

Innovative and sustainable tendering for European motorways

Luc Rens, Managing Director, EUPAVE

Overview

- The starting points
 - Public Procurement Directive
 - Green Public Procurement Criteria for Roads
- The questions
 - Is the pavement market **open**?
 - Open and fair competition
 - MEAT and Life-Cycle Costing
 - Innovative tendering methods
 - Is the pavement market **green**?
 - EUPAVE's Infographic and Fact Sheets
 - High Albedo
 - Less Fuel consumption
- Closing remarks

Public Procurement Directives

From 18 April 2016, entry into force of:

- [Directive 2014/24/EU on public procurement](#)
- [Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors.](#)
- According to EC, they aim for a procurement market that is “*competitive, open, and well regulated*”
- **MEAT**= Most Economically Advantageous Tender

EU Green Public Procurement (GPP) criteria for roads

- Voluntary criteria for potential use by Member States
- Covers environmental impacts relating to design, construction, use, maintenance and end of life
- Recommends a holistic approach over the entire service-life of the road



JRC SCIENCE FOR POLICY REPORT

Revision of Green Public Procurement
Criteria for Road Design,
Construction and Maintenance

*Procurement practice
guidance document*

Elena Garbarino, Rocío Rodríguez Quintero,
Shane Donatello, Oliver Wolf (JRC)

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Is the pavement market open?

- Need for an “open” and “fair” competition

“Open” (/healthy/competitive) competition

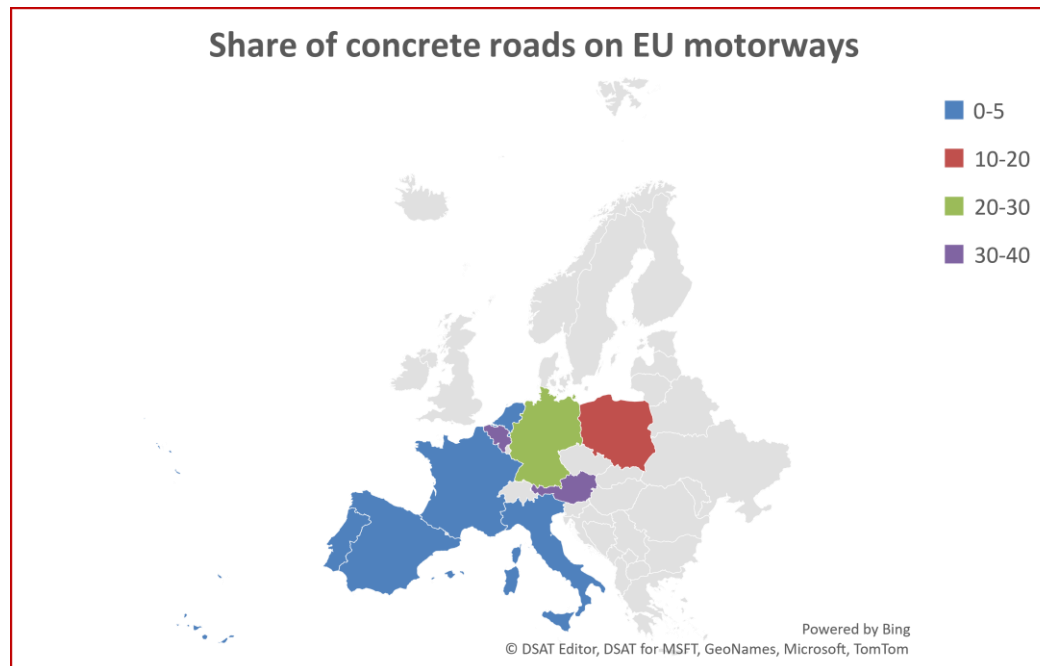
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“Fair” (/transparent/objective) competition

Both are desirable!

Is the pavement market open?

