2-content and it should not receive subsidies.

Emissions from **industry** can be significantly reduced by a more efficient use of energy. Previously, energy efficiency efforts by industry were driven by a voluntary agreement scheme for energy-intensive enterprises, and several evaluations have assessed this scheme as being effective. An essential element in the voluntary agreement scheme is that the enterprises obtain tax relief if they implement cost-effective energy savings and introduce an energy management system that ensures a forward-looking and long-term approach to energy efficiency. The current voluntary agreement scheme is being phased out because industrial companies are close to paying no energy or CO_2 taxes at all, but the Danish Council on Climate Change recommends that the scheme be renewed with special focus on CO_2 reduction. The incentive to participate in the scheme could be an easing of the general greenhouse gas tax in addition to the allowances given to industries exposed to competition.

If emissions from the **transport** sector are to be significantly reduced, it is crucial that Danes start buying electric cars instead of the traditional petrol and diesel-powered cars. Sales of electric cars in Denmark are still sluggish compared to neighbouring countries, despite significant tax cuts. Part of the explanation lies in the concern about whether the car can be charged when needed. Here, the government plays an important role, and the Danish Council on Climate Change recommends that a national strategy be developed in this area to ensure the necessary expansion of the charging infrastructure and a transparent and well-functioning charging market.

The most obvious reduction measure in **agriculture** is to stop cultivating carbon-rich organogenic soils. When these soils are no longer drained, the release of the carbon from the soils to the atmosphere in the form of CO_2 slows down. The Danish Council on Climate Change recommends further focus on conversion of these soils, but at the same time stresses that more scientific certainty is needed of the effects and that the current scheme must be improved if it is to be effective. This is important government work in the very short term.

We have to start on the development track now

We will not reach the 70 per cent target if we are only pursuing well-known transition elements and instruments in the implementation track. As mentioned above, it is likely that the track will fall short of the 70 per cent target by around 10 percentage points. This is why it is important to initiate a number of political measures now that can put the transition elements in the development track into play in the long term. This track includes brand new technologies that are still only at the demonstration stage, a completely different product focus in industry and agriculture, and that citizens and businesses change their consumption patterns and transport behaviour. The transition is likely to become more difficult and face obstacles of a technical, economic and cultural nature. Moreover, it is unclear which transition elements should be focused on in order to reach the target. Therefore, it will be necessary to implement many initiatives, and it is likely that only some of the initiatives identified by the Danish Council on Climate Change will be able to deliver real reductions at affordable costs by 2030. However, they may still be necessary in order to achieve climate neutrality by 2050.

Initially, the development track will require a strategic perspective on the part of the government in collaboration with the companies that will develop the transition elements. The development track requires focus on research and development, demonstration and market maturation, new and supportive regulation, and a break with habits that make society choose fossil rather than green alternatives. The development track is unlikely to provide significant reductions this side of 2025, but it is extremely important that we do not wait for the end of the implementation track before we think about how the reduction efforts are to continue, and before we begin measures to promote the transition in the development track. Precisely because of the built-in delay, it is crucial that we start on the development track now. Therefore, the Danish Council on Climate Change stresses the need to start on the necessary strategic development work as soon as possible to determine, among other things, whether the various options can work on a large scale and at a reasonable price.

The last 10 percentage points to the 70 per cent target correspond to approximately 8 million tonnes of CO_2e. Table 1.2 lists possible transition elements that may help close this shortfall. The potentials of the transition elements are associated with considerable uncertainty but provide a total of more than 8 million tonnes of CO_2e if they are all realised. However, we cannot expect that all of the transition elements will be able to live up to their potential by 2030 and possibly not in the longer term either. Therefore, the table also includes a probability assessment of whether the technology and behaviour behind the individual transition element are developing sufficiently for the potential to be realised without becoming unreasonably expensive. With the underlying illustrative probabilities, the Danish Council on Climate Change estimates that it is possible to reach the 70 per cent target by 2030. However, it is important to note that other probability estimates can give different results and that it is extremely difficult to assess the probability that the individual potentials will be realised by 2030.

