Dutch procurement approach for a more Sustainable Infrastructure

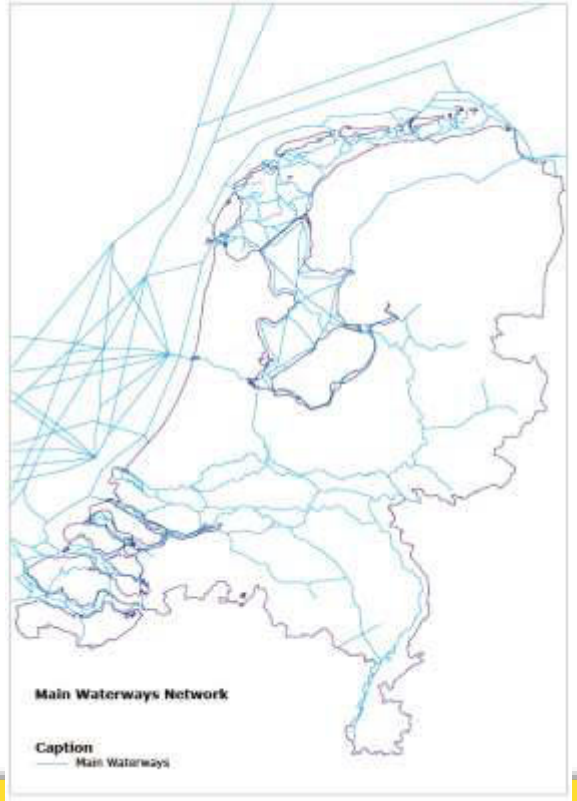
Harald Versteeg
Rijkswaterstaat

10th EAPA Symposium on 1 June 2017 in Paris
#EAPASymposium2017

Rijkswaterstaat operates to ensure the Dutch inhabitants have

- protection against flooding
- sufficient clean water
- a smooth and safe transport by road and water
- reliable and useful information
- a sustainable living environment

Rijkswaterstaat is in charge of three national infrastructure networks



Sustainability goals Rijkswaterstaat

Focus:

1. **Energy and Climate**
2. **Circular economy**
3. **Sustainable regional development**

4. Sustainable transport
5. Sustainable water management
6. Health

Sustainability goals Rijkswaterstaat

Energie en klimaat

"To make Paris real"

- 2020: -20% CO2
- 2030: Energie Neutral
- 2050: Climate Neutral

Circulaire economie

"Waste less Economy "

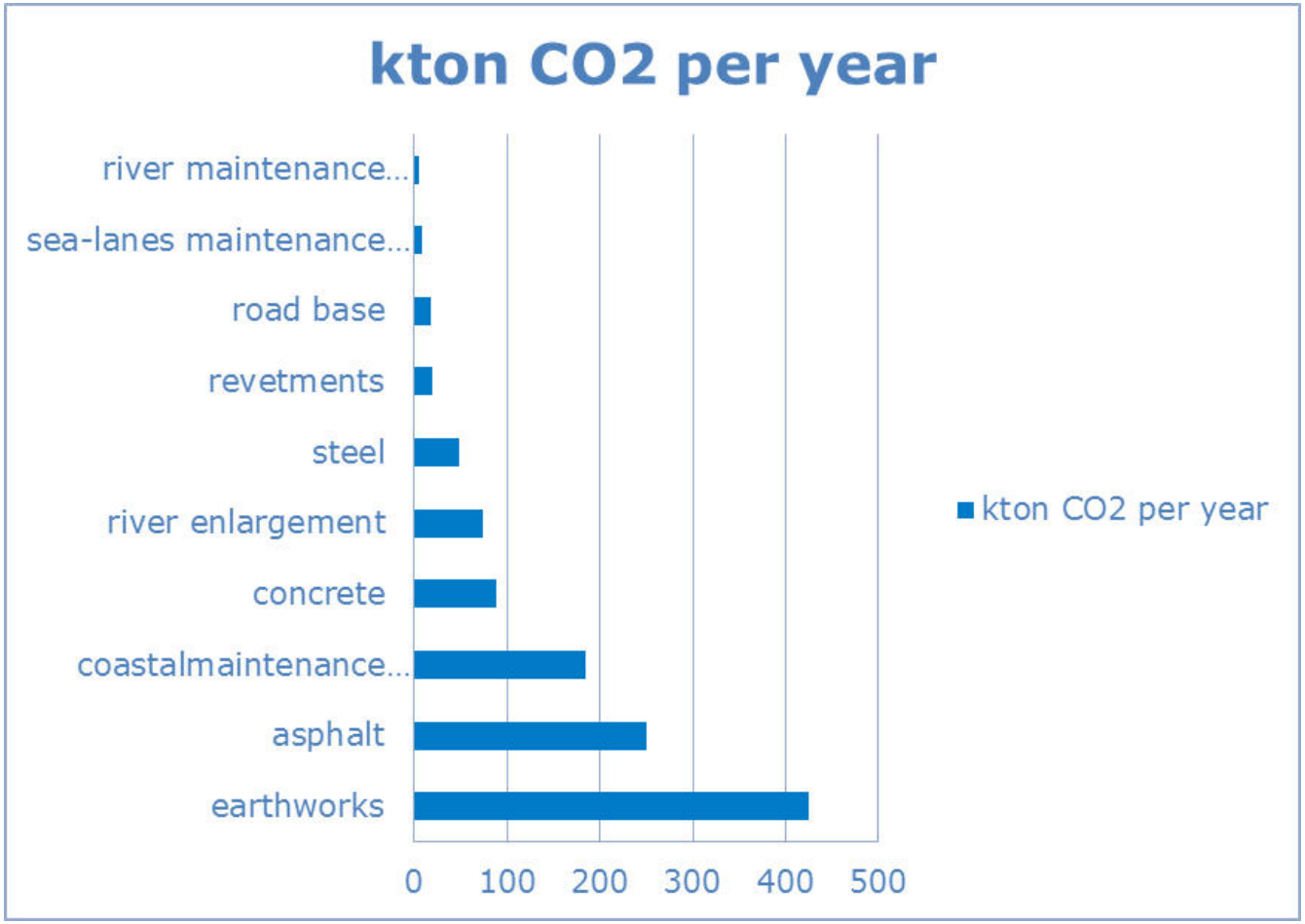
- 2020: ECI value – 20% in RWS projects
- 2030: RWS circular
- 2030: -50% primary or raw materials
- 2050: Zero waste

Duurzame gebiedsontwikkeling

"Sustainable area development "

- *Holistic approach of a region*
- *Multiple functions, more complex multi-disciplinary projects*
- *Co-funded projects will be the standard*

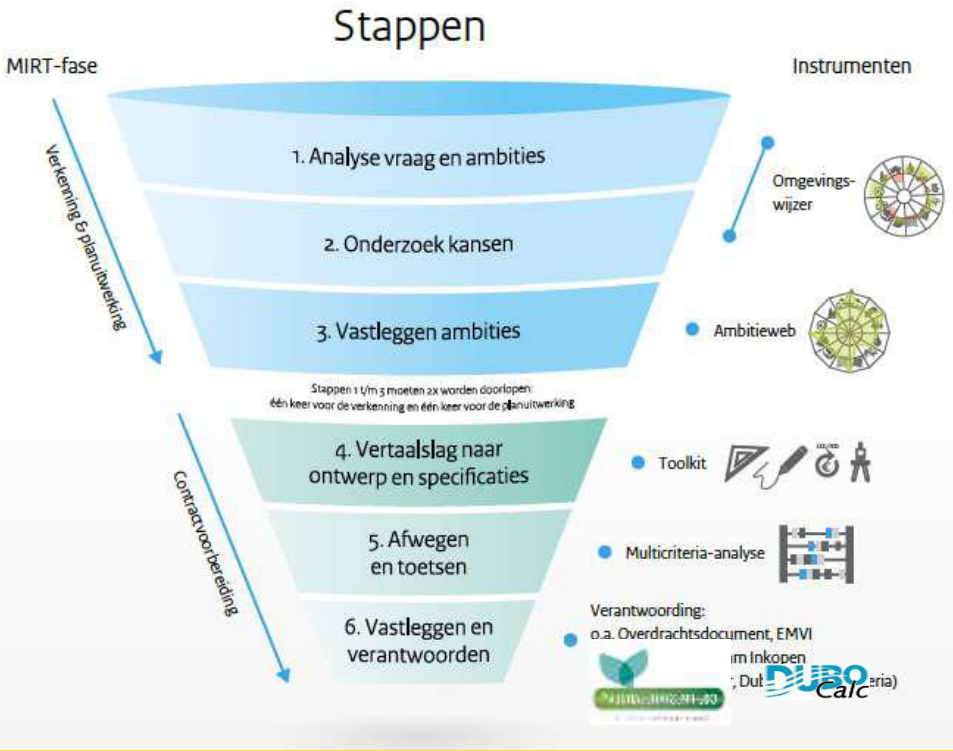
ASPHALT IS IMPORTANT



The sustainable Civil Infrastructure approach

Green deal duurzaam GWW 2.0: Sustainability is standard procedure in the Dutch infrastructure sector projects (rail, road and water) for <u>construction</u> and <u>maintenance</u>

Public-Private Collaboration: sustainability is 'business as usual



PROCUREMENT: IN THEORY

1. **Functional specifications**
   - Ideal: no specific technical solutions demanded!!!

2. **All decisions based on Lifecycle Costing and Total cost of Ownership.**
   – Design, building and maintenance in one contract

3. **Contract specifications**
   – Standard in all projects (***NEW from 1-1 2018 for asfalt!!***)
   – Project specific set of minimal contract specifications (e.g. energy use or technical)

4. **Besides prize, sustainability is an awarding criterion (OBJECTIVE comparison!)**
   – Obligatory tools to be considered: CO2 ladder and DuBoCalc
   – optional: focus on issues identified in planning phase

PROCURING (ASPHALT)ROADS

- **Fixed specifications for many parts of the road construction**
  - Road layout is political decission
  - Top layer is always very open asphalt
  - Uniformity over the width of the road is Rijkswaterstaat policy
  - Technology is accepted if quality can be proven

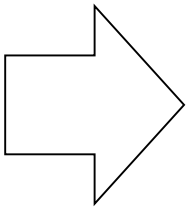
- **What can be varied by the contractor in tender procedures?**
  - the asphalt composition
  - The production proces (temperature, sourcing materials, re-use %)
  - Layer thickness in some layers
  - Depending on type of contract we allow the contractor to take risc of innovations (D&C less allowed than in DBFM contracts)

