

# Preparing Roads for Future Climatic Change

Presentation

by

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at

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Conditions"**

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# Preparing Roads for Future Climatic Change

## National Background

### ATV

- the Danish Academy for the Technical Sciences:  
"Effects of Climate Change - Adaptations in Denmark"  
(2001- 2003) May be downloaded from [www.atv.dk](http://www.atv.dk)

#### "Recommending

- that it is evaluated if dimensioning of systems for draining and removing water from roads ..... is sufficient to meet with the more intensive precipitation of the future.

- that roads in low terrain, where ground water level is expected to raise as a result of increasing sea level are gradually secured"

## Government initiative 2005-2007

# Preparing Roads for Future Climatic Change

## ATV conclusions on roads

- adaptations may be implemented on short notice
- higher summer temperatures pose different, but well-known, demands on road pavements, which can be met through the ordinary repavement schemes
- increasing intensity of precipitation may demand better water removal. Risk of water....can on locations of high exposure be reduced through draining pavements or increased (transverse) sloping of the road.
- accumulation of water in the road body reduces its bearing capacity and thus its usage life. Effective removal of water is an important prerequisite for keeping costs of good maintenance at an acceptable level.

# Preparing Roads for Future Climatic Change

## Climate outlooks

Three model scenarios

2 from IPCC's SRES report (2000)

A2 and B2

1 "truncated" at 2030 levels of GH gases

EU2C

Three 30-year prediction periods, centered around 2020, 2050 and 2080:

[2006-2035], [2036-2065], [2066-2095]

## Climate outlooks

Climate model A2	[2006-2035] change	[2036-2065] change	[2071-2100] change
Annual avg. temp.	+ 0.6 °C	+ 1.4 °C	+ 3.1 °C ± 1.5 °C
Annual avg. precip.	+ 2 %	+ 4 %	+ 9 %
Summer avg. precip.	- 3 %	- 7 %	- 15 %
Summer max. 24 hrs. precip.	+ 4 %	+ 10 %	+ 21 %

## Climate outlooks

Climate model B2	[2006-2035] change	[2036-2065] change	[2071-2100] change
Annual avg. temp.	+ 0.6 °C	+ 1.4 °C	+ 2.2 °C ± 1.5 °C
Annual avg. precip.	+ 2 %	+ 5 %	+ 8 %
Summer avg. precip.	- 2 %	- 4 %	- 7 %
Summer max. 24 hrs. precip.	+ 5 %	+ 12 %	+ 20 %

## Climate outlooks

Climate model EU2C	[2006-2035] change	[2036-2065] change	[2071-2100] change
Annual avg. temp.	+ 0.6 °C	+ 1.3 °C	+ 1.5 °C ± 0.7 °C
Annual avg. precip.	+ 2 %	+ 4 %	+ 4 %
Summer avg. precip.	- 3 %	- 6 %	- 7 %
Summer max. 24 hrs. precip.	+ 4 %	+ 9 %	+ 10 %

# Preparing Roads for Future Climatic Change

## Challenges of climate change for roads in Denmark

- Increasing max. 24 hrs precipitation (S,M,L)
- Increasing normal and max. sea level (S,M,L)
- Increasing max. temp. in surface layers (M,L)
- Increasing maximum wind speed (M,L)



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## Consequences and interventions

Increasing maximum day precipitation			
[years] scenario	Consequences for roads	Spontaneous action	Possible intervention
['06-'65] All	More frequent aquaplaning	Warning road users	Draining pvmts. on risk sections
['36-'65] All	Loss of bearing capacity	More maint. of edge and ditch	Increased water removal capacity
['71-'00] A2 & B2	More frequent aquaplaning	Warning road users	As before + transverse slope
	Loss of bearing capacity	More maint. of edge and ditch	Increased water removal capacity

# Preparing Roads for Future Climatic Change

## Consequences and interventions

Increasing max. temperature in surface layers			
[years] scenario	Consequences for roads	Spontaneous action	Possible intervention
['06-'35] All	none	none	none
['36-'65] All	Less friction + more rutting	Marking damaged sections	Change to suitable pavement
['71-'00] A2 & B2	as above		

# Preparing Roads for Future Climatic Change

## Consequences and interventions

Increasing normal and maximum sea level			
[years] scenario	Consequences for roads	Spontaneous action	Possible intervention
['06-'35] All	More frequent floods in low, coastal areas	Redirecting traffic during flooding	Interventions not required
['36-'65] All	More frequent floods in low, coastal areas	Redirecting traffic during flooding	Reconstruction of some exposed road sections
['71-'00] A2 & B2	as above		

# Preparing Roads for Future Climatic Change

## Consequences and interventions

Increasing maximum wind speed			
[years] scenario	Consequences for roads	Spontaneous action	Possible intervention
['06-'35] All	More frequent windfalls	Warn users and clear roads	None required
['36-'65] All	More frequent windfalls	Warn users and clear roads	Removal of risk trees along road
['71-'00] A2 & B2	More frequent windfalls	do.	do.
	Damage of portal signs	None required as such signing will be electronic in-vehicle	

# Preparing Roads for Future Climatic Change

## Derived and adjoining challenges:

- Key guidance and norm documents loose relevance
- New decision paradigm is needed
- The Water Framework Directive implementation complicates the issues

# Preparing Roads for Future Climatic Change

## Key guidance and norm docs loose relevance

- numerous road standards linked to climate data
- climate/weather assumed to follow statistics based on past observations
- "certainty" of statistics must be replaced by "uncertain" predictions based on evolving insight into climate change
- authoritative sources for such predictions must be identified
- EU-wide notification of national prediction authority probably needed to meet internal market demands

# Preparing Roads for Future Climatic Change

## New decision paradigm is needed

- From EIA to final design
- How will predicted future climate impact the environment, design, function and cost of each road infrastructure element ?
- Is this acceptable ?
- Difficult cost and benefit analysis

# Preparing Roads for Future Climatic Change

## The WFD complication

**DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND  
OF THE COUNCIL**

**of 23 October 2000**

**establishing a framework for Community action in the field of  
water policy**

**Proposal (17 July 2006) for a**

**DIRECTIVE OF THE EUROPEAN PARLIAMENT AND  
OF THE COUNCIL**

**on environmental quality standards in the field of water policy  
and amending Directive 2000/60/EC**



## WFD time schedule for implementation

2006	Establishment of monitoring network Start public consultation (at the latest)	Art. 8 Art. 14
2008	Present draft river basin management plan	Art. 13
2009	Finalise river basin management plan including programme of measures	Art. 13 & 11
2010	Introduce pricing policies	Art. 9
2012	Make operational programmes of measures	Art. 11
2015	Meet environmental objectives	Art. 4

# Preparing Roads for Future Climatic Change

## ToR for "strategy for adaptation to climate change"

Purpose: describe expected impacts and possible interventions

Special focus: objects for infrastructure planning

Climate models: IPCC A2 and B2 as well as EU2C

Proceed through two phases:

1. Problem analysis – catalogue of consequences and action opportunities
2. Strategy proposal (temporary)

Project conducted by interministerial WG. Report due in March 2007.

# Preparing Roads for Future Climatic Change

**End of the presentation**

**Thanks for your attention**