Table 1.2 Transition elements and reductions in the development track

	Reduction potential in 2030 *million tonnes of CO_2e*	Probability
CCS on biogas	1.2	High
CCS on waste plants	1.1	High
CCS on industrial plants	1.2	High
CCS on biomass CHP plants	1.0	High
More electric cars (1.5 million in 2030)	0.8	Low
Effect of CO_2 tax on the number of kilometres driven	0.7	High
Further reduction in the number of kilometres driven	0.8	Low
Further reductions in heavy transport	0.2	Medium
New food habits and new technologies in agriculture	2.0	Medium
Electrification of drilling platforms	0.5	Medium
Electrification and hydrogen on refineries	0.3	High
Hydrogenation of diesel	0.3	Low
Hydrogen in the gas network	0.1	Medium
Electrification and hydrogen for domestic ferries and aircraft	0.2	Medium
Electrification of the motorway network – electric trucks	0.2	Low
Increased deployment of biogas	0.9	High
Less consumption of diesel in the construction sector	0.1	High
Less consumption of diesel in agricultural and forestry machinery	0.2	Medium
Pyrolysis for bio coke and fuel production	4.0	Low
Aggregated reduction potential	**15.8**	
Probability weighted reduction potential	**8**	

Note 1: The probability assessment is based on whether the development reaches a sufficient stage for the potential of the transition element to be realised without being unreasonably expensive.

Note 2: The probability-weighted potential has been calculated with the probabilities: 10 per cent. for *low*, 50 per cent for *medium* and 90 per cent for *high*. For the transition element *Effect of CO_2-tax on the number of kilometres driven*, the probability is set at 100 per cent.

Note 3: Generally, there is limited overlap between the different potentials. However, more electric cars and fewer kilometres driven by cars will have an overlap, for example.

Source: The Danish Council on Climate Change

The Danish Council on Climate Change points at CO_2 capture and storage as crucial for reaching the 70 per cent target

In the development track, the Danish Council on Climate Change notes in particular that Carbon Capture and Storage (CCS) is an element that cannot be ignored. CCS has a considerable reduction potential, it is affordable

(around DKK 1,000 per tonne), and the technology already exists in large demonstration projects around the world. Therefore, the Danish Council on Climate Change recommends that Denmark start preparing for a future where CCS plays a significant role in climate efforts. However, it must be emphasized that according to the Council, CCS is only one piece in the puzzle to achieve the 70 per cent target, and that CCS does not mean that we do not have to worry about the use of fossil fuels in the future.

The first part of the CCS process consists of capturing CO_2 in high concentrations from chimneys, for example. The most likely sources before 2030 are biogas plants, waste incineration, larger industrial plants such as Aalborg Portland cement plant and possibly newer biomass-fired CHP plants. In the second part of the process, the captured CO_2 is compressed and transported by ship, truck or pipeline to underground storage, which can be either onshore or offshore.

A national strategy for the area is required if Denmark is to make serious use of CCS. For example, it will require state planning to identify the areas where the CO_2 is to be stored. It also requires that regulation be developed concerning matters such as 1) who is allowed to establish infrastructure for transport and storage of CO_2 and under what conditions, 2) who has legal responsibility for ensuring that the CO_2 remains underground and for how long, and 3) how carbon storage is incorporated into the tax system, including subsidies for carbon storage from non-fossil sources. Finally, it must be clarified how various forms of carbon storage are to be included in the UN greenhouse gas inventories.

An alternative to CCS is carbon capture and use (CCU), where the captured CO_2 is used to produce carbon-based fuels by adding hydrogen, instead of being stored. These fuels can replace fossil fuels in ships and aircraft, for example. By burning the new fuels, the CO_2 is again emitted, but the emission of CO_2 from fossil fuels is saved, so overall the climate effect is the same as with CCS. However, calculations made by the Danish Council on Climate Change indicate that CCS is probably the cheapest. Furthermore, while CCU can only lead to carbon neutrality, in the long term CCS can lead to overall negative emissions, provided energy for aircraft and ships can be based entirely or partially on carbon-free energy forms such as pure hydrogen and ammonia.