A9 HOLENDRECHT – DIEMEN

A9 HOLENDRECHT – DIEMEN

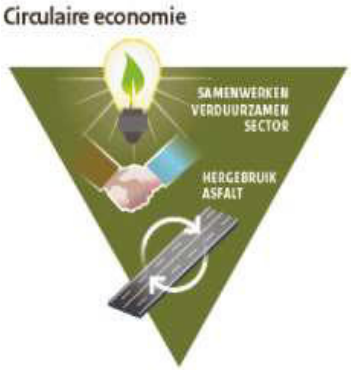
EAPA

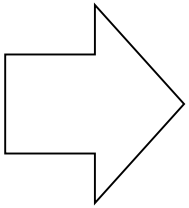
SUSTAINABLE PROCUREMENT
TWO INSTRUMENTS FOR USE IN TENDER PROCEDURE



CO_2 PERFORMANCE LADDER

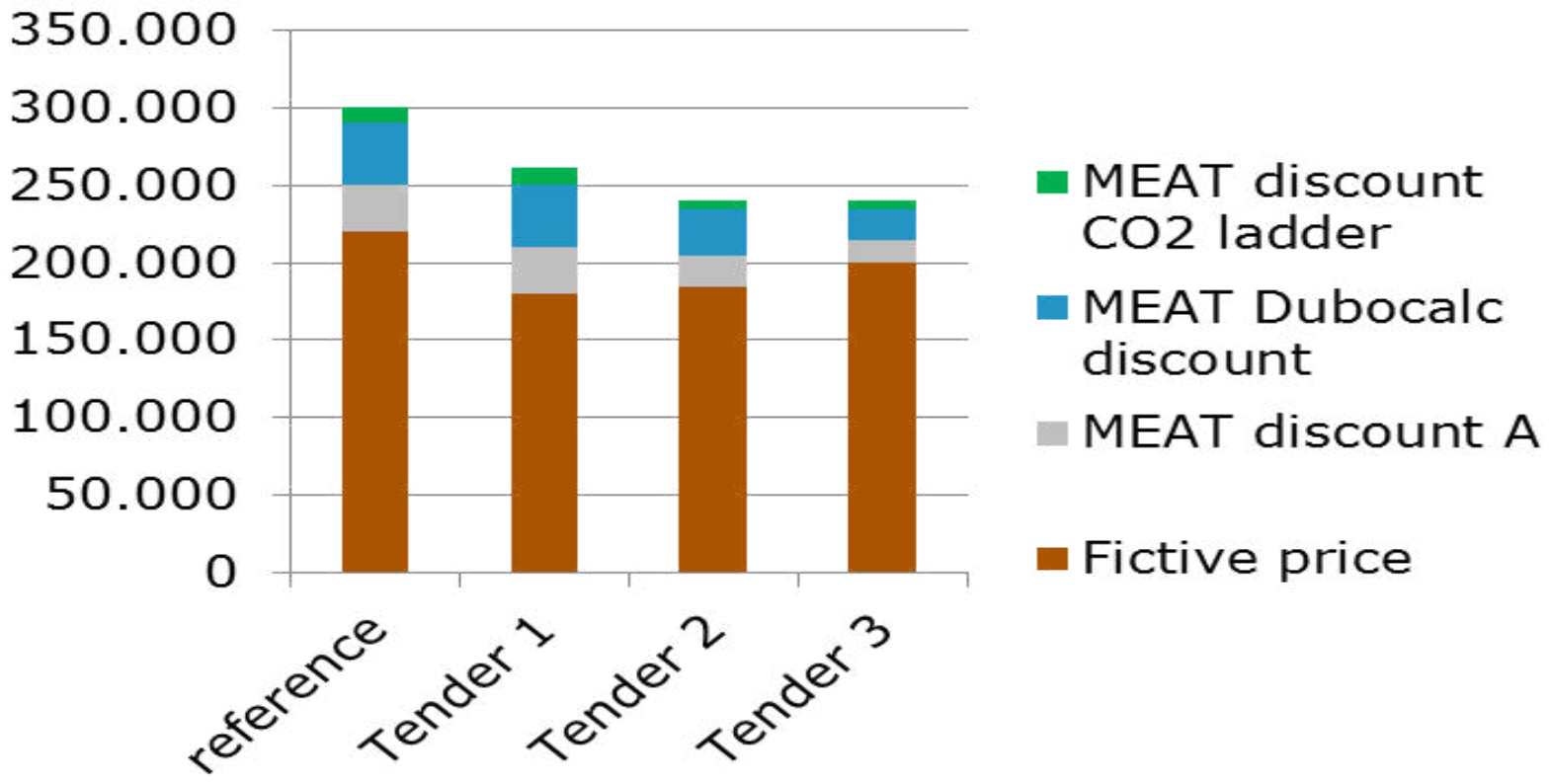
Working together to cut CO_2





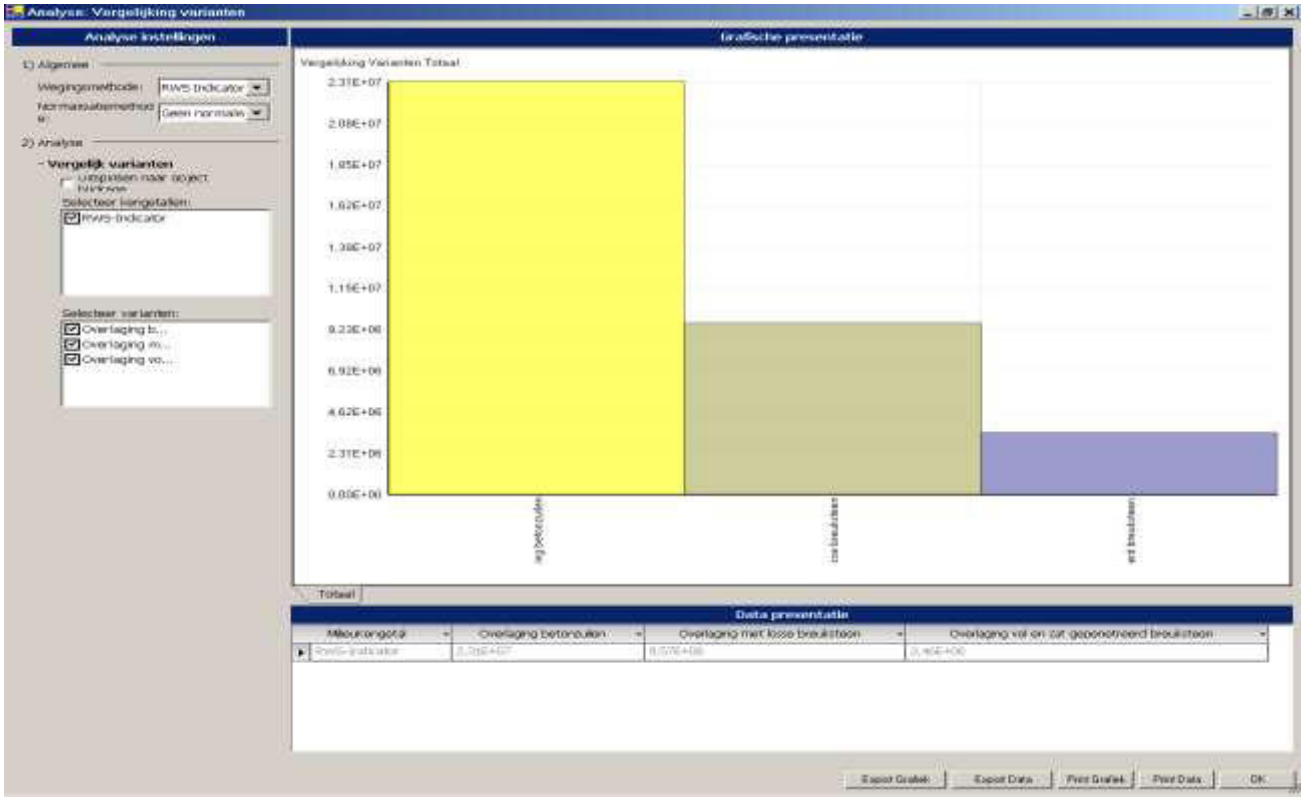
DUBO Calc

COMPARING OFFERS/TENDERS



COMPARING DESIGNS: ENVIRONMENTAL COST INDICATOR (ECI)

DUBOCalc



Design

- Materials
- Energy use
- Energy production
- (Building) Process
- Logistics

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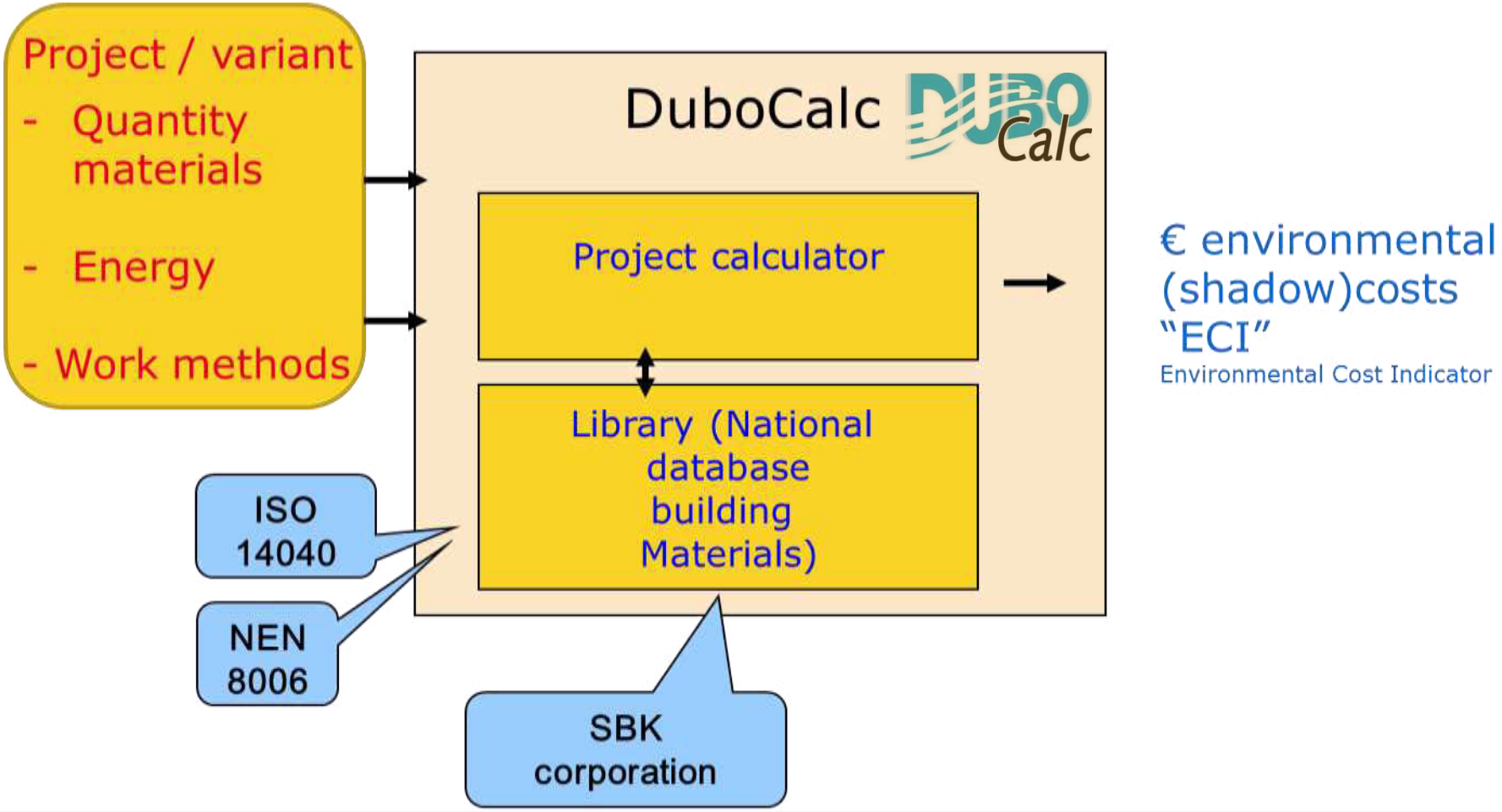
LIFE CYCLE BASED: ENVIRONMENTAL DATA TO "EURO'S"

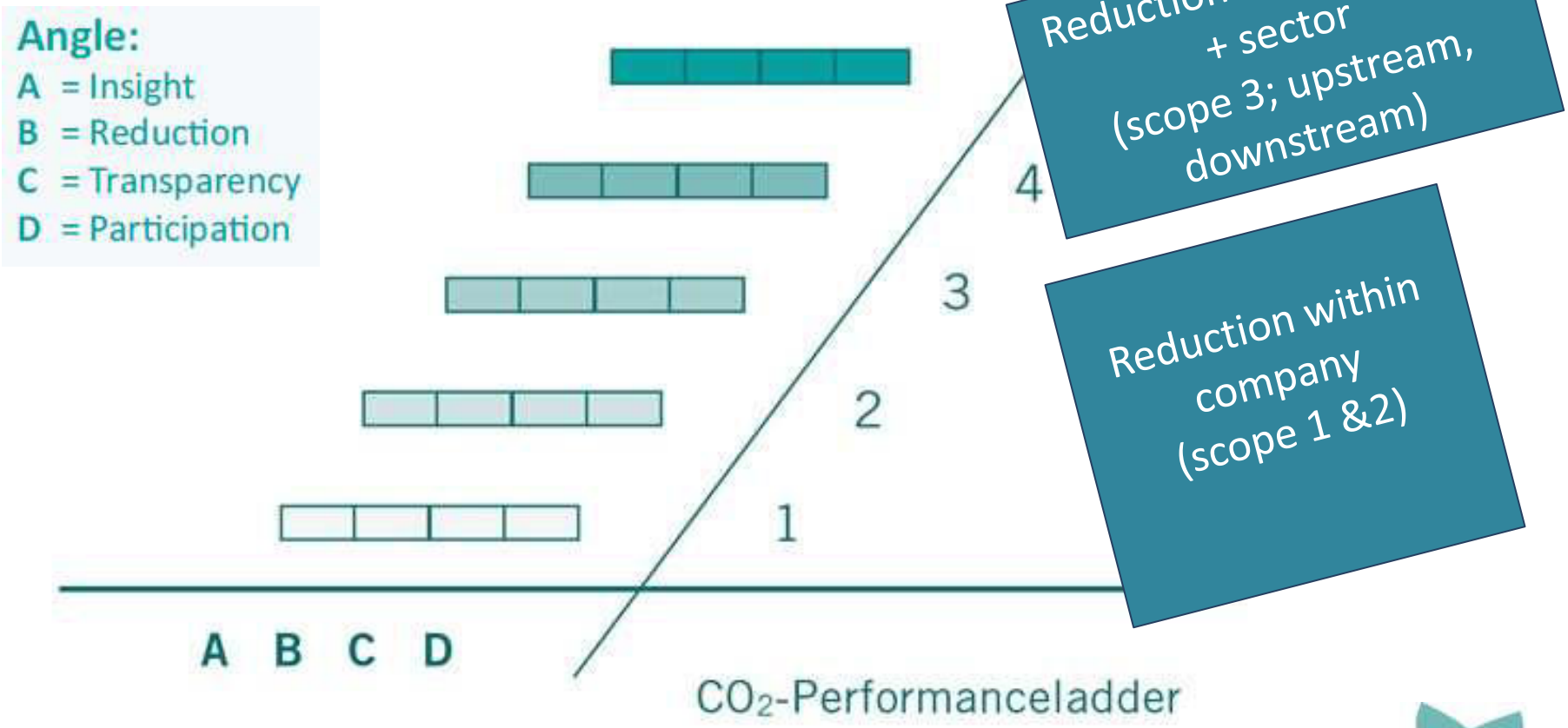


THE CO_2 PERFORMANCE LADDER IS…

- **A certification system with 5 levels for companies that encourages companies to stimulate their CO_2 awareness in their business operations and projects.**

- **A procurement system which allows the certificate to be used as proof of project delivery during execution of projects**
  - Extra effort is rewarded: a higher score on the ladder means a higher advantage in the tendering process (1-5% reduction of tenderprice at RWS)
  - Fully compatible with European regulations and the Public Procurement (Tendering Rules) Directive.

