

STRATEGY FOR ADAPTING TO CLIMATE CHANGE





Strategy for adapting to climate change

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Why have a plan, when no-one knows what the future climate will be?

You are correct in saying that we don't know what the climate will be like in 100 years. But a significant number of predictions suggest that more rain is on the way! The government has chosen to use the combined scenario A1B from the United Nation's climate panel (IPCC) and the DMI, and the Danish Road Directorate follows these. It is the best prediction we have.



THE DANISH ROAD DIRECTORATE'S STRATEGY FOR ADAPTING TO CLIMATE CHANGE

The Danish Road Directorate is responsible for the national road network, consisting of around 3,800 km of roads and more than 2300 structures, including 50 major bridges and four tunnels. The national road network accounts for just 5% of all public roads, but carries almost half of Denmark's total traffic volume.

Providing roads suited for the climate is a well-known problem for the Danish Road Directorate and this has taken on new meaning as a result of the challenges presented by climate change, especially in the last decade. For this reason, the Danish Road Directorate has been implementing additional safety dimensions across the road network for some time, and we are well prepared for the future.

Relevant research and the development of climate prediction models show that over the next century, Denmark should be prepared for significant changes in climatic conditions. For this reason the Danish Road Directorate has prepared a strategy for managing climate change that can affect the national road network.

DENMARK PREPARES FOR CLIMATE CHANGE AND THE DANISH ROAD DIRECTORATE WILL BE A PART OF THIS

The Danish Road Directorate shall manage the national road network in a responsible and professional manner to ensure safety and traffic flow, both under current and anticipated climatic conditions. The national road network plays a significant role in modern Denmark. Infrastructure, such as bridges and roads, often has a life expectancy of 100 years. The Danish Road Directorate must therefore plan and be prepared for climatic conditions that will change as we look towards the next century.

The aim of the climate strategy is to ensure that our actions are undertaken in an economically responsible and efficient manner, within the framework conditions to which the road network is subject to, including the Government and Trans-



port Ministry's climate protection plan. For this reason the strategy focuses only on national roads.

Actions to reduce greenhouse gasses, preparedness for winter or measures for The Directorate's buildings are not covered.

CLIMATE CHANGE RESULTS IN MORE WATER ON THE ROADS

Many different predictions have been made about future climate. A key aspect for most of these predictions is that we in Denmark must expect increasing levels of CO₂ and with that, higher temperatures and increased rainfall – seen as both an overall annual increase, but also in the form of more intensive precipitation. Furthermore, storms are likely to become both more common and more violent.

The Government's strategy for climatic adaption has a background in scenario A1B, a model developed at the Danish Meteorological Institute and based upon the United Nations climate panel's scenarios. The scenario is used to predict rainfall. With this as a background we can see that annual

rainfall will increase by 11% by 2050 and 22% by 2100. Furthermore, the number of days experiencing more than 20mm of rain will increase from the climatic norm of two, to five days by 2050 and seven days by 2100. The Danish Road Directorate evaluates the risk for flooding on national roads against the background of these and other predictions.

Over the last few years it has become clear that the Danish Road Directorate's central challenge is increased rainfall, which can result in road flooding. This creates problems for traffic safety and traffic flow. At the same time, flooding also reduces the lifetime of roads. The effects of increased groundwater are important for road drainage and foundations.

The climate strategy therefore focuses on the effects of more and more intense rainfall and with this, increased levels of groundwater, and how the Danish Road Directorate can prepare its initiatives so that the incidence of road closures as a result of flooding can be minimised.

Why aren't the Danish Road Directorate's water conduits larger?

The Danish Road Directorate dimensions its equipment to have a flow of 140 l/s per hr, for 10 min. The Directorate considers this dimension to be sufficient for increased future rainfall, despite the uncertainty around the average value upon which this is based. The problem is therefore not that the conduits are too small, but that extreme downpours flood the surrounding areas. This means that there is nowhere for the water to run off to.



WHAT IS A CLIMATE-RELATED EVENT ON THE ROADS?

For the Danish Road Directorate, with regards to an event to be managed in accordance with the climate strategy, we use the definition “a climate-related event”. We define a climate-related event as a complete or partial closure of a national road, or part of that road, for the duration of more than 1 hour, as a result of water on the road surface. If the closure is for less than 1 hour, the event can have a number of causes and the necessity for further analysis must be considered in each individual situation.