Transport as well as food and agriculture are other key areas in the development track

Traffic and the number of cars on the Danish roads are expected to increase significantly in the next ten years, so even with 1 million electric cars in 2030, which the Danish Council on Climate Change has assumed in the implementation track, emissions from transport will fall only slightly. The lifetime of cars means that every petrol or diesel car sold tomorrow will most likely still be on Danish roads in 2030. With a stop on sales of new petrol and diesel cars from 2030, Denmark will be on the way to an almost entirely carbon-neutral car stock in 2050. However, compared with the 70 per cent reduction in 2030, it is worth considering whether the electrification of transport can go even faster. One option is to aim for 1.5 million electric cars by 2030, if we are to significantly reduce the number of fossil-fuel cars, which is a prerequisite for transport to make a greater contribution to the 70 per cent target. This will probably require a tax system that greatly encourages the purchase of electric cars. Another option is to impose limitations on traffic. Here, the Council's proposal for significantly higher taxes on petrol and diesel will contribute. Another option, although less effective, is to increase the use of public transport or car-pooling. Considerably higher gasoline and diesel prices will promote public transport at the expense of the use of private cars, while more car-pooling will require platforms to match cars and passengers and will require improved framework conditions for car-pooling.

Effective technical tools are in short supply for the food and agriculture area. Therefore, we should already be considering how we can develop Danish agriculture and steer Danes' food habits in a direction that is sustainable and consistent with the long-term ambition of climate neutrality. This process includes two different approaches that need to be started now: 1) a technical approach that looks at new technologies in agriculture and entirely new ways of producing food, and 2) a consumer-oriented approach to steer Danes' food habits in a more climate-friendly and plant-based direction.

This is a significant transformation of a key industry in the Danish economy, and it will require strategic planning, research and development by authorities, research institutions and the industry itself. Conversely, it could potentially give new Danish strongholds in a rising global market for climate-friendly food.

The Danish Council on Climate Change recommends that the reduction in 2025 be between 50 and 54 per cent

This report primarily focuses on 2030. However, a key issue in the upcoming negotiations on a climate action plan will address the speed of the reduction of greenhouse gas emissions in the slightly shorter run. As mentioned above, the political agreement on a new Climate Act stresses the need for climate action in the short term, and therefore, these negotiations must set an interval for an indicative greenhouse gas target for 2025.

The purpose of a greenhouse gas target in 2025 could be to ensure that Denmark follows a cost-effective reduction profile towards 2030 by phasing in the transition gradually, with the cheapest reductions first and avoiding postponing efforts to a time closer to 2030, which could prove to be unnecessarily expensive. The purpose could also be to secure significant reductions in accumulated Danish emissions from 2020 to 2030, so Denmark contributes to keeping the global temperature increase down. In practice, it is difficult to conclude how ambitious a Danish 2025 target should be for Danish climate policy to be consistent with a global 1.5-degree target. Nevertheless, the less Denmark emits on the path towards 2030, the greater the Danish contribution to this target.

If the Danish greenhouse gas reductions follow a linear trend towards the 2030 target, we will have reduced emissions by 54 per cent in 2025 compared with the level in 1990. A linear development may seem natural, but requires that instruments to realise reductions are adopted several years in advance. This is due to the significant time lag between policy and effect. Based on the policy adopted today, the projections do not indicate that we can expect significant reductions in greenhouse gas emissions by 2025, and this limits the size of the reduction that realistically can be achieved in just five years. The Council's transition elements in the implementation track result in a reduction in 2025 of 50 per cent if they are implemented quickly and if the Danish Energy Agency's baseline projections do not change significantly. For this reason, the Danish Council on Climate Change recommends that Denmark aim for a reduction in 2025 of at least 50 per cent compared to the level in 1990.