THE CO_2PL FOR ORGANISATIONS



A10 - Oost/ A1 Diemen (completed)	2012 – 2014
A1/A6 Diemen - Almere Havendreef	2014 – 2020
A9 Holendrecht - Diemen	2015 – 2020
A6 Almere Havendreef - Almere Buiten-Oost	2017 – 2020/22
A9 Badhoevedorp - Holendrecht	2019 – 2024/26

PROCURA+ AWARD WINNING SAA PROJECT: A6 ALMERE FOR *'BEST TENDER PROCEDURE OF 2016'*

- Smart transportation solutions
- Use of recycled materials
- Smart use of asphalt
- Energy neutral

PROCURA+
European Sustainable Procurement Network

Reduction of 52.800 ton CO2/Energy reduction 15.048 toe /Reduction of 39.900 ton asphalt

WISHLIST FOR ASPHALT

- **Decreasing lifecycle costs for roads & asphalt**
- **Decreasing ECI value for road construction including asphalt**
  - >90% re-use for all layers
  - Low temperature
  - ..
- **Practical way to include effect on trafic emissions in ECI calculations**
- **Continued cooperation with industry (in the Netherlands very well organised)**
  - On Quality assurance
  - On Validating new technology (in RWS Innovation Testcentre)
- **interaction with industry about**
  - Ambition speed of change that is possible
  - Use of award criteria and the size of the incentives necessary to stimulate change

EAPA

the world as we know it

Risk management

Proven technology

Protecting

Safeguards

Small project scope: 1 issue

Independent projects

Principal **vs** contractor

Sticks

the world we can create

Look for opportunities

Innovation programs

Creating, adding value

Incentives

Integrated, multiple goals

Cooperation between agencies

Principal **with** contractor

Carrots

CONCLUSIONS

With this approach we achieve

- Lower environmental impact
- An optimized design
- Lower total cost of ownership
- An incentive to improve and innovate

In a very cost effective way

- for Rijkswaterstaat and our suppliers

Communicating your sector

Why, when and how?

Why communicate?

Gives your product or service **visibility** in a crowded marketplace

Builds and maintains valuable **partnerships**

Gives you a **voice** in the sector

Drives **decision-making** that affects company

Facilitates creativity and **innovation**

Contributes to your company's **growth**

Audiences

Policymakers

National, regional and local authorities

Stakeholders:

- ✓ road owners
- ✓ road specifiers
- ✓ road users

General public

Media (multipliers)

Why are they/should they be interested?

Clarifying your aim

To raise awareness of the advantages of asphalt from four perspectives: economic, comfort, safety and environmental.

Messaging

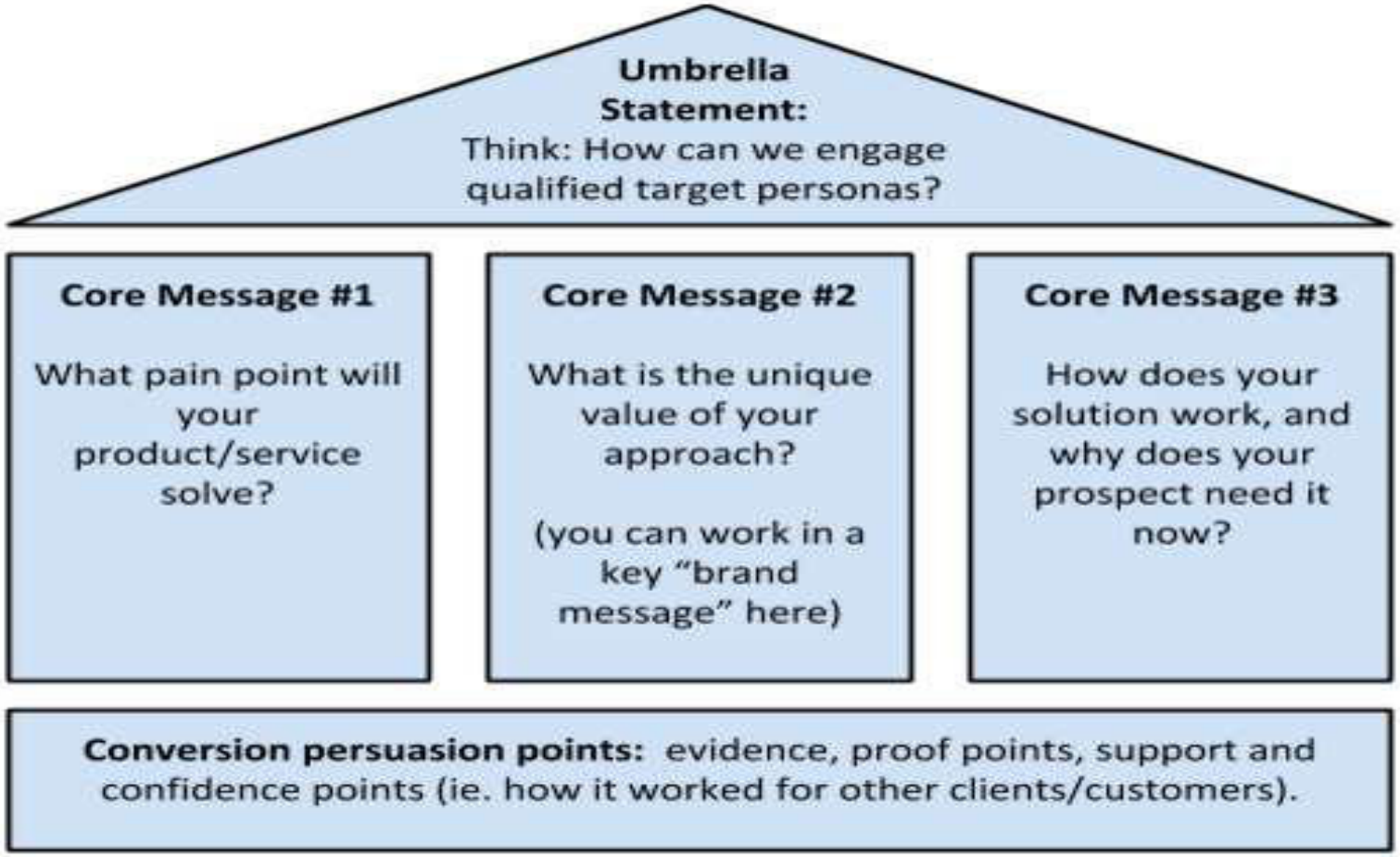
Umbrella message

Asphalt is at the heart of our daily lives.

Everyday when we travel to work or school, visit the doctor or hospital, see our friends and family, go to the shops or cinema, play tennis, deliver online orders, enjoy a bike ride, take off from a runway, or play the park, we are using asphalt surfaces.

Without asphalt, we simply wouldn't be connected.

Key messages for key audiences



When to transmit them?

Calendar

Identify hooks to communicate e.g.:

Company anniversary or event

Partner event

New product or service

Relevant local or national days

Seasonal opportunities

EU policy announcements + EC consultations

Channels

Website + e-newsletter

Audio-visual – animated clips, audio or visual podcasts, 30” adverts, news reports

Social media – visuals, GIFs, clips, tweets, posts

Publications – infographics, leporellos, posters, brochures

Events – stakeholder dialogue, media breakfast, public

Media outreach – press releases, events

Video

The preferred content type for Baby Boomers all the way up to Generation Z.

Television is the preferred medium of Europeans.

Digital

MEPs:

88% on Facebook, 76% on Twitter, 61% follow social media conversations daily in their legislative work

49% want to meet stakeholders in person and 20% want to be emailed

European public:

Nearly four in ten Europeans now use social networks every day or almost every day (huge use, low trust)

Over six in ten Europeans now say they use the Internet every day or almost every day.

Remember the 10 ‘C’s

Correct

Credible (fact-based)

Clear

Candid

Concise

Consistent

Concerning (relevant)

Coherent (brand recognition)

Creative (entertaining, visual, shareable)

Continuous

Tools

- Mapping
- Influence
- What target groups think now
- What you want each to think

- Design
- Content
- Visuals
- Media Corner
- Twitter Feed
- Video
- E-newsletter
- SEO

- Video clips
- Animation
- Interviews
- FB teasers

- Leporellos
- Infographics
- Brochures
- Leaflets
- Posters

Tools

- Partner(s)
- European Parliament
- Stakeholders
- General public

- Media hooks
- Media breakfast
- Press pack: Press release, visuals, case studies & FAQs
- Celebrity endorsement

- Mapping influencers/followers
- Thematic calendar
- Content development (tweets, posts, GIFs, clips, visuals etc.)

Go forth and multiply!

EAPA

Belgian Road Research Centre
Your partner for sustainable roads

Status-quo and outlook for Rolling Resistance in Europe

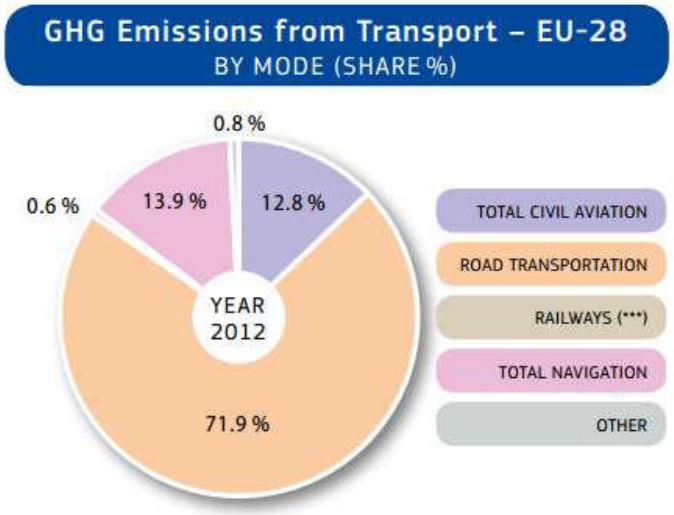
Johan Maeck, PhD CE
Belgian Road Research Centre

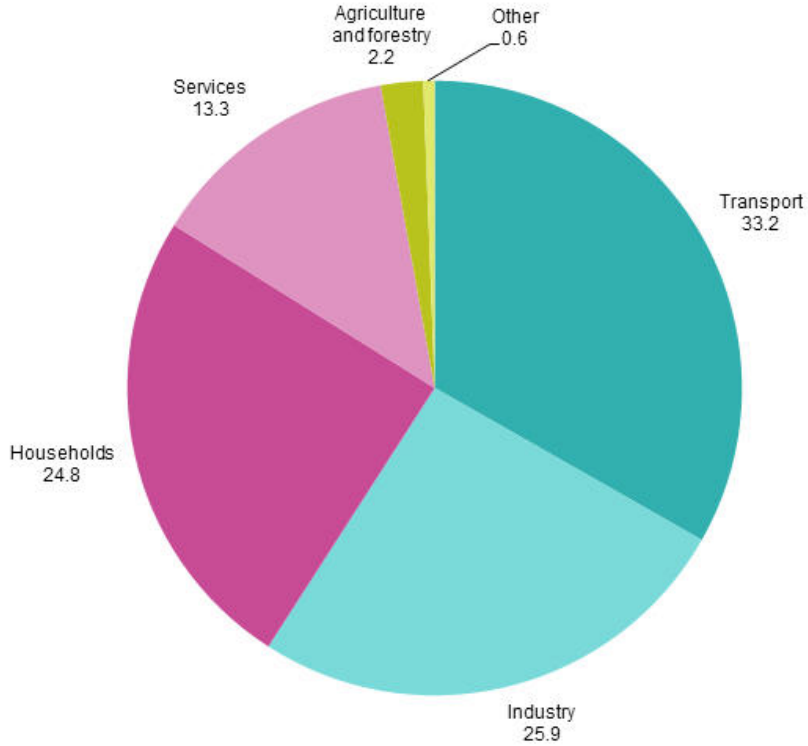
10th EAPA Symposium on 1 June 2017 in Paris
#EAPASymposium2017

WHY ROLLING RESISTANCE

EU has set itself the target of **reducing CO_2e** by 20% with respect to 1990 levels by 2020, recently even by 40% by 2030

The **transport sector** accounts for ~25% of all GHG emissions, major part is caused by road transport





Final energy consumption, EU-28, 2014
(% of total, based on tonnes of oil equivalent)

Source: Eurostat (online data code: nrg_100a)

Evaluation and Decision Process for Greener Asphalt Roads

2014 -2016, **Call 2013: Energy Efficiency: Materials and Technologies**

'green' asphalt

Any bituminous mixture produced by using specific **materials** and/or **technologies** with the aim of reducing the environmental impact

Stage	1 - HMA	2 - WMA	3 - WMA with RA	4 - CIR	5 - HMA with steel slag
A1-raw materials	16.9	26.8	21.8	18.0	13.9
A2-transport to plant	5.5	5.5	4.2	0	6.2
A3-production in plant	22.3	19.1	19.1	2.3	22.3
A4-transport to worksite	5.8	5.8	5.8	3.4	6.4
A5-laying	1.2	1.2	1.2	1.2	1.2
B1-road use	1.97e4	1.97e4	1.97e4	1.97e4	1.97e4
B2-4-maintenance	0	0	0	0	0
C1-demolition	3.1	3.1	3.1	3.1	3.1
C2-waste transport	5.8	5.8	5.8	5.8	6.4
C3-waste processing for recycling	2.0	2.0	2.0	2.0	2.0
C4-waste disposal	0	0	0	0	0
Total (excluding B1)	62.7	69.4	63.1	33.5	59.6

- Materials & production & recycling
- use stage
- transport

CEDR's perspective of pavements with low rolling resistance

Pieter De Winne, Chair, CEDR Task Group Research

Also other important influencing factors for energy consumption in road sector in comparison with rolling resistance

- Vehicle performance (motor technology, type of engine)
- Driver behaviour, speed optimization
- Inflation of tyres, tyre technology
- Network and traffic management

Questions ?

