The energy-saving road

- Danish Road Directorate
- Dynatest
- NIRAS
- NCC Roads

Ole-Jan Nielsen, NCC Roads
Purpose of the project

1. If possible – to reduce energy consumption and therefore CO$_2$ emissions to the atmosphere by reducing the road pavement’s contribution to the rolling resistance between tire and road.

2. Given a positive result under (1.), to influence the granting authorities to realise this gain through better funding for road maintenance.
Aims of the project

1. State-of-the-art international expertise, supplemented by own studies as required, to identify the road pavement’s contribution to the rolling resistance between tire and road.

2. Cost-benefit analysis for replacing the existing wearing course with an energy-saving wearing course.
Force distribution

- $F_v = \text{internal friction}$
- $F_{RR} = \text{rolling resistance}$
- $F_d = \text{air drag}$

Speed (km/h):
- 0%
- 20%
- 40%
- 60%
- 80%
- 100%
- 120%
- 140%
- 160%
The energy-saving road

Rolling resistance:
• Texture
• Roughness
• Rigidity of road pavement
The results of the ECRPD project have shown:

When the texture of the road increases by 1 mm, rolling resistance increases by:

- 17% at 50 km/h
- 30% at 90 km/h
IRI - International Roughness Index

The results of the ECRPD project have shown:

When the roughness of the road increases by 1 m per kilometre, rolling resistance increases by:

2% at 50 km/h
6% at 90 km/h

Bjarne Schmidt, VI, DK
Concrete roads save fuel?

"Fuel consumption will be cut by 1.1% if the road surfacing consists of concrete instead of asphalt."

Shown by a study conducted by VTI north of Uppsala in Sweden
Energy loss during deformation

Dr. techn. Per Ullidtz, Dynatest DK
Why focus on MPD and IRI?

- All other things being equal, more rigid road pavements will have less rolling resistance than less rigid road pavements.

- Compared to the total driving resistance, the influence on rolling resistance from deformation represents only a small percentage of the overall rolling resistance, and only for heavy vehicles.
A 10% reduction in rolling resistance will reduce fuel consumption by 3%.
Potential fuel saving on the trunk road network in Denmark

Reducing MPD to 0.6 and IRI to 0.9 will save:

48 million litres of fuel per year ~ 3.3%

Connie Nielsen PhD, NIRAS, DK
Noise-reducing wearing course SRS

Friction vs. MPD

R² = 0.0017

13 stk.
Benefits per year

• Fuel saving:
  48 million litres

• GHG emissions:
  Reduced by 45,000 tonnes
  \( \text{CO}_2 \) equivalents

• NO\(_x\) and SO\(_4\) emissions:
  Reduced by 76 tonnes
Value of benefits per year

- **Fuel saving:**
  DKK $250^{10}$ – DKK $410^{24}$ million

- **CO$_2$ emissions:**
  DKK 31 million

- **NOx emissions:**
  DKK 28 million

- **Total DKK 309 – 469 million**

*Calculation standard from The Danish Energy Agency*
Danish Road Directorate’s expected budget

Road surfacing budget MDKK

Total value of savings per year 309
The energy-saving road

• A technical report
• A socio-economic report
• Both in Danish and English

• Download from
  www.ncc.dk/greenroad
What do we do now?

Have applied for and been granted MDKK 13.8 (17.0) for a four-year project from the Danish Strategic Research Council – Sustainable transport and infrastructure

Development and modelling of new road surfaces for the sustainable transport solutions of tomorrow