The upper limit for a 2025 target should be regarded as a ceiling for the ambitions in the upcoming climate action plan, if climate efforts are not to become unnecessarily expensive, given that there are only five years to 2025. A linear reduction path from 2020 to 2030 entails a reduction target of 54 per cent in 2025. In this perspective, the Danish Council on Climate Change does not currently see compelling reasons to aim for a reduction of more than 54 per cent. Therefore, the Council's recommendation is that this be the upper limit, so that the interval is 50 to 54 per cent. Setting the target higher than 54 per cent in 2025 will entail considerable political willingness to pay.

An important objective of the 2025 target is to serve as an indicator of whether climate action is on track to achieve the 70 per cent target by 2030. However, the 2025 target should be supplemented by additional indicators that more specifically consider whether the necessary policy to reach the 2030 target is in place, so that the transition elements can be rolled out sufficiently quickly.[2] This is particularly relevant for the transition elements in the development track, which in reality will only be able to contribute with reductions after 2025.

A number of initiatives can be implemented immediately

The longer it takes politicians to announce new framework conditions, the greater the risk of lock-in investments that do not pave the way towards the target in 2030. This concerns, for example, the choice of solutions in the heating sector. At the same time, it will be more difficult to realise a significant climate effort by 2025. Therefore, the Danish Council on Climate Change recommends considering implementing or initiating a number of the instruments proposed in this report as a package of immediate actions. This package of immediate actions could consist of initiatives or clear declarations which can be implemented immediately. For example, it could consist of:

Political decisions to be adopted immediately:

- Reduction of the tax on electric heating.
- Cancelling the rules that bind certain customers to natural gas.
- Increasing the CO_2 price in the assumptions for socio-economic calculations.
- Bringing forward public tendering procedure for the second offshore wind farm in the Energy Agreement.

In addition, elements that require further efforts in the form of analytical work and planning, which can be financed and initiated as soon as possible:

- Strategy and plan for rolling out charging infrastructure for electric cars.
- Analytical work that can lead to a strategy for CCS in Denmark.
- Prioritizing work on preparing and implementing a model for agricultural farm accounts.

Finally, the Council recommends areas for broad political declaration of the desired direction, so that players can start their planning accordingly. This includes:

- Announcing that initiatives will be launched from 2030, so that cars that are wholly or partly fuelled by petrol or diesel are no longer sold.
- Bringing forward the current 2030 ban on coal for electricity and district heating, so that it takes effect as soon as possible and by 2025 at the latest. The proposal should be put forward as soon as possible so that the companies that own the coal-fired power plants and other players have a better opportunity to plan the transition.

The proposals in the list above all form part of the Council's proposal for a consolidated climate effort towards 2030. The initiatives have been selected to be a part of a smaller package of actions that can be implemented immediately. They have been selected because they are likely to have limited fiscal effect in the short run because, in the Council's opinion, there is little doubt that these instruments should be part of meeting the 70 per cent target, and because there is a risk of misdirected investments if clear political signals about key instruments are not sent immediately.

The report focuses primarily on emissions in Denmark
The 70 per cent target relates to Danish territorial emissions, and for that reason, this report is generally limited to a national scope. However, the climate problem is global, which is why the new Climate Act also suggests that Denmark's impact on global emissions should be a focal point. Therefore, this report also focuses on limiting the extent of carbon leakage, although this means that the 70 per cent target may be more expensive. In later analyses, the Danish Council on Climate Change will address the Danish contribution to reductions in global emissions.

Chapter 2 of the report introduces the national 70 per cent target and the criteria for appropriate target fulfilment applied by the Danish Council on Climate Change. Chapter 3 assesses the reduction potentials in the implementation track with well-known transition elements, while chapter 4 recommends instruments that can support these transition elements. Chapter 5 describes possible elements in the development track to close the final gap to the 70 per cent target, and finally chapter 6 presents the Council's recommendation for an indicative 2025 target. Further calculations and descriptions are in the accompanying background notes on the Council's website (in Danish).