- **How to measure a priori or a posteriori ? Harmonised standard in Europe ?**
- **How to implement "rolling resistance" in the tender documents ?**
  How to calculate the amount of fine/penalty ?
- **How to implement rolling resistance data in Pavement Management Systems ?**
  Evolution models for rolling resistance ? Maintenance strategies ?

MIRAVEC - Modelling Infrastructure influence on RoAd Vehicle Energy Consumption

The model used in MIRAVEC, also based on ECRPD / VTI Coast-down trials :

• Fuel consumption function developed in MIRIAM SP2 was used.

$$Fcs = c1 \times (1 + k5 \times (Fr + Fair + d1 \times ADC \times v^2 + d2 \times RF + d3 \times RF^2))^{e1} \times v^{e2-1}$$

where *Fcs* is fuel consumption, *Fr* is rolling resistance, *Fair* is air resistance, *ADC* is average degree of curvature, *RF* is rise and fall (gradient), *v* is velocity, and c1, k5, d1, d2, d3, e1 and e2 are empirical parameters.

$$Fr = (Cr00 + CrTemp \times (T0 - T) + Cr1 \times IRI \times v + Cr2 \times MPD) \times m \times g$$

where *T* is the ambient temperature, *IRI* (International Roughness Index) is an unevenness measure and *MPD* (Mean Profile Depth) is a measure of macrotexture.

30% RR per MPD
6% RR per unit IRI
3% FC per 10% RR

The ROSANNE project was funded in the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n°605368

WP3 ON ROLLING RESISTANCE

Objective

- prepare international and EU standardization of measurement methods for road surface rolling resistance properties

Program tasks

- Analysis of the ***available methods*** and test equipment.
- Definition & analysis of ***influencing parameters:*** tests in laboratory and on the road
- Proposal of a robust ***calibration*** method for trailers
- Comparison with other methods (***fuel consumption*** et ***coast-down***)
- Provision of a ***draft standard*** of a procedure for harmonized rolling resistance measurement, validated through a **"Round Robin Test" program**

ROUND ROBIN TEST (RRT)

- measurements on a test track (IFSTTAR) with 12 road surfaces & measurements on trafficked roads (effect of road **unevenness &** surface **ageing)**
- 5 teams and 7 devices in total:
  - ***5 RR trailers*** *(TUG, BRRC (ARW1 & ARW2), BASt, Colas)*
  - 1 test vehicle for ***fuel consumption*** and ***coast-down*** tests *(VTI)*
  - 1 ***Road Surface Tester*** (texture, fuel consumption, transversal and longitudinal roughness, IRI) *(VTI)*

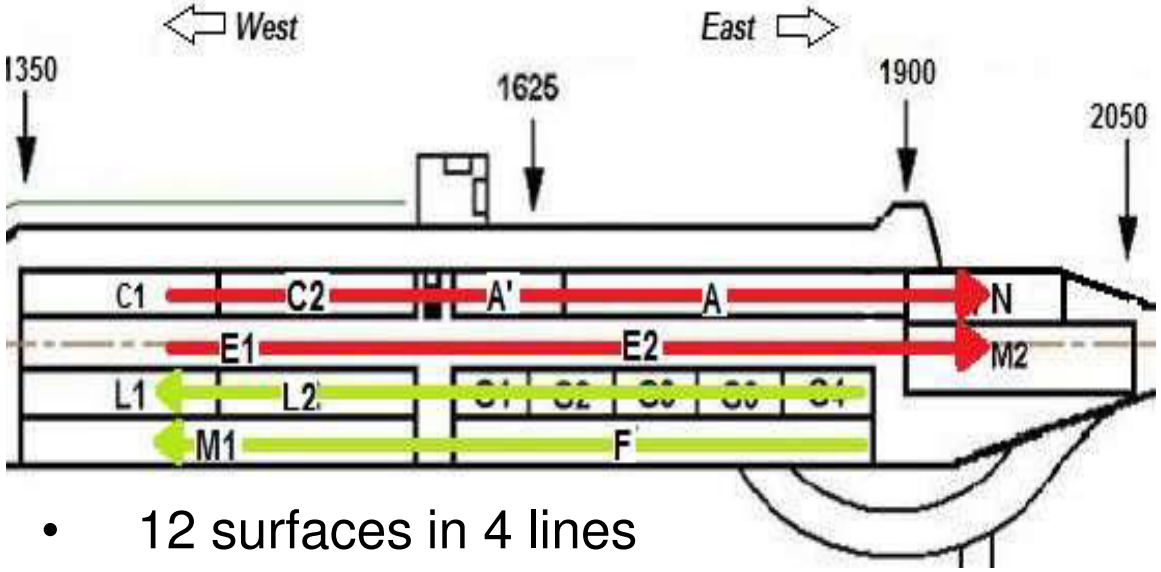
MEASUREMENT PARAMETERS

- 2 types of test tyres :
  - P1 (ASTM SRTT F2493): P225/60 R16 97S
  - H1 (Avon AV4 Supervan): 195 R14C 106/104N
- Tyre pressure: 210 +/- 5 kPa
- Tyre load: 4 ± 0.02 kN
- 2 reference speeds: 50 and 80 km/h

Important:

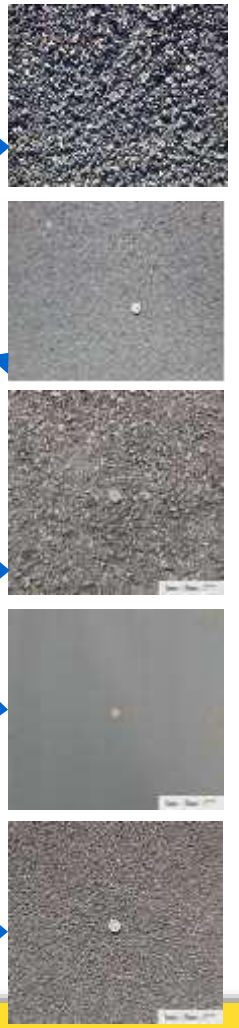
- Air (& tyre & road surface) temperature
- warming up procedure (15 min at test speed with no stop)

MEASUREMENTS ON TRACK

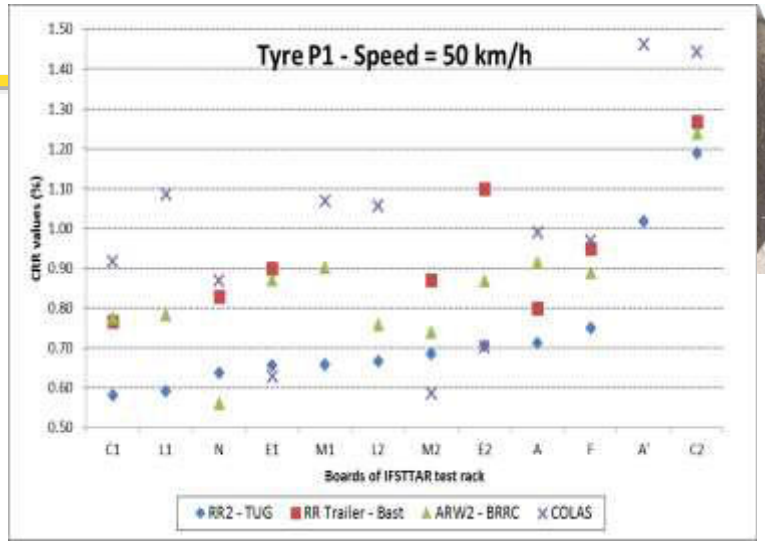


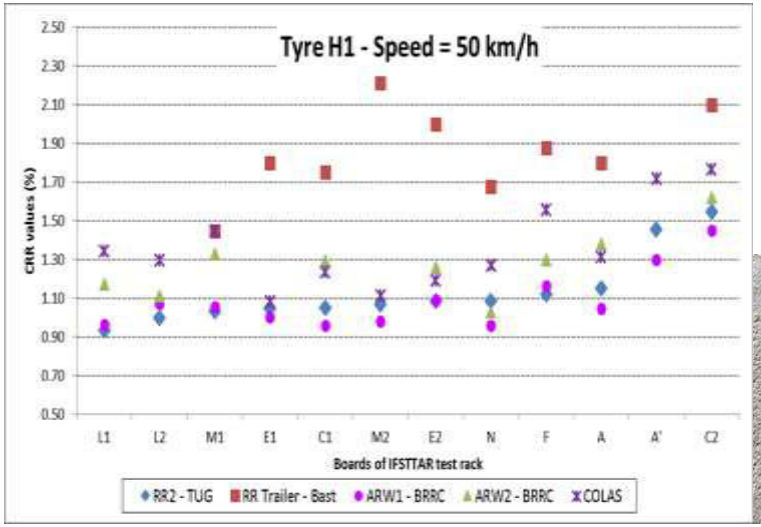
- 12 surfaces in 4 lines
  - broad set of textures (MPD ranging from 0.12 to >3)
  - 50m to 250m long
  - straight, no uneveness
- **Measurement C_{RR}** : 1 “standard” test + 2 short term repetition + 1 day-repetition

Code	Line	Type of surface	Length (m)	MPD (mm)	IRI
C1	L1	Fine surface dressing	140	**0.33**	1.83
C2	L1	Coarse surface dressing 0/14	100	**3.96**	2.21
A'	L1	Coarse surface dressing 8/10	50	**3.08**	2.15
A	L1	Porous AC 0/6	220	1.23	1.02
N	L1	ISO „type" – DAC 0/6	186	0.36	1.94
E1	L2	DAC 0/10 (new)	252	0.87	1.87
E2	L2	DAC 0/10 (old)	250	1.12	1.59
M2	L2	VTAC 0/6, class 2	150	1.30	1.69
L1	L3	Epoxy Resin (smooth)	128	**0.11**	1.15
L2	L3	Sand asphalt 0/4	116	0.71	1.68
M1	L4	VTAC 0/10, class 1	244	**1.42**	1.59
F	L4	High friction surface dressing 1/3	250	**1.42**	1.41



COMPARISON OF DEVICES





- clear outliers: BASt and COLAS trailers
- for the others, similar trends
- close results for BRRC(ARW1) & TUG (tyre H1)

REPEATABILITY

%	TYRE P1		TYRE H1		
	50 km/h	80 km/h	50 km/h	80 km/h	*Avg*
ARW1			1.4	1.8	***1.6 %***
ARW2	2.3		7.5		***4.9 %***
BASt	5.6	8.1	0.5	1.4	***3.9 %***
TUG	2.4	3.9	2.2	1.7	***2.6 %***
COLAS	19.0	6.3	9.1	11.3	***11.4 %***