Here are two examples of climate-related events.

In Svendborg

On June 29th 2012 there was a cloudburst over Sydfyn. The Svendborg motorway was flooded and closed, as there was more than half a metre of water on the road surface. Over the next 7 hours the water was removed and the road re-opened.

In this instance the problem was that one of the council's drainage conduits overflowed. The backflow from this forced water onto the motorway, which came to function as an overflow basin.

The Lyngby road

The Lyngby road was closed on three occasions between 2010 and 2011, as many people may have heard. The Helsingør motorway at Ryparken Station is sunk into the surrounding land to reduce noise levels, among other things and to create space for a crossroads. The road's drainage can cope with water run-off from the road, but the conduits through which the water is pumped also function as an overflow channel for northern Copenhagen. Problems can arise therefore, when the conduits are overburdened. Greater Copenhagen Utility has since implemented a number of measures to increase the capacity of these conduits. The risk of flooding has therefore been reduced, but the possibility for future flooding cannot be eliminated, as it is such a vulnerable location.



THE DANISH ROAD DIRECTORATE MANAGES, IMPROVES AND PREVENTS

The Danish Road Directorate protects road surfaces and equipment against increased temperatures and stronger winds. Temperature and wind mainly affects road furnitures with a short lifetime (<20 years), e.g. road surfaces, signage, signage structures, barriers and noise reduction screens. The Danish Road Directorate continually replaces worn road surfaces and evaluates the dimensioning of road-sign structures in relation to relevant climatic models. Adaption takes place through the regulation of road regulations and as such, climatic adaption is already incorporated into the system.

The Danish Road Directorate has opted for a three-pronged strategy with regard to increased rainfall and water on roads - we manage, we improve and we prevent.

We manage flooding, when it occurs

When a road has to be closed due to flooding, the Danish Road Directorate, in cooperation with the police, call-out services and authorities, will manage the situation to optimise goals for road users, with regard to the condition of the road.

We achieve this through:

- **having call-out services ready.** By call-out service we mean that the Danish Road Directorate has an agreement with a company who will respond within a certain amount

Wouldn't it be better if the Danish Road Directorate tackled the reasons for climate change, rather than managing the symptoms?

We are doing that too. The Danish Road Directorate has a number of projects aimed at reducing levels of CO₂ produced by motor vehicles.

of time and who will, where necessary, close the road and thus ensure road-user safety. This type of call-out service also manages other situations on national roads, e.g. traffic accidents and lost goods. The Danish Road Directorate currently has a call-out services agreement with Falck.

- **informing road users about the flood.** The road-user information centre at the Danish Road Directorate provides information about flooding on all of its traffic information services, such as vejdirektoratet.dk, mobile telephone apps and GPS. The Road Directorate also cooperates closely with Danmarks Radio with regard to traffic updates.
- **clearing up quickly.** Pumps and other electrical installations should work at optimal levels, even during extreme conditions. A number of emergency pumps are located across the country, and doubling the number of pumps in areas particularly prone to flooding is being considered. This is to ensure that roads are re-opened as quickly as possible, and that material damage is kept to a minimum.
- **being part of the strategic road network.** The designation of the Strategic Road Network shall ensure a focus on roads with the greatest economic significance. Focus will be centred, among other things, on initiating a number of measures aimed at guaranteeing or improving traffic flow on the relevant roads. One of the most important measures is the establishment of regular diversion routes.

Why can't the Danish Road Directorate simply raise roads in problem areas?

Well yes, in principle this is possible. But it is only financially viable to raise a road in rare cases, because it is a very expensive option which might not necessarily solve the problem. For this reason the Danish Road Directorate has elected to have highly efficient call-out services to remedy problems for road-users and limit delays as much as possible.

We make improvements to roads, where we can

After a road flooding, it is important for the Danish Road Directorate to analyse the event and decide what measures should be implemented.