Box 1.1: Instruments recommended by the Danish Council on Climate Change

The Danish Council on Climate Change proposes a package of instruments to support realisation of the reduction potentials in the implementation track, but also to provide a foundation for some of the elements in the development track. The package of instruments is the Council's response to the forthcoming negotiations on a climate action plan. Some of the instruments can, however, be implemented sooner. The instruments are both restatements of the Council's previous policy recommendations, as well as new ones.

Greenhouse gas tax
The foundation of the Council's policy instrument package is a general tax on emissions of greenhouse gases. As a starting point, the general tax is imposed on all types of greenhouse gas emissions, and the price is set relative to the amount emitted. Such a tax is a cost-effective instrument that also underpins the polluter-pays principle.

- The climate and energy tax system should be reformed to focus on greenhouse gases. A future uniform tax on greenhouse gases should have a rate significantly higher than the sum of the energy and CO_2 tax today. The tax rate should be announced now and phased in over a number of years, so that companies and citizens can adapt to the higher taxes early on.

- Companies in industries that are particularly exposed to international competition should have a basic deduction in the greenhouse gas tax to limit carbon leakage. The basic deduction could be production-dependent in certain industries, so that reduced production lowers the deduction. For these industries, the tax deduction should be counterbalanced by a corresponding tax on consumption of the industry's products, irrespective of whether they are produced in Denmark or elsewhere. This may be especially relevant for products such as beef and cement which are traded internationally and have a large climate footprint.
- Taxes and deductions must also apply to agriculture when true and fair accounts have been developed for individual farm emissions. In the short term, agriculture must be encouraged to more climate-friendly production through a simple tax model or a wide range of instruments, such as requirements for certain green technologies and subsidies for their implementation.
- In the presentation of its annual climate programme, the government should also estimate the necessary increase in the greenhouse gas tax if the initiatives for the development track do not appear to provide the expected effect. Such a tax rate can illustrate what is required to meet the 70 per cent target, and forge credibility that the target will be achieved, even if it requires tougher instruments.

Phasing out coal

Coal will still be used in 2030 according to the baseline projection. However, if Denmark phases out coal even earlier than 2025, significant reductions can be achieved.

- A ban on burning coal for electricity and district heating production should be adopted as soon as possible, and by 2025 at the latest, in light of the need for rapid reductions and the relatively low cost of phasing out coal. This ban should be realised as an actual ban or through other framework conditions that either make it impossible to continue coal-based production or make coal clearly less attractive than the alternatives.

Green electricity

Increased electrification of energy consumption requires that electricity generation based on renewable energy be expanded simultaneously. Offshore wind plays a key role in this expansion, and this requires active participation by the authorities.

- Public tendering procedures and commissioning of offshore wind farms adopted under the 2018 Energy Agreement should be brought forward, and further calls for tenders should be adopted for, initially, 3 GW offshore wind farms for commissioning as soon as possible. This capacity corresponds to the additional electricity demand entailed by the transition elements in the implementation track. At the same time, additional calls for tenders should be prepared for the additional electricity demand entailed by the transition elements in the development track.
- Current calls for tenders for onshore wind, nearshore wind and solar projects should continue in auctions for as long as significant capacity of each of the technologies is not being established under market conditions.
- Sufficient funds should be allocated to dealing with complaints, so that the development of renewable energy projects is not impeded by complaint processing. This will ensure that sound wind and solar projects can be deployed quickly when the financial framework are in place.
- The government should prepare a strategy to promote energy storage and flexible electricity consumption, which can ensure the balance of power supply, help to secure supply in periods without sun and wind, and support a reduction in fuel-fired plants.
- The government should prepare a new compensation model for transmission projects that can ensure popular acceptance locally for the establishment of additional overhead power lines.