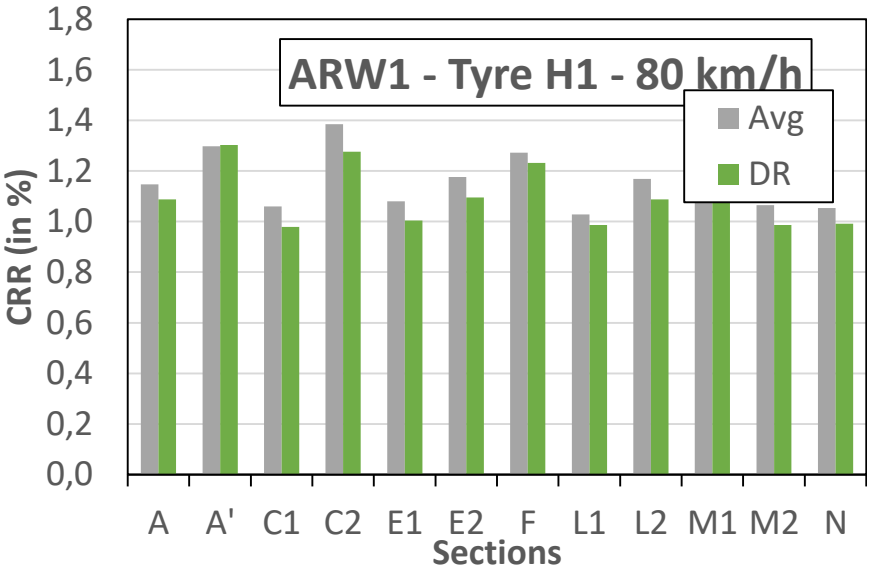
Short term repeatability

Standard deviation of repeatability % average value

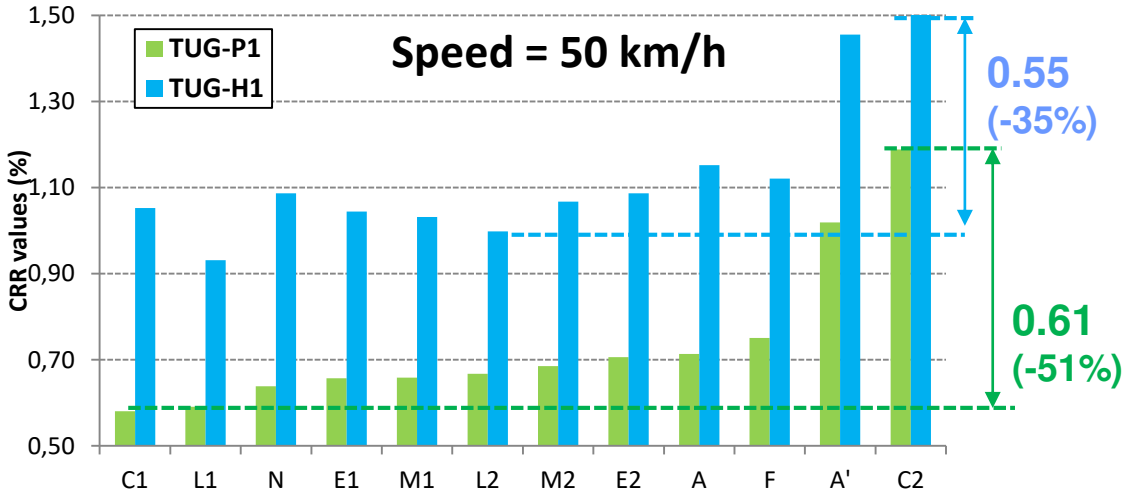
overall standard deviation of repeatability (tyre H1, both speeds, 3 trailers): $\sigma_R = 0.035$

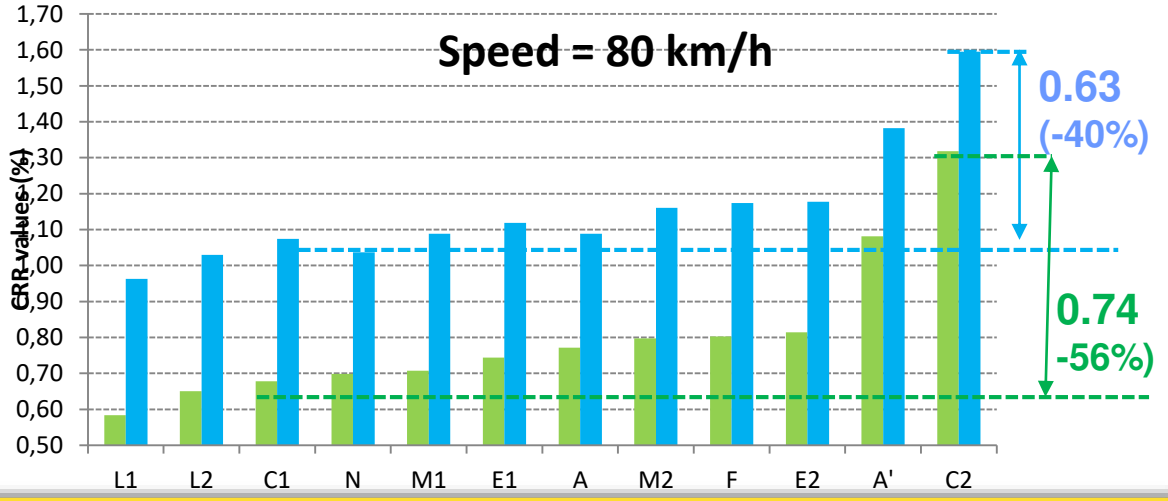
Day-to-day repeatability

TUG: < 4%
BRRC (ARW1): 7%
BASt: 10% (1 outlier, 4.5% when excluded)



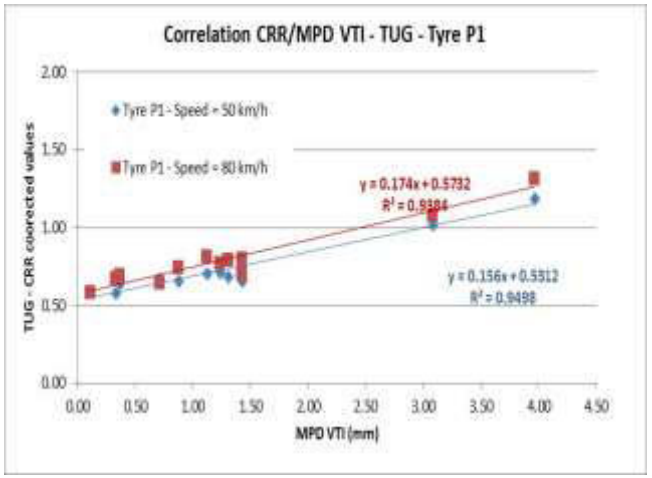
PAVEMENT VS. TYRE EFFECT

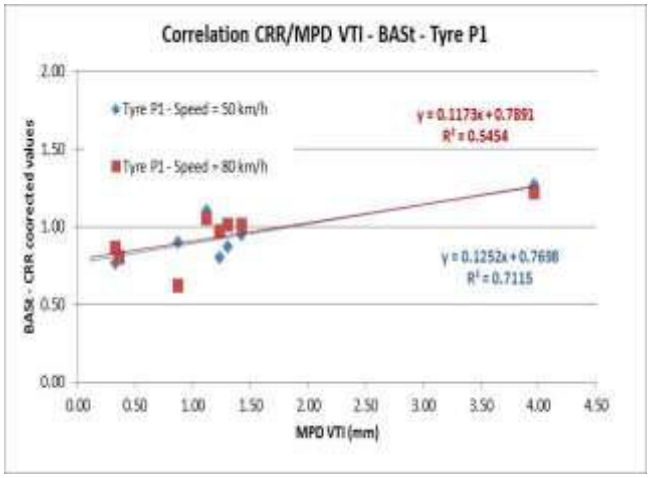


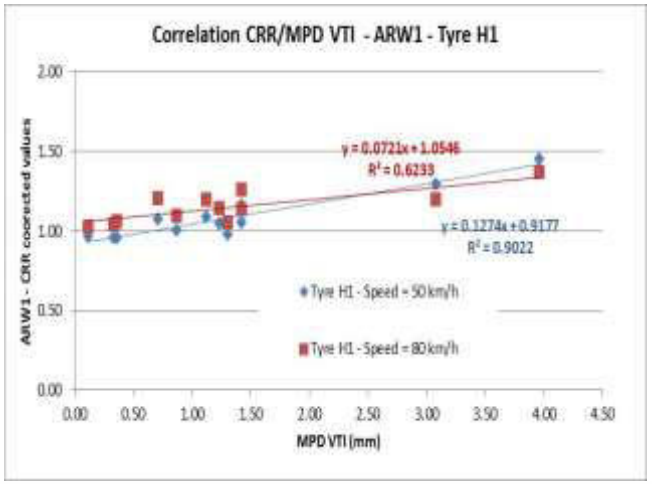


EFFECT OF PAVEMENT TEXTURE

Correlations between C_{RR} and texture indicator MPD







- clear trend of a linear relationship for all tyres and devices
- quality of the correlation is device dependent

draft standard preparation

- **Scope draft standard: measuring RR**
  - under realistic conditions
  - on real road surfaces
  - using pneumatic reference tyres
  - trailer-based method

Angle based

Force based

- Parasitic influence of:
  - Friction losses
  - Offset force transducers
  - Acceleration
  - Slope of road
  - Air drag
  - Prestress/unevenness in static condition
  - …

CONCLUSIONS
WP3 ROSANNE

- Large amount of data has been collected and will be of interest beyond the project
- Two trailers showed close results with
  - Similar trends for pavement ranking
- Comparability between devices still needs progress: discrepancies are higher than pavement effect on RR
- Road surfaces tested showed a potential of 35% to 56% reduction in rolling resistance (depending on the tyre)
- C_{RR} is well correlated with MPD and megatexture of pavements.
- RR measurements on site are very complex and need further investigation

MIRIAM PLATFORM

Models for rolling resistance **I**n **R**oad **I**nfrastructure **A**sset **M**anagement systems

OBJECTIVE

- Highlight the added value of rolling resistance
- Address how rolling resistance projects from within the MIRIAM consortium can be brought into application & implementation

TOPICS

- Rolling resistance
- Pavement life cycle
- Socio economical perspectives on energy efficient pavements
- Rolling resistance measurements and modelling

Vejdirektoratet

MIRIAM PLATFORM

http://miriam-co2.net/

MIRIAM I (2010 – 2011)

Investigating pavement characteristics, energy efficiency, modelling, and raising awareness

MIRIAM II (2012 – 2015)

Focus on developing CO_2 controlling models in road infrastructure asset management systems to give decision makers a tool for reducing CO_2-emission from the road infrastructure

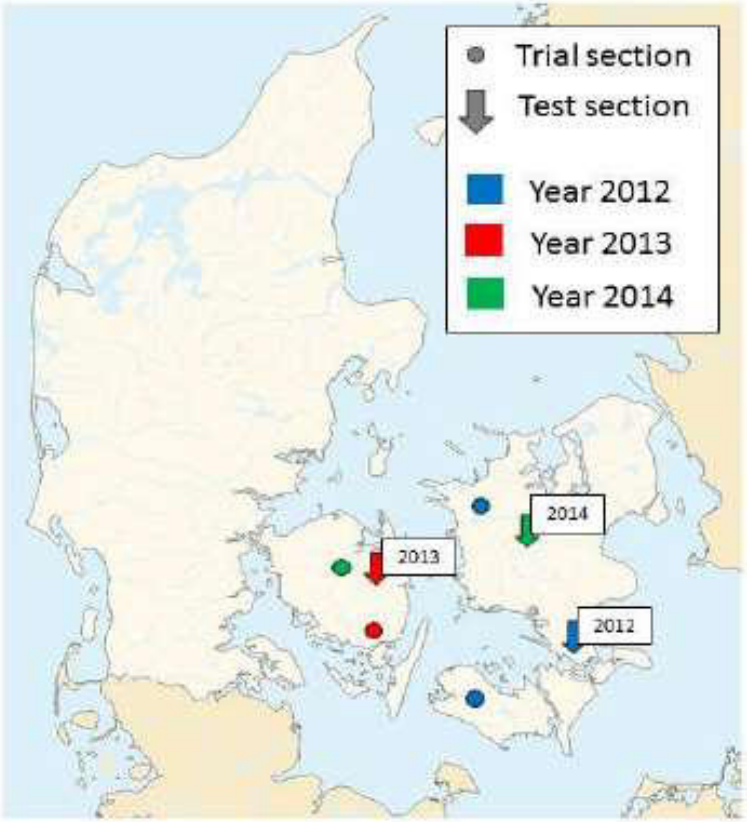
MIRIAM III (2016 – 2018)

Focus on implementation, added value, durability, asset management, among others

Vejdirektoratet

INTRODUCTION
COOEE project

Cooee project focused on *development of novel pavements types* and *asset management solutions* that minimize the rolling resistance for cars and trucks



Two SMAs, with a maximum nominal size respectively of 8mm (SMA8 COOEE) and 6mm (SMA6 COOEE), were appropriately developed by NCC aiming an optimized texture capable of introducing a reduction in Rolling Resistance.