- What is the situation of concrete pavements on the European market?
 - Very different from country to country
 - From almost 0 to 40% share of concrete on motorways



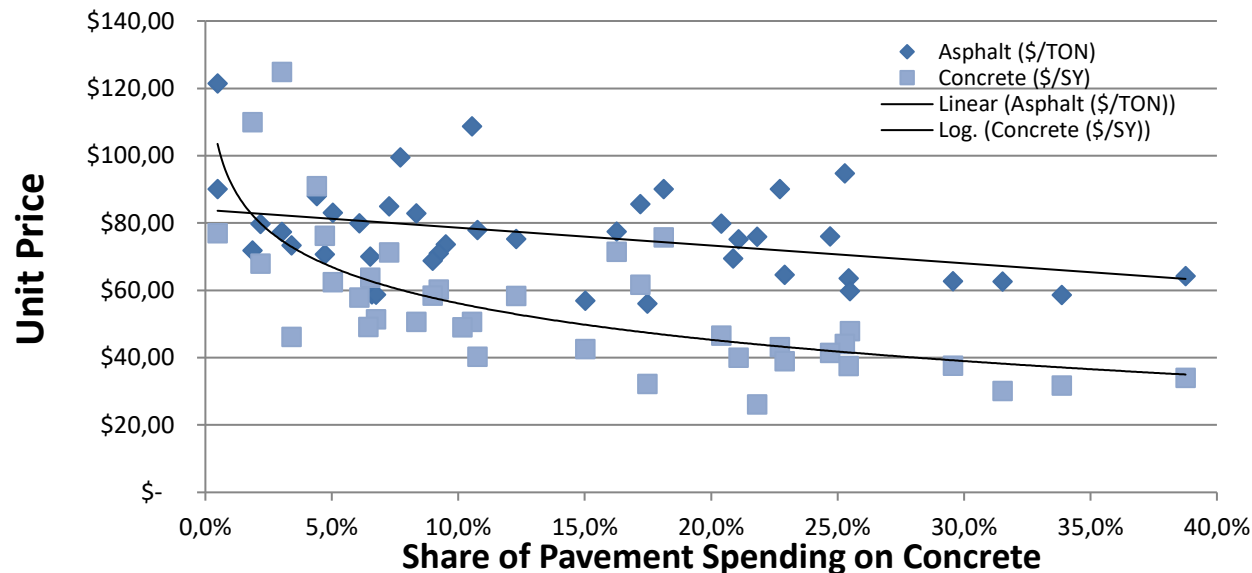
Is the pavement market open?

- A study* from the US concrete industry uses highway agency bid information for 45 US states.
- US states that use a more even balance of pavement types (asphalt and concrete) get better value for money

*Pavement type selection: what is the ideal process?
Leif Wathne, ACPA



Is the pavement market open?



- As the share of concrete in the overall paving budget increases from 0 to 35%, asphalt and concrete unit prices drop
- That means a road authority could get over one million square metres of extra concrete pavements for the same annual budget!
- MIT has further studied this effect with similar results

MEAT & Life Cycle Costing (LCC)

- Provides a way of comparing the expected benefits from a proposed investment with the costs of that investment
- = aid in decision process
- Leads to identification of “preferred alternative” for the design, maintenance, preservation, rehabilitation or reconstruction of a particular project

MEAT & Life Cycle Costing (LCC)

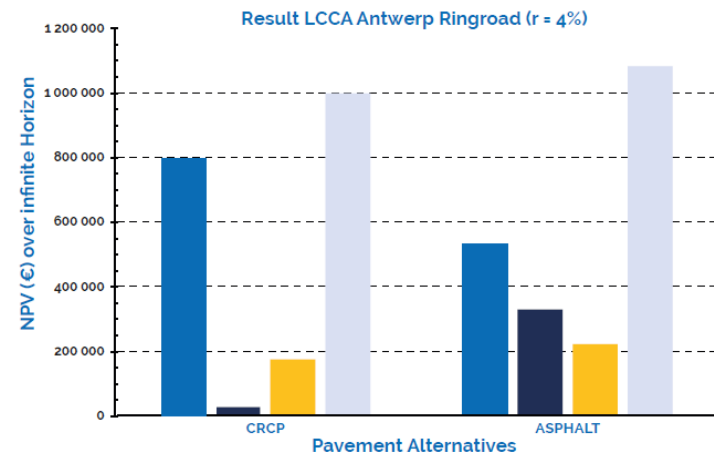
Initial construction costs
 + Maintenance costs*
 + Rehabilitation costs*
 - Salvage value