Green heating

In order to accelerate the phase-out of fossil fuels and promote the use of heat pumps in the heating field, a number of initiatives are needed.

- The tax on electricity used for heating should be lowered to DKK 0.1 per kWh in 2022 and further to DKK 0.05 per kWh in 2023 as a consequence of lower support for electricity generation based on renewable energy.

- Flexible tariffs should be introduced into the electricity grid, which are temporally and regionally different, to reflect the actual costs of using both transmission and distribution networks.
- Further to the two first points, the Danish Council on Climate Change also recommends phasing out the combined heat and power requirement and the fuel requirements in the district heating area.
- The tax on certified waste heat should be abolished.
- The price of CO_2 assumed in the socio-economic calculations used in approving district heating projects should reflect the cost of meeting the 70 per cent target.
- The rules that tie certain heat customers to natural gas should be removed as soon as possible.
- The government should review the rules for decoupling from the natural gas network in order to make it cheaper for the citizens to phase out their natural gas boilers.

Electric cars

An essential part of reductions in transport emissions is to replace petrol and diesel cars with electric cars in particular. A number of initiatives can help this process.

- As soon as possible, it should be announced that initiatives will be launched to ensure thatfrom 2030 cars wholly or partly fuelled by petrol or diesel are no longer sold. This includes plug-in hybrids.
- The current "battery deduction" for electric cars in the registration fee should be made permanent and not expire at the end of 2022, as in the current rules. Instead, the deduction should be gradually reduced as the price of batteries falls.
- Buying an electric car should result in a fixed subsidy regardless of the size of the car. In order to achieve a total positive effect on sales, the subsidy should initially be at least DKK 50,000, but gradually decrease as sales of electric cars increase and not from year to year. Plug-in hybrids should also receive a subsidy set as a proportion of the subsidy for a fully electric car. At least 100,000 cars should be subsidized to ensure that the market is sufficiently mature before the subsidy is phased out. At the same time, electric cars and plug-in hybrids should be fully encompassed by the registration fee rules.
- Insufficient charging infrastructure is a barrier in itself for electric cars and therefore measures should be taken to improve the charging infrastructure. A package of initiatives should be prepared to contribute to a more transparent and competitive market for electric car charging. Among other things, the package should address equality of electricity taxes for all drivers of electric vehicles as well as better framework conditions and opportunities for setting up charging points. Sufficient charging infrastructure should also be ensured in both cities and on the motorway network. This can be done, for example, by inviting tenders for fast and rapid chargers at specific locations resulting either in a tax to the state or in support to the operator.

Organogenic soils

The current scheme for conversion of carbon-rich organogenic soils should play a more significant role in the future. However, the scheme must be improved if it is to have a significant effect.

- As soon as possible, better knowledge of emissions factors and actual land conditions must be generated. However, conversion of organogenic soils should not be put on hold until this knowledge is available.
- The scheme should be organised so that it is sufficiently flexible to deal with the new knowledge about emission factors for different soil types as it becomes available.

Waste

Reducing emissions from waste incineration requires focus on separation and recycling of plastic waste, so as to reduce the total amount incinerated. This demands clear requirements from the public sector.

- The forthcoming Waste Plan should require companies to either separate and manage their waste by hiring a private waste company or to choose municipal waste schemes, and the statutory framework allowing them to do so should be in place.
- A new regulation should be prepared to ensure that plastic packaging can actually be reused.
- It should be considered whether the non-recyclable part of the separated plastic could be stored in Denmark until there is certainty that the plastic can be handled properly. This reduces the risk of the plastic being incinerated without CCS or ending up in uncontrolled landfills abroad.

Energy efficiency

A socio-economically appropriate and balanced transition to renewable energy requires the implementation of energy savings where socio-economically reasonable. In some cases, this requires better incentives and adjusted framework conditions.