TEST SECTIONS

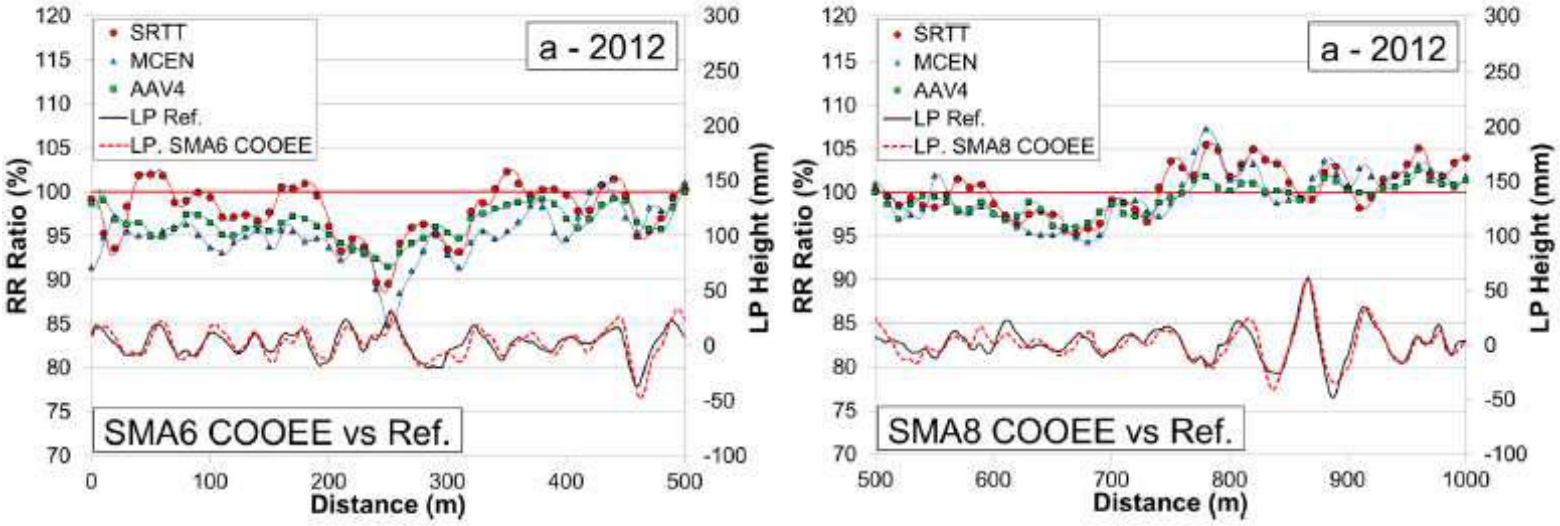
1) Stensved in 2012
2) Langeskov in 2013
3) Sorøvej in 2014

Vejdirektoratet

Vejdirektoratet

STENSVED
RR measurements

- Both *MPD and LP profile should be investigated combined*
- An average of 5% reduction in 2012 measured on the SMA6 COOEE while 3% in the SMA8 COOEE



- From 2012 to 2014, the difference on the RR properties is reduced approximately by 60% on the SMA6 COOEE

Vejdirektoratet

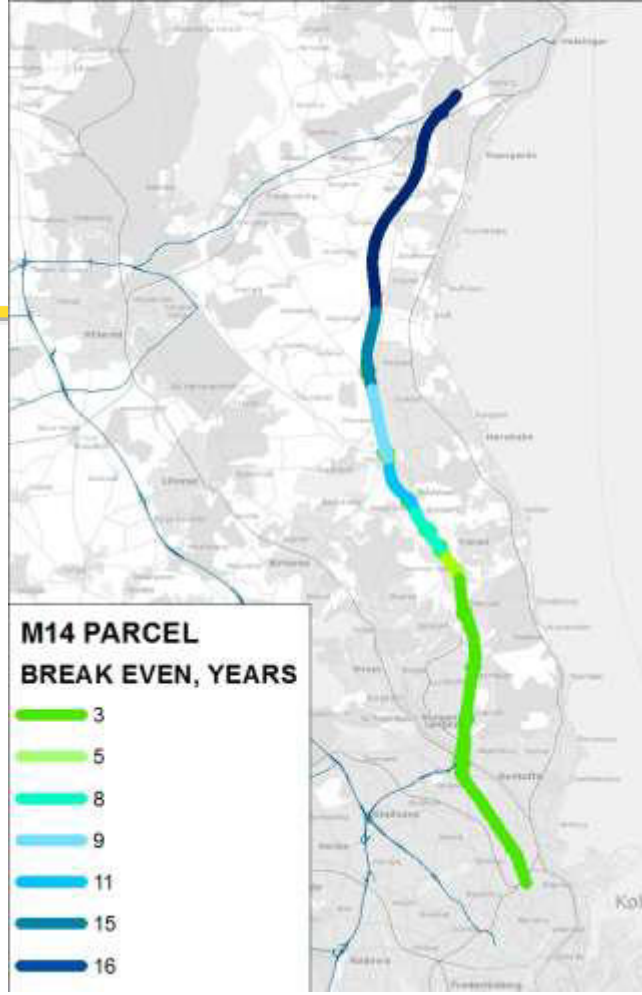
Vejdirektoratet

MIRIAM, partner meeting

DRD 2016 RR HIGHLIGHTS

- New mix design
- More knowledge on construction (control)
- New test section, incl. measurements
- Circular tests, VTI
- Socio economic results in PWRR* implementation

ROAD	BREAKEVEN	NPV / Return factor
M10	4 Years	8,53
M14	3 Years	4,67
M40	11 Years	0,53
M50	15 Years	-0,82
M80	15 Years	-0,30



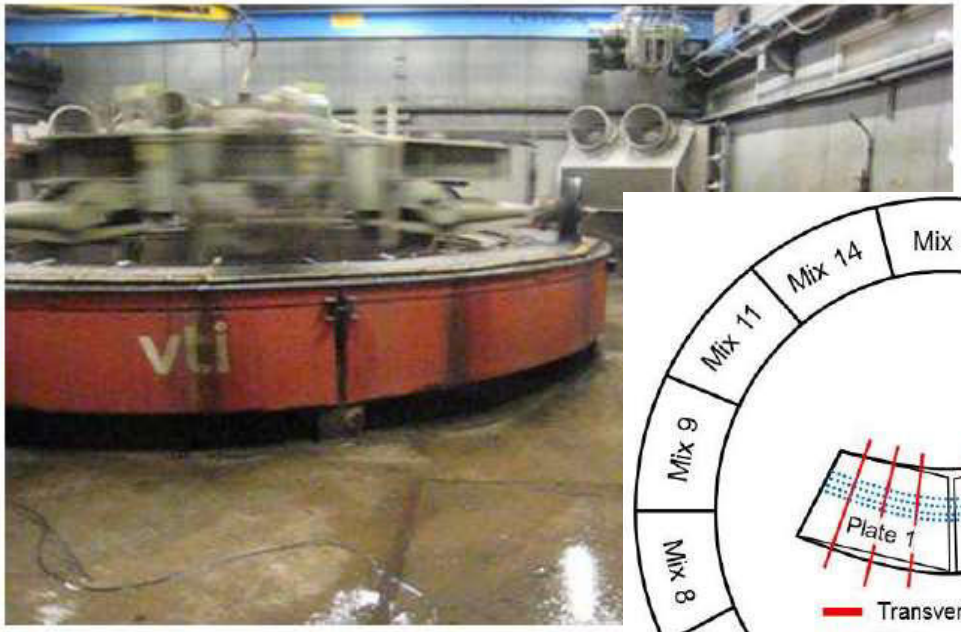
- Fuel consumption
- Price
- Traffic (evolution)
- Noise (evolution)

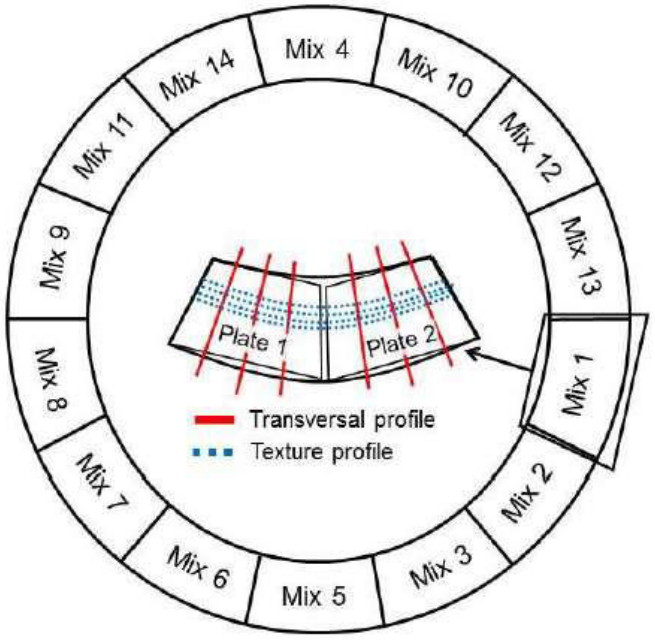
http://www.cooee-co2.dk/

Christian Axelsen <CAX@vd.dk>

DURAPAV project
Objective

The main focus was on *accelerating the wearing mechanism and the pavement deterioration*.





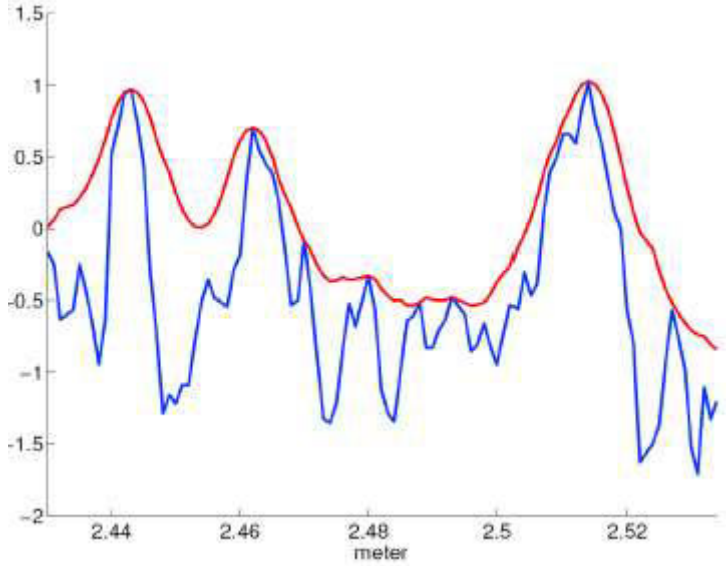
1	SMA11 standard - "in-situ"
2	SMA8 standard
3	SMA8 COOEE+
4	SMA6 COOEE+
5	SMA8 standard - lean
6	SMA8 COOEE+ - lean
7	SMA8 standard 7%V
8	SMA8 COOEE+ 7%V
9	SMA6 COOEE+ 7%V
10	SMA8 COOEE+ - "in-situ"
11	SMA6 COOEE+ - "in-situ"
12	SMA8 standard - PMB2
13	SMA8 COOEE+ PMB2
14	SMA6 COOEE+ PMB2

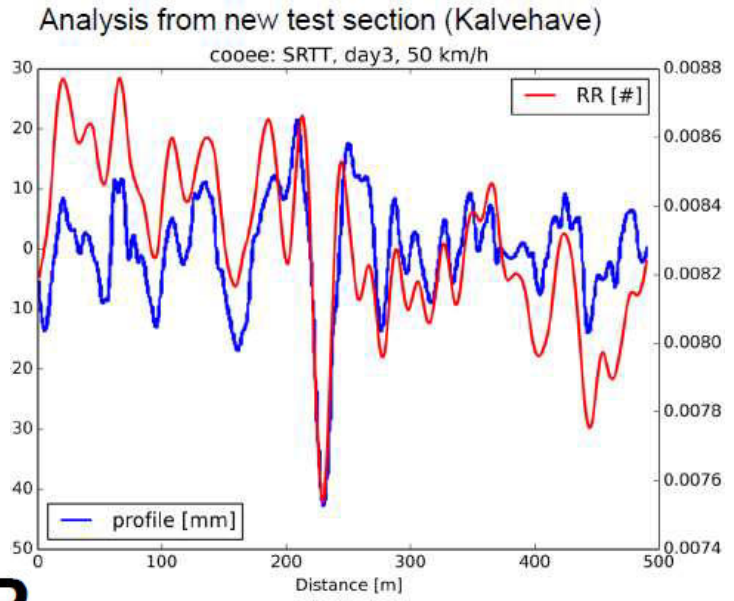
Alternative Texture Parameters

Vejdirektoratet

Development of alternative parameters derived from texture data:

- MPD does not always provide sufficient correlation (controversial?)
- Envelope, Texture Penetration Area (**TPA**), Skewness, **<your favorite here>**
- **Challenge**: Find alternative/compliment to MPD to increase texture-RR correlation





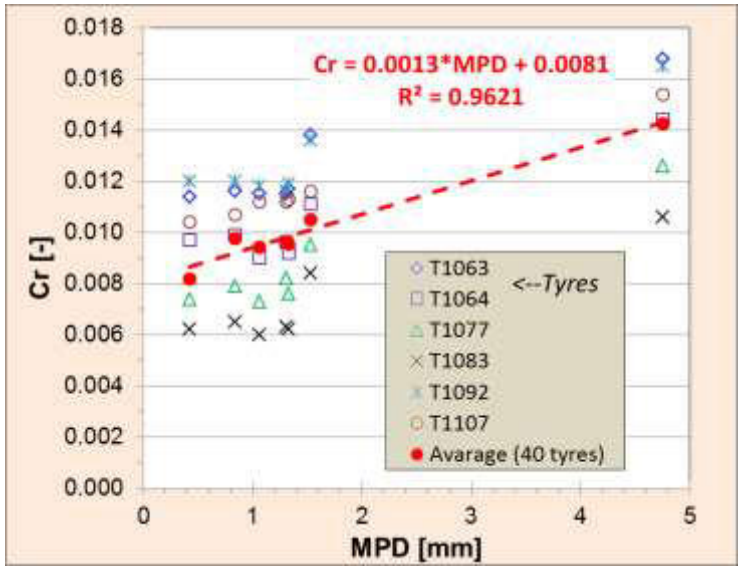
Influence of unevenness on RR

The influence of unevenness (and mega-texture):

- COOEE data analysis by Matteo showed: **influence from uneveness**
- Jureks drum experiments at TUG showed:
- **Challenge**: Incorporate unevenness into RR modelling.