We achieve this through:

- **analysing the event.** This analysis also includes a cost/benefit analysis of the different solutions, as well as a description of the course of events. What is best for society and the Danish Road Directorate? Should extra emergency provisions be established? Should alterations to the road or the surroundings be implemented, or should we not do anything at all? The Danish Road Directorate carries out analyses as a matter of course, and with our background and experience from previous climatic events, we are preparing a book of guidelines for this type of investigation.
- **creating a database of events.** The database will provide the Road Directorate with an overview of the distribution, type of event and consequences of each event, at a national level. This data will be used to continually update strategy.
- **implementing improvements.** The Danish Road Directorate improves the road if the analysis suggests a financially viable solution, which can minimise the risk of subsequent similar events occurring.
- **cooperating with the relevant authorities.** Cooperation can identify opportunities for reducing risk with coordinated measures.





We prevent, wherever this is possible

The Danish national road network is 3800 km long. Assessments have demonstrated that it is neither necessary nor economically viable to prevent climate-related events across the entire national road network. There are many other conditions which the Danish Road Directorate can address.

We achieve this through:

- **screening for particularly vulnerable sections.** “Blue spots” are locations on the road network where there is a particularly high risk of flooding. Screening with the help of maps is intended to point out vulnerable stretches of road and areas with increased risk of future flooding. In a risk analysis we can subsequently monitor selected locations, where further analysis would determine whether improvement to the road section would be economically viable.
- **participation in legislative work relevant to the management of rainfall on roads.** Changes to road legislation means that economic considerations concerning climatic adaption are already being carried out with relation to new structures.
- **exercising prudence in the planning and construction phase.** It is cheaper to climate-proof during the construction phase than to adapt during the operational phase. Climatic adaption is factored in when we plan and construct a road. This means that road regulations are constantly updated and that we investigate the possibility for climate-proofing to a greater extent. We achieve this by planning new roads away from locations at high risk of flooding or by creating structures with higher barriers, if the road cannot be built in a different location. This practice has been in operation at the Danish Road Directorate for a considerable time. For this reason, a number of roads are already climate-proofed, to the extent that they can be.
- **considering climatic adaption in connection with carriageway widening.** A number of carriageway expansion projects on particularly busy sections are taking place at present, and this provides a good opportunity to climate-adapt the roads where required, whilst construction work is already underway.
- **focusing on research, and developing methods and knowledge about climatic adaption.** The Danish Road Directorate collaborates with research and development partners to find both short and long-term solutions with regard to the surrounding environment and climate-related challenges. This work on climate-related problems focuses on ensuring optimal run-off, prevent flooding, utilising resources to the full and supporting strategic planning.
- **international cooperation and information-sharing in the field.** The rest of the world, and Europe in particular, is focussing on the consequences of climate change. Through cooperation in research projects and information-sharing, the Danish Road Directorate is ensuring access to valuable inspiration for Danish solutions.

WATER FLOWS ACROSS ALL ADMINISTRATIVE BORDERS

Road-surface water cannot be seen as a problem just for the Danish Road Directorate. Water flows where it can, often across administrative borders. For this reason the Danish Road Directorate cooperates with councils to find the best solutions for climatic adaption of roads and their surrounding areas.

This cooperation directs its attention to climatic adaption in public cooperation between the Danish Road Directorate service locations and council and supply companies, as well as in cooperation in joint projects, for example through SAM-KOM, a national forum for cooperation between councils and the Directorate

FOR HOW LONG IS THIS STRATEGY VALID?

There is significant growth in the development of new methods for climatic adaption. The UN climate panel (IPCC) is continually providing new prognoses. National authorities and councils are developing climate-management plans and the Danish Road Directorate continually runs research projects and analysis which make it possible for us to plan and manage in response to the most up-to-date information available on climate. The strategy will therefore be a dynamic document, which can be revised and updated. Those revisions will be implemented through annual management plans.

READ MORE HERE

„Vejdirektoratets klimatilpasningsstrategi – baggrundsrapport“. VD report no. 452, 2013

„Kortlægning af klimaforandringer – muligheder og barrierer for handling“, Task force for klimatilpasning, May 2012.

„Sådan håndterer vi skybrud og regnvand – Handlingsplan for klimasikring af Danmark“, Regeringen December 2012

Transportministeriets klimahandlingsplan, 2010





The Danish Road Directorate's headquarter is situated in Copenhagen and local offices are situated in Aalborg, Skanderborg, Middelfart, Næstved and Fløng.

You will find more information on www.vejdirektoratet.dk.

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