- The industry's voluntary agreement scheme should be reintroduced, focusing particularly on CO_2 savings.
- The building code with regards toenergy efficiency in renovation and refurbishment should be enforced through random checks combined with fines or injunctions if the regulations are not complied with.
- Assistance should be given to optimize technical installations in buildings, for example through better information on energy saving potentials and free energy checks.
- Financing solutions through Energy Service Companies (ESCO) should be promoted, for example, by providing more guidance on the scheme with examples from specific cases in Denmark.
- Requirements for energy renovation of municipal and regional buildings should be imposed. At the same time, it should be investigated whether it is possible to exempt investments in energy efficiency and indoor climate from the Danish cap on municipal and regional capital expenditure, if these investments pay back within a given period.

Biogas

Biogas must play a prominent role to ensure the phase-out of natural gas. Biogas is already receiving significant support, and it is important that this support be organised appropriately so that the overall green transformation is not made unnecessarily expensive.

- One or more calls for tenders concerning biogas production should be initiated so that total production increases to around 35 PJ in 2025. How much additional biogas production is needed will be determined when the size of the expansion realised under the current support schemes is clear.
- The support scheme for electricity generation based on biogas should be changed to provide proper socio-economic incentives to use biogas only when the wind is not blowing, or the sun is not shining. This may be in the form of a reduced subsidy added to the market price of electricity corresponding to the support for new, other renewable energy, such as offshore wind.
- As soon as possible, requirements to reduce emissions from biogas plants should be introduced and only plants that meet the requirements should qualify for support.
- Precise measurements of the emissions from biogas plants should be carried out so that the leakage rate in Denmark's emission inventories for the EU and UN can be changed based on this specific documentation.

Public-sector decisions

The public sector is the largest player in Denmark and it can spearhead efforts in the climate field by leading the way. However, today, inadequate measures make it far from certain that the climate is adequately considered in public decision-making processes.

- All Danish municipalities and regions should develop climate strategies that provide clear guidelines for climate-friendly choices in, for example, canteens, transport, construction and procurement. The strategies should be monitored to clarify whether they are being followed and the targets are being met.
- The government should further develop guidelines and tools for green procurement. This includes a tool for calculating the municipality's climate footprint, both inside and outside the municipality.
- All relevant legislative proposals, and major public capital investments and other decisions regarding infrastructure, should be calculated for climate impacts.
- Socio-economic calculations that support decisions on public projects should be carried out applying a price assumption of greenhouse gas emissions consistent with the 70 per cent target. According to the Council's assessment, the price should be close to DKK 1,500 per tonne. This corresponds to the estimated marginal cost of the transition elements needed to meet the 70 per cent target.

Research, development and altered habits

To realise the reduction potentials in the development track, the Danish Council on Climate Change recommends focusing on a massive and strategic effort in research and development as well as demonstration

and market maturation of new technologies that will close the not insignificant gap to the 2030 target. This especially applies to carbon capture and storage, the agricultural and food sectors, the transport sector with focus on heavy road transport, ships and aircraft, and finally industry.

In order to influence consumers' food and transport habits, the Danish Council on Climate Change recommends that, in addition to the CO_2 tax on greenhouse gases, introduction is considered of 1) taxes on climate-intensive foods, 2) environmental zones in cities to promote sales of CO_2-neutral trucks and 3) incentives for increased car-pooling.

Finally, the Danish Council on Climate Change recommends that the government impose a tax on air travel. Although this will only have a marginal effect on Danish emissions, it is considered an important instrument for reducing the greenhouse gas emissions from aviation, as discussed in previous analyses by the Danish Council on Climate Change.

Notes

[1] The government (Socialdemokratiet), Venstre, Dansk Folkeparti, Radikale Venstre, Socialistisk Folkeparti, Enhedslisten, Det Konservative Folkeparti og Alternativet, *Agreement on a new Danish Climate Act*, 6 December, 2019.
[2] The Danish Council on Climate Change, *A Framework for Danish climate policy*, 2019.