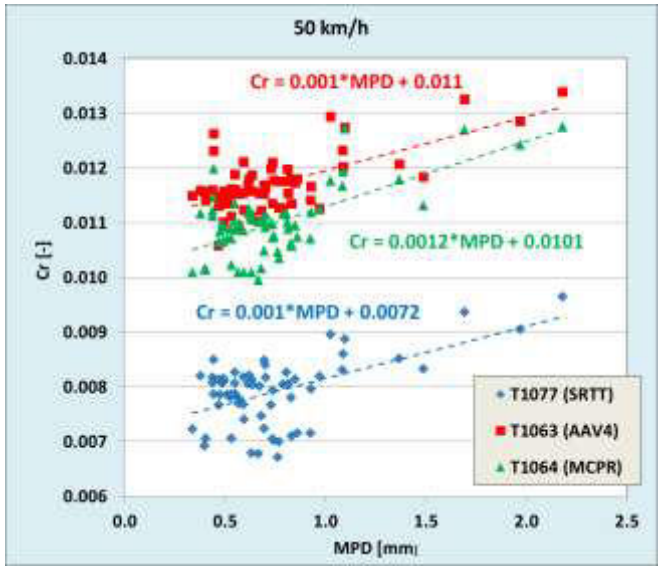
GDAŃSK UNIVERSITY OF TECHNOLOGY

DRUM MEASUREMENTS



Influence of MPD on rolling resistance of passenger car tyres tested at TUG conditions

ROAD MEASUREMENTS



Results of rolling resistance measurements on road sections - speed 50 km/h

Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

Influence pavement texture on fuel consumption trucks

RWS Water, Traffic & Environment (WVL)

Determine ΔFC (fuel consumption) of trucks driving on:

PAC + (6/16) vs. 2 layer PAC (4/8 and 2/6)

Earlier results for LV (ligh vehicles), based on TUG trailer

- *Rolling resistance* *-9 to -11%*
- *FC* *-2 to -3%*

Measurement setup

Measurements:

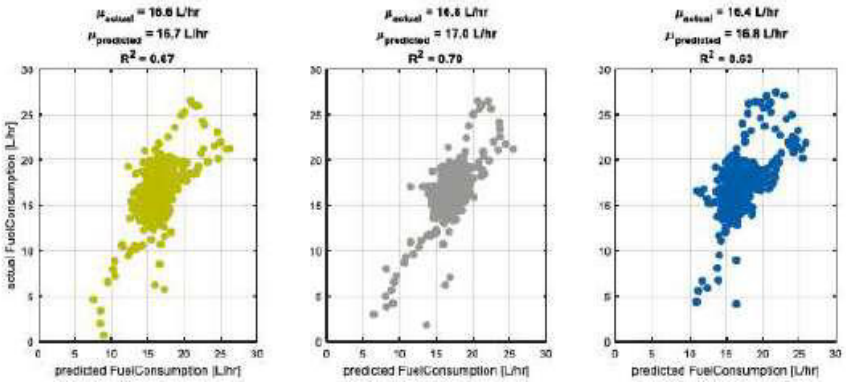
- Fuel consumption
- Road texture, IRI, RMS, skewness

- Influencing factors
  - Surrounding traffic, environment
  - Wind vector
  - Velocity
  - Temperature tyre, air
  - Slope and height
  - Position gas, brake pedal
  - Steering angle

$$Consumption \sim (0{,}31 \pm 0{,}02) \cdot MPD$$

Vermindering brandstofverbruik tweelaags ZOAB (fijn) t.o.v. ZOAB op basis van compensatiemodel aangevuld met MPD. De opgegeven marges zijn de 95% betrouwbaarheidsintervallen, die zijn opgebouwd uit de gecombineerde onzekerheid van de berekende brandstofverbruiken.

wegdek	gemiddelde MPD-waarde [mm]	vermindering brandstofverbruik t.o.v. ZOAB [%]
ZOAB	1,8	0,0
tweelaags ZOAB 4/8	1,3	0,9 ± 0,2
tweelaags ZOAB 2/6	0,9	1,7 ± 0,2



Fringe benefit: effect side winds on FC trucks

- 0,5 m/s 0,2% FC
  3 m/s 6%
  5 m/s 16%

-> Effect noise barriers, trees on FC ..

DP3 Development of asphalt roads with low rolling resistance and good durability against wear by studded tires

Aim:

- To develop a new generation of SMA16 for Swedish conditions
  - Lower rolling resistance and equally good durability vs studded tires
  - The mix design should take into account how texture develops over time as a result of the use of studded tires in Scandinavian countries.

To conclude:

- RR is **relevant**: CO_2 ⬇ in use stage
- RR is challenging to be **measured** directly, but texture is a good indicator
- RR prediction **models** are investigated

Challenges

- Raising **awareness** at NRA level, demonstrating socio-economic benefits
- **Predict** RR from surface characteristics
- Combine low RR with **durability**

Thanks for your attention

Johan MAECK
Researcher

- Surface Characteristics, Markings and Noise Unit (Environment, Concrete Roads, Geotechnical and Surface Characteristics Division)
- Division Asphalt Pavements, Bituminous Applications and Chemistry

Belgian Road Research Centre
Boulevard de la Woluwe 42, 1200 Bruxelles, Belgique
TEL.: +32 (0)2 766 03 48
j.maeck@brrc.be

Environmental Responsibility of the asphalt industry

Geir Lange
EBA / Veidekke Industry

10th EAPA Symposium on 1 June 2017 in Paris
#EAPASymposium2017

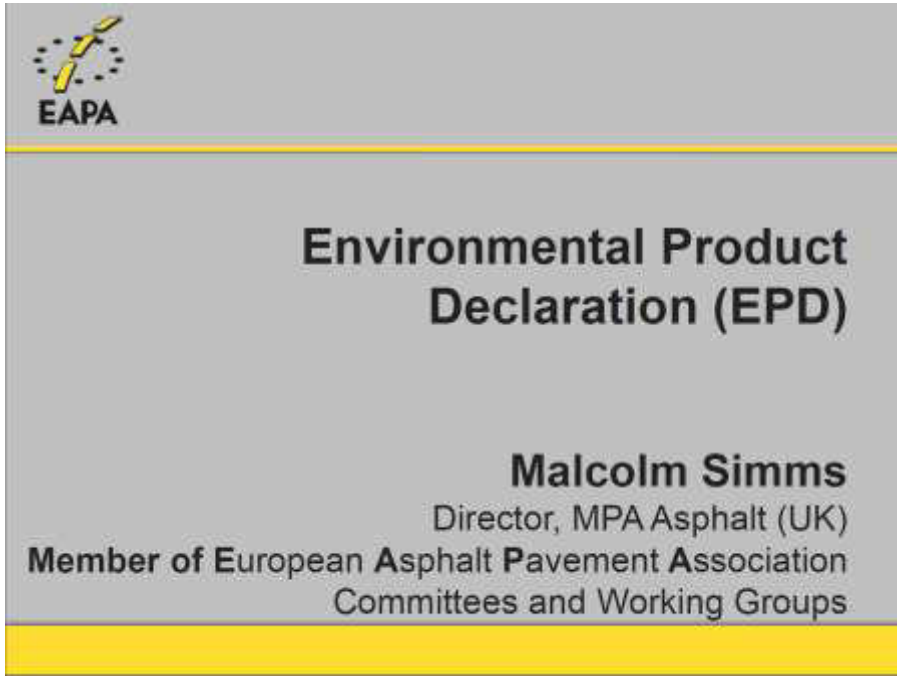
INTRODUCTION

Subtitle;

Environmental Product Declaration (EPD) and Asphalt Recycling/Circular Economy

Report of Committee Work - Task Group Carbon Footprint

Background reading; Malcolm Simms presentation in 2016



THE PAST 10 YEARS

2006-2010
$CO2_{EQ}$ REDUCTION POSSIBLE?

The industry start to discuss Environmental responsibility.

Measured usage of heating oil/gas on yearly basis.

2009

Avg. emission from some 80 asphalt plants in Norway was

18,5 kg CO_2 eq/t

+
Bitumen?
Aggregate?
Additives?
Installation?

Total CO_2 = ?

2010 THE FIRST PCR FOR ASPHALT

The Norwegian Asphalt Producers needed a set of common rules. The first EPD for AC 11 approved

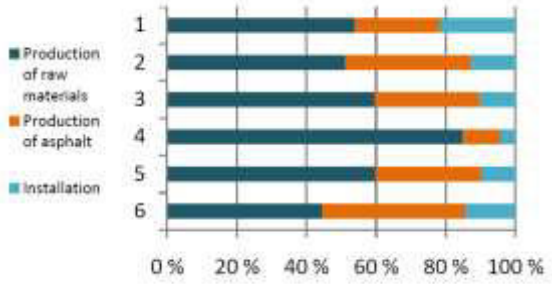
THE PAST 6 YEARS

AGB 11 asphalt (industry average)

FAV
FORENINGEN ASFALT OG VEISERVICE

INDUSTRY AVARAGE NORWAY

Raw materials		30 kg
Production		18 kg
Cradle-Gate A1-A3		**48 kg**
Installation		8 kg
A1-A5	**=**	**56 kg**



2011 LCA AND ASPECT UK

Transport Research Laboratory

PUBLISHED PROJECT REPORT

Protocol for the calculation of whole life cycle greenhouse gas emissions generated by asphalt

Part of the asphalt Pavement Embodied Carbon Tool (asPECT)

by M Wayman, I Schuni-Meller and S Cordel

with the advice of the Environmental Focus Group:

C Loveday Mineral Products Association & Tarmac
R Gossling Mineral Products Association & Lafarge Aggregates
D James Highways Agency
M Simms Mineral Products Association
C Southwell Refined Bitumen Association

Prepared for: Project Record: Collaborative Research Programme 2006-11

Client: Highways Agency, Mineral Products Association & Refined Bitumen Association

Copyright Transport Research Laboratory May 2011

The views expressed are those of the author(s) and not necessarily those of the Highways Agency, Mineral Products Association & Refined Bitumen Association.

MARCH 2012 EAPA DIRECTORS' GROUP

EAPA ENV-12-N007

The document to be produced by the Environment Group should provide:

- a good understanding of Carbon Footprint calculator results
- a protocol for creating tools for calculating the Carbon Footprint
- a procedure how to calculate a carbon footprint
- an explanation how to obtain the LCI data needed for a Carbon Footprint calculator
- references to the international standards for deriving and reporting LCIs
- information what to include (and what not to include) in a Carbon Footprint calculator
- guidance how to use Carbon Footprint calculators and what needs to be declared
- the "hot spots"; what are the important areas
- the impact of a whole life cycle approach

The first meeting of TG-CF 30 October 2014

PIARC REPORT 2015

- PIARC report on "*Reducing the life cycle carbon footprint of pavements*"
- Evaluated 9 different LCI tools
- Same input of an dense asphalt
- Output: 42 - 76 kg CO_2(e)/tonne