 = Total life cycle cost

*converted to “present-day euros” using a discount rate



■ INITIAL COST
 ■ MAINTENANCE PV over ∞ H
 ■ RECONSTRUCTION PV over ∞ H
 ■ GRAND TOTAL NPV over ∞ H



MEAT & Life Cycle Costing (LCC)

- For EUPAVE, the use of LCCA is essential for a fair public procurement
- More information and examples are available:
 - in our publication
 - From the author: Manu Diependaele, MSCE, P.E., LCCA Consultant -
manu.diependaele@gmail.com
Mob.: +32 495 58 71 90



**A guide on the basic principles
of Life-Cycle Cost Analysis (LCCA)
of pavements**



Innovative Public Procurement - Contract models

- Criteria can be applied to various contract types:
 - Separate design and build contracts
 - Design and build
 - Design, build, (finance), operate (DBO & DBFO)
 - Public-private partnerships (PPPs)
 - including the use phase by guaranteeing the availability of the road may have an impact on technical choices
- Innovative bidding procedures
 - The use of bid alternates



Example:

Ministry of Transportation, Ontario

- Past:
 1. MTO used Life-cycle costing (LCC) to compare different designs
 2. Lowest LCC pavement chosen
 3. Contract for tendering includes only selected design

Now:

- **Alternate bidding contracts:** these incorporate LCC into the bidding process to allow both asphalt and concrete contractors to bid on the same contract
- Construction Bid + Bid Adjustment Factor = Total Adjusted Bid

Is the pavement market green?

CONCRETE PAVEMENTS MAKE ROADS MORE SUSTAINABLE

LESS GLOBAL WARMING

Concrete roads can strongly contribute to reduction of CO₂ emissions from road transport.

Vehicles consume up to 6% less fuel when riding upon smooth and non-deformable road surfaces.

Concrete roads require minimum maintenance work, thereby causing less traffic jams.

Light coloured concrete surfaces have a high light reflection, which counteracts global warming.

-25 to 38 kg CO₂/m²

-80%

up to -6%

HIGHER RESILIENCE TO CLIMATE CHANGE

Concrete roads show better resilience to climate change and extreme meteorological events.

They withstand extreme temperatures.

Concrete roads resist floods as they retain their structural performance in the event of sub-base subsidence.

Pervious concrete pavements are essential in storm water management: they allow surface water either to infiltrate in the soil or to be stored in a "reservoir road" with a deferred evacuation.

SUSTAINABLE WATER MANAGEMENT

Concrete contributes to a more ecological water cycle management.

Concrete is neutral on polluting agents and totally harmless for the soil.

100% CIRCULAR

Concrete roads are made with local raw materials, offer a long service life and are 100% recyclable.

At the end of its service life, a concrete road can be crushed and recycled, used for new concrete pavements or foundations.

Concrete pavements have a service life of 40 years or more, significantly longer compared to other pavement types. This allows savings in natural resources such as sand and gravel.

≥40 years

Fact Sheets



FACT SHEET
High albedo

Concrete roads can strongly contribute to reduction of CO₂ emissions from road transport



Albedo is the ability of a surface to reflect light rays. Because of a light coloured concrete surface (high albedo) 0.30 to 0.60 more energy is reflected in the atmosphere compared to a black surface. Several studies show that the high albedo of concrete pavements offers several benefits:

- Slowing down the global heating**
Changing 1m² of black asphalt surface into a light concrete helps countering the climate change as if 22.5 kg CO₂ was not emitted. That is enough to offset 30 to 60% of the CO₂ emitted during the manufacturing process of the cement used in that concrete pavement.
- Reducing the Urban Heat Island Effect (UHIE)**
UHIE is the warming effect that occurs in large metropolitan areas. Light-colored pavements have lower heat absorption; they limit the harmful impacts of UHIE by a reduction of the ambient temperature, the duration of extreme heat days and the likelihood of smog.
- Saving cost and energy for road lighting**
Road lighting designers base themselves on the reflected light as it is perceived by the driver of a vehicle. The superior reflectivity of concrete makes it possible to achieve savings by placing fewer lighting columns or by using lamps of a lower luminance. In both cases, costs can be reduced up to 35% either by the lower number of lighting columns or by reduced lighting power loads resulting in less electricity consumption.
- Offering a better visibility**
When road lighting is not available, the light coloured surface of a concrete road still offers a better visibility, especially in difficult circumstances when visibility plays an important role at night and in bad weather conditions such as heavy rain or dense fog.

-22.5 kg CO₂/m²



FACT SHEET
Less Fuel Consumption

Concrete roads can strongly contribute to reduction of CO₂ emissions from road transport



- 78 kg CO₂/m² thanks to concrete

Fuel consumption is not only influenced by the vehicle type of engine, aerodynamic profile, tyres, but also by the pavement it is driving on. The factors related to the surface of the pavement are, for instance, the surface texture and the deflection.

Several researches indicate around 2% fuel savings for trucks driving on concrete pavements compared to asphalt. This was found both in theoretical studies (by METI and in field tests).

The differences are higher for slower traffic speeds and for higher outside temperatures.

When calculating a LCA for a motorway, reduced greenhouse gas emissions due to lower fuel consumption should be taken into account in the use phase of the pavement, together with other influencing factors. Based on data of the European road transport network, changing from flexible asphalt to rigid concrete creates over 50 years a difference in GWP (Global Warming Potential) estimated to be 78 kg CO₂/m² of pavement, more than offsetting its own CO₂.

Considering the total motorway network and freight road transport in Europe, there is a total potential of saving 2.5 million tonnes of CO₂ per year. In addition, reduced fuel consumption also means less pollution and less operating costs for truck transport companies.

-78 kg CO₂/m²

Fact Sheet “High Albedo”

- Albedo =
 - ability of a surface to reflect light rays (= energy)
 - Reflected light/Incident light
 - 0.30 on average for earth

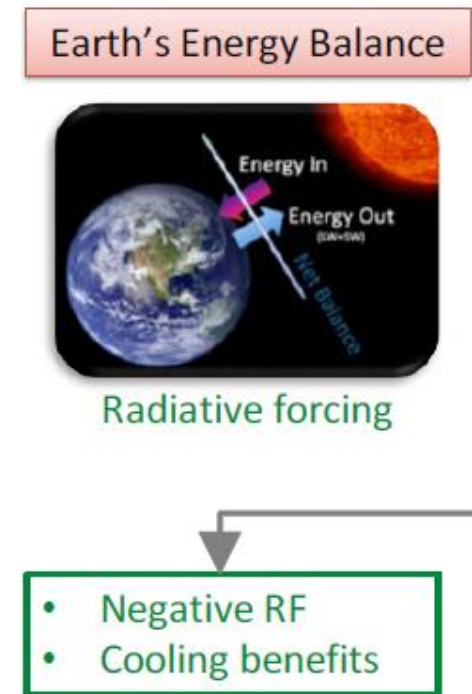
SURFACE	ALBEDO
Fresh snow	0.81 – 0.88
Old snow	0.65 – 0.81
Ice	0.30 – 0.50
Rocks	0.20 – 0.25
Wood	0.05 – 0.15
Soil/Ground	0.35
Concrete	0.20 – 0.40
Asphalt	0.05 – 0.15

- 4 x beneficial!!!!

Fact Sheet “High Albedo”

1. Slowing down global warming

- More reflection = increase of outgoing radiation at the top-of-atmosphere
- Potential to alter earth’s energy and consequently climate change effects
- Greenhouse gases and surface albedo are both forcing agents and can be expressed as a capture or release of CO₂



Fact Sheet “High Albedo”

1. Slowing down global warming

- Changing asphalt (black) into concrete (white) = Δ albedo of + 0.15
- Scientific studies: Δ albedo of + 0.01 = - 1.5 kg CO₂/m²
- Asphalt to Concrete = $15 \times 1.5 = - 22.5 \text{ kg CO}_2/\text{m}^2$ expressed as 50 years GWP
- 1m² of highway, 25 cm thick, 350 kg/m³ CEM I at 803 kg CO₂/tonne cement:
 - $803 \times 0.350 \times 0.25 = 70.26 \text{ kg CO}_2/\text{m}^2$
- $22.5/70.26 = 32\%$ compensation for GWP of cement production
- In some cases (secondary roads, 20 cm thick, CEM III): up to 60%

Fact Sheet “High Albedo”

2. Reducing the Urban Heat Island Effect

- Higher temperature in urban environments
- Increased energy demand due to air conditioning
- Higher risk on smog and air pollution
- “Cool pavements” strategy

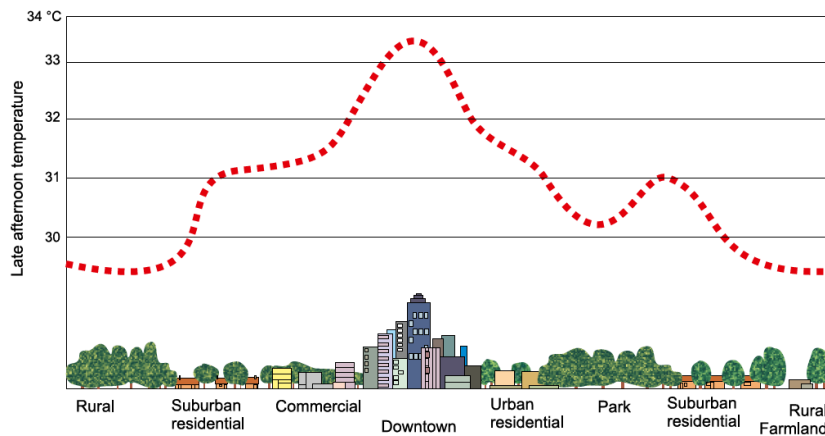
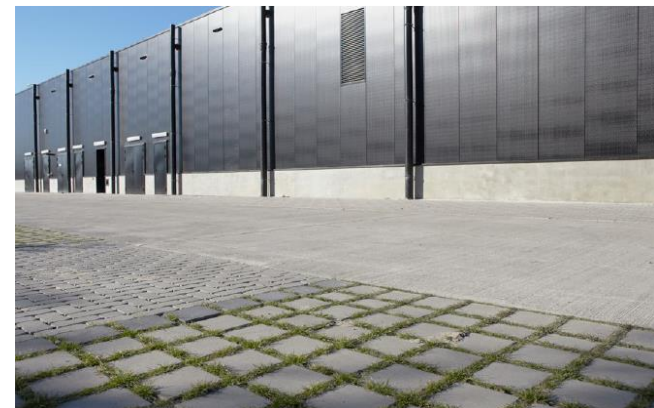


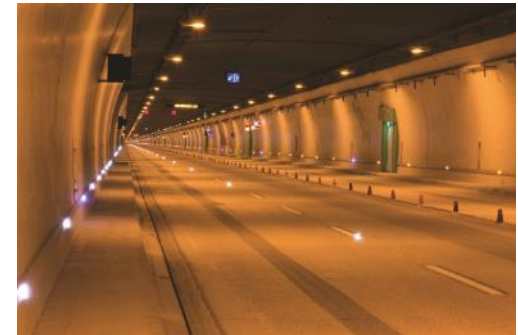
Figure 1 Urban Heat Island Effect © EDA UIC



Fact Sheet “High Albedo”

3. Saving cost and energy for road lighting

- Fewer lighting columns
- Lamps of lower luminance
- Savings around **30 – 35%**
- Particular case of tunnels



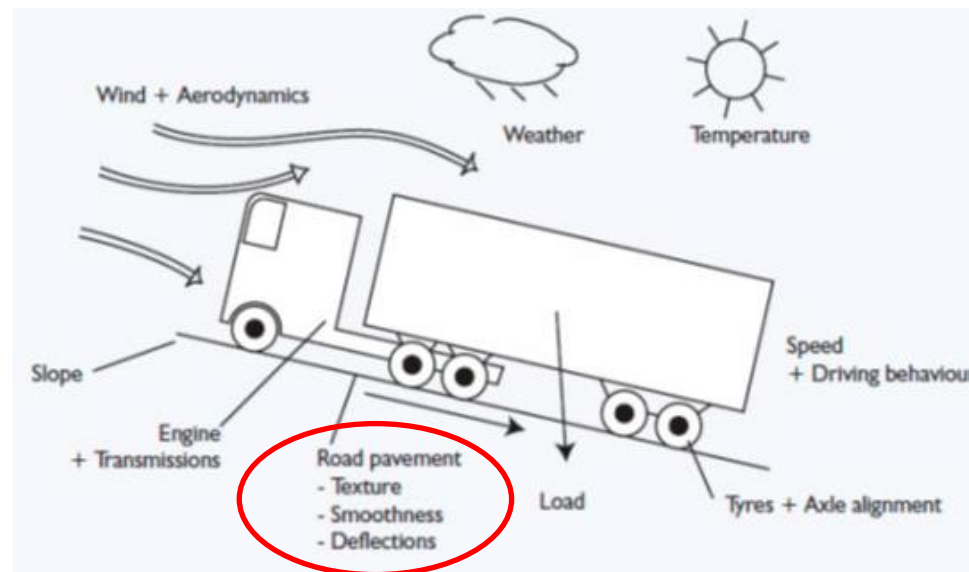
4. Offering a better visibility

- Enhanced visibility in difficult circumstances (heavy rain, dense fog)
- Traffic safety



Fact Sheet “Less Fuel Consumption”

- Not only electrical vehicles but also physical road infrastructure can contribute to the reduction of CO₂-emissions by road transport !!
- Influencing factors:



Fact Sheet “Less Fuel Consumption”

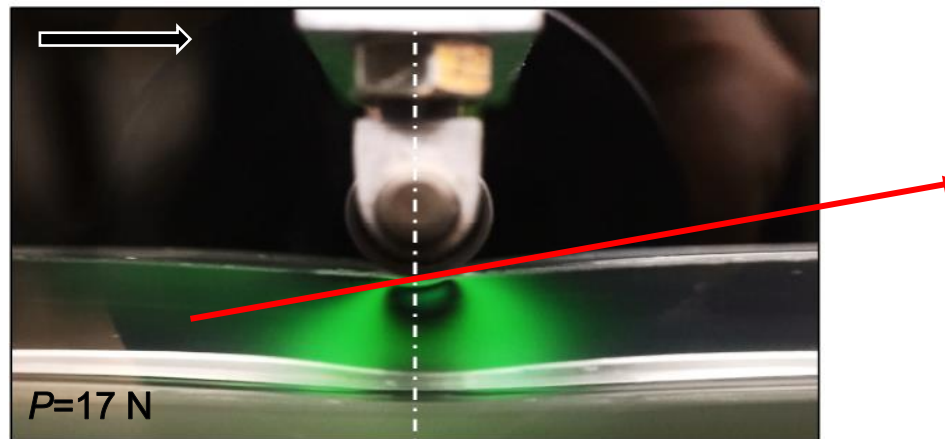
- Evenness & Texture: depend on quality of construction and/or safety requirements, both for concrete and asphalt roads
- Deflection depends on stiffness of the pavement



The deformation (not at scale) of an asphalt road under a wheel load has the same effect as a vehicle driving uphill, requiring more energy, fuel and CO₂.

Fact Sheet “Less Fuel Consumption”

- Several field studies (Canada, Sweden, Florida)
 - Less fuel consumption on concrete compared to asphalt up to 6%
 - Impact of differences in texture and deflection
- Theoretical study by MIT
 - Mathematical model of the Pavement Vehicle Interaction (PVI)
 - Desktop Experiment



Fact Sheet “Less Fuel Consumption”

- Theoretical study by MIT
 - Results depending on speed and temperature

	LOW VALUE	AVERAGE VALUE	HIGH VALUE
Asphalt	0.21	1.07	6.25
Concrete	0.07	0.25	0.50
Delta	0.14	0.82	5.75

Fuel consumption (litre/100 km)
due to deflection of the pavement
by heavy truck traffic
[Akbarian, M. (2015)]

- - $0.8233 / 35 = -2.35 \%$
- This means, on average, for the EU motorway network:
 - - **78 kg CO₂/m²** of pavement
 - Total potential of annual saving = **2.5 million tonnes of CO₂**

The best is yet to come...

- New Fact Sheets on environmental topics
 - 100 % Recycling
 - High Resilience
 - ...

- Comparative LCA
 - For different types of roads
 - Adding up the benefits



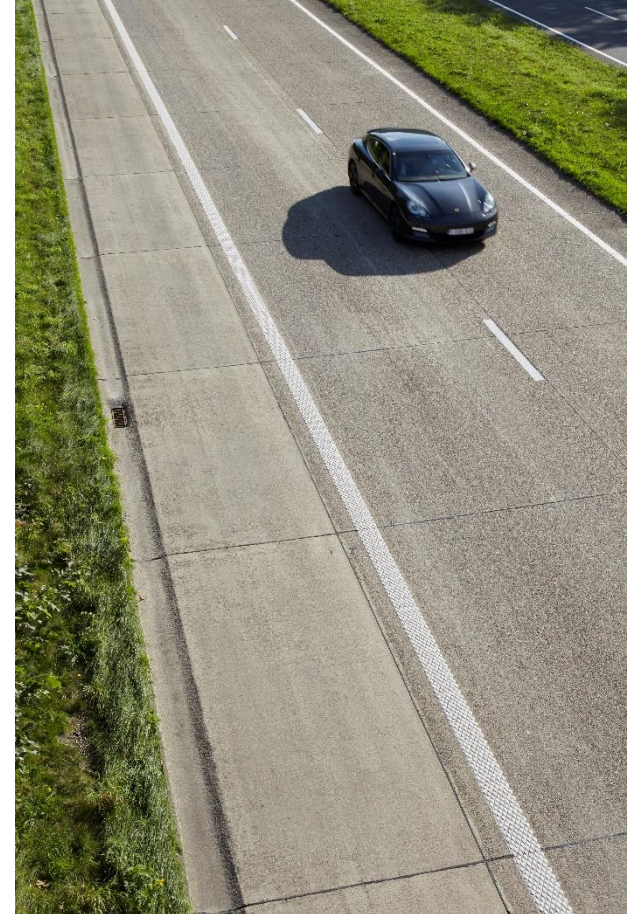
Closing remarks

- Is the pavement market open and green?
 - The concrete pavement market is green! ...but the overall pavement market should be open for more competition in order to become greener as well
- We request the EC to:
 - encourage Member States to take a more innovative approach in public procurement;
 - ensure open and fair competition in EU-funded projects, including a holistic life-cycle approach (LCA / LCCA)
 - Ahead of upcoming new Regulation for the TEN-T: introduce binding sustainability criteria in bids related to TEN-T projects

Closing remarks

EUPAVE is ready to help with:

- Sharing know-how and experience,
 - Information sessions
 - Publications
 - ...
- Assistance in developing technical solutions, e.g pavement design
- Use of LCCA – LCA
 - Providing input parameters
 - Comparing alternative solutions





Thank you for your
kind attention