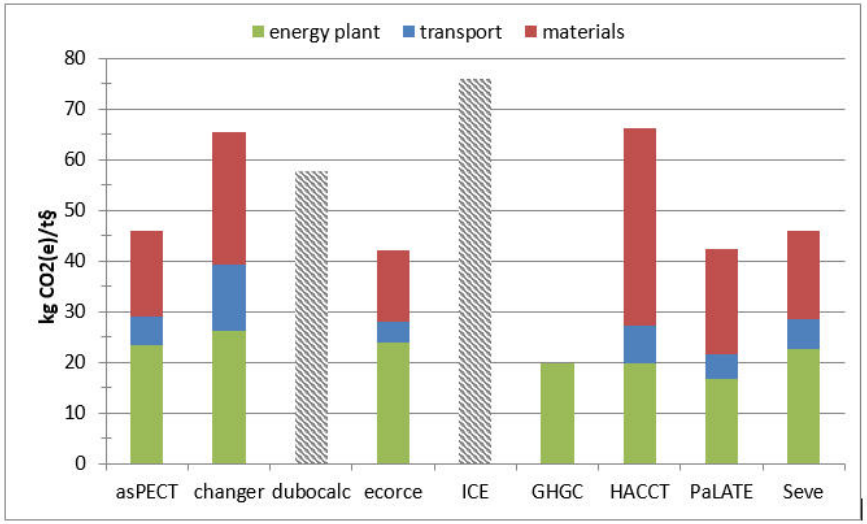
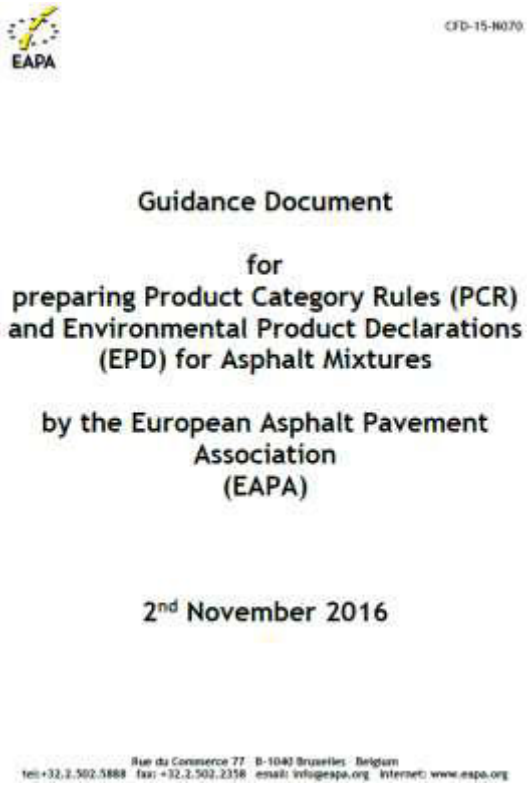


Figure 1. Carbon footprint/tonne for dense asphalt according to the tools evaluated

THE PAST 3 YEARS

- **EAPA to develop a Guidance document to prepare PCR**
- **Task Group meetings/members**

Name	Company, Country
Arne Aakre	EBA, Norway
Kurt Birngruber	Vialit, Austria
Ismail Cavagnol	USIRF, France
Anne Karin Johannessen	Veidekke Industri AS, Norway
Carsten Karcher (Chairmen)	European Asphalt Pavement Association, Belgium
Geir Lange	Veidekke Industri AS, Norway
Christine Leroy	USIRF, France
Laurent Porot	Arizona Chemical, Belgium
Malcolm Simms	Mineral Products Association, UK
Iain Simpson	Mineral Products Association, UK
Mike Southern	Eurobitume, Belgium


EAPA

CFD-15-N070

Guidance Document

for
preparing Product Category Rules (PCR)
and Environmental Product Declarations
(EPD) for Asphalt Mixtures

by the European Asphalt Pavement
Association
(EAPA)

2nd November 2016

Rue du Commerce 77 B-1040 Brussels Belgium
tel:+32.2.502.5888 fax: +32.2.502.2358 email: info@eapa.org Internet: www.eapa.org

SINCE 2. NOV 2016

EBA Norway started an EPD program last year to;

1. **Develop a PCR for Asphalt - Approved 7/4-17**

epd-norge.no
The Norwegian EPD Foundation

9. Verification and Validity of an EPD

As in PCR part A.

Approved 07.04.2017, valid until 07.04.2022.

Norwegian EPD Foundation, Technical committee

Christofer Skaar

Christofer Skaar
Leader of the Technical committee

10 Bibliography

As in PCR part A, including the following additions:

- NS-EN 12591: 2009 Bitumen and bituminous binders - Specifications for paving grade bitumens.
- NS-EN 14023: 2010 Bitumen and bituminous binders. Framework specification for polymer modified bitumens.
- S-EN 13808: 2005 Bitumen and bituminous binders. Framework for specifying cationic bituminous emulsions.
- EAPA CFD-15-N070 - Guidance Document for preparing Product Category Rules (PCR) and Environmental Product Declarations (EPD) for Asphalt Mixtures
- PMS2010. Brukerveiledning for entrepenører. Statens Vegvesen, Vegdirektoratet, februar 2010. Document in Norwegian. Translated title: PMS 2010, guidance document for road contractors.

epd-norge.no
The Norwegian EPD Foundation

PCR for Asphalt v 1.0

PRODUCT CATEGORY RULES

EN 15804

NPCR 025 version 1.0

Issue date: 07.04.2017
Valid to: 07.04.2022

PCR – Part B for Asphalt

NPCR 025:2017 Version 1.0 Part B for Asphalt

2016

EBA started an EP

1. Develop a PCR
2. **Develop an EPI**

ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025, ISO 21930 and EN 15804

Eier av deklarasjonen:	Veidekke
Programoperatør:	The Norwegian EPD Foundation
Utgiver:	The Norwegian EPD Foundation
Deklarasjonsnummer:	
Publiseringsnummer:	Ikke tildelt
ECO Platform registreringsnummer:	Ikke tildelt
Godkjent dato:	
Gyldig til:	

AC 16 Surf Viaflex 65 Mv 7 Ab 16 Pellets

Veidekke

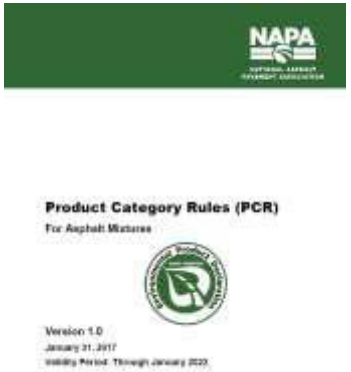
www.epd-norge.no

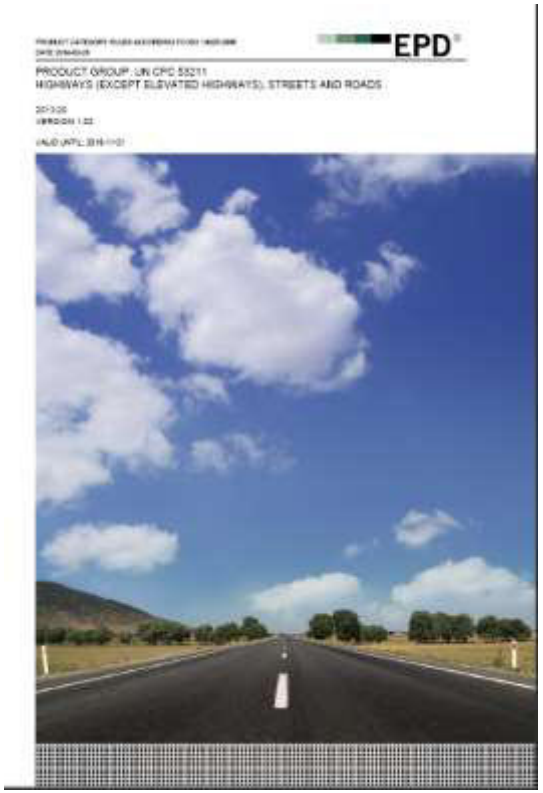
DIFFERENT EPD

SINCE 2. NOV 2016

- NAPA launched their EPD-program in 2016

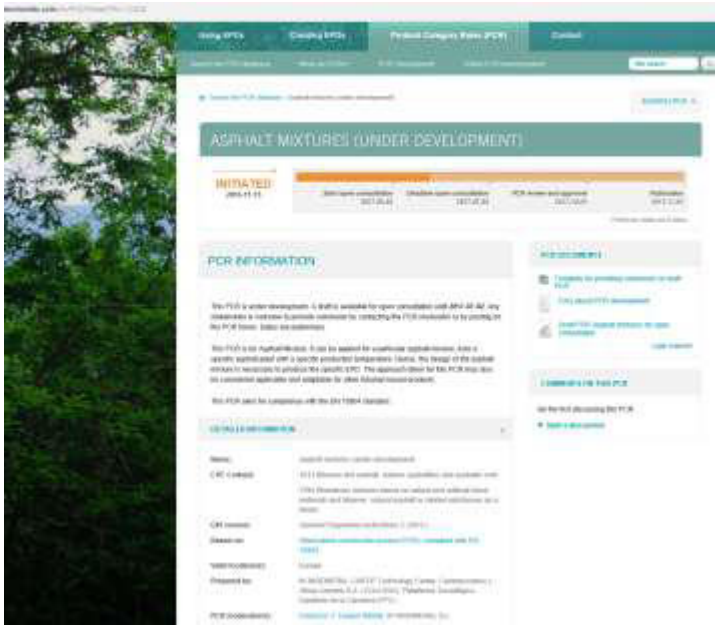
- PCR approved January 2017
- EPD tool developed



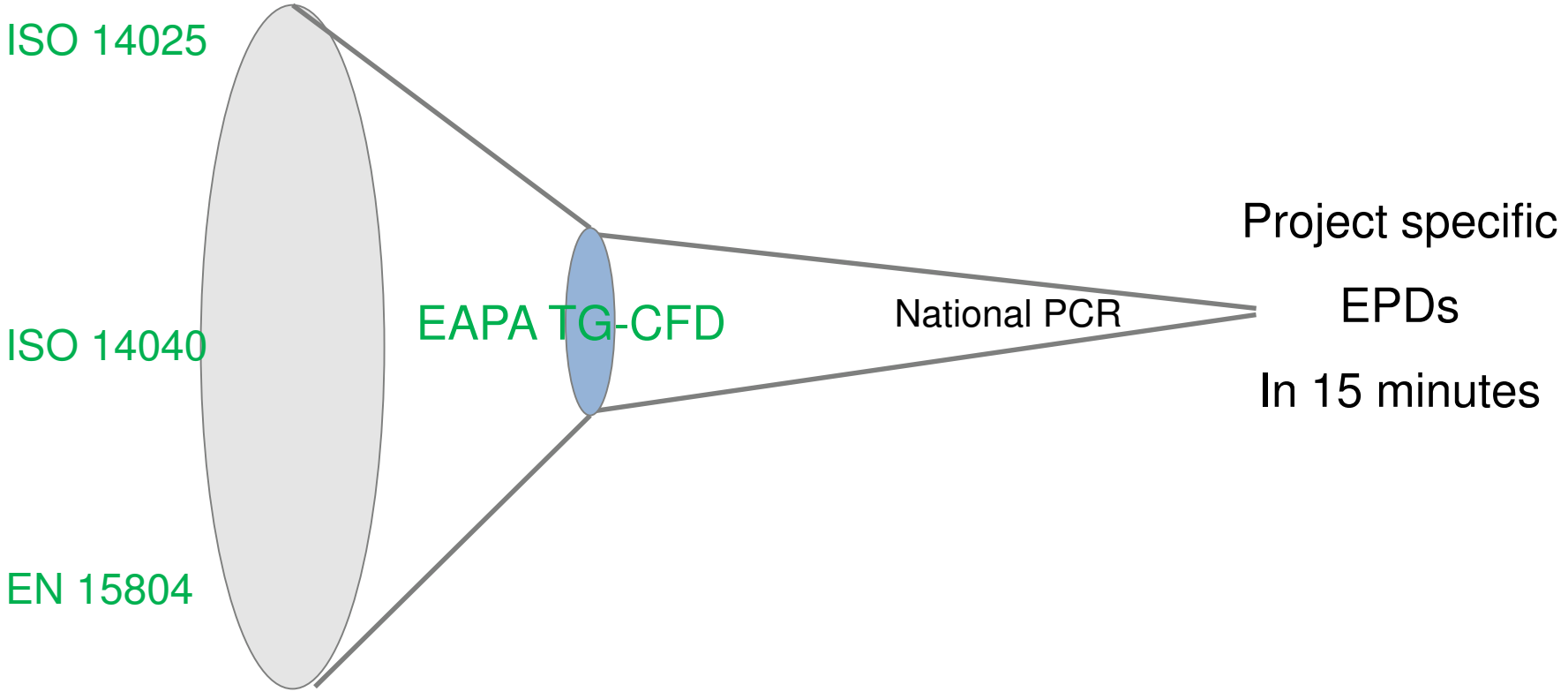


LAST WEEK

- **One more PCR is launched**



NEXT YEAR


ISO 14025
ISO 14040
EN 15804
EAPA TG-CFD
National PCR
Project specific
EPDs
In 15 minutes

WARM MIX ASPHALT (WMA)

- **WMA technique reduce the production temperature**
- **Gives less fume on site and improved working conditions on site**
- **With lower energy usage, it leads to CO_2 reduction**

The EPD show this in figures

PRODUCTION OF WARM MIX ASPHALT FROM 2013 TO 2015 (100-150°C)

For this table Warm Mix Asphalt is defined as mixtures produced by using special techniques and/or additives to reduce the production temperature. The production temperature is between 100°C and 150°C.
(in million tonnes)

Country	2013	2014	2015
Austria	0,000	0,000	0,000
Belgium	no data	no data	<0,05
Croatia	0,000	0,040	0,060
Czech Republic	0,030	0,001	0,020
Denmark	0,120	0,200	0,200
Estonia	no data	no data	0,008
Finland	0,000	0,120	0,240
France	3,550	4,023	4,552
Great Britain	<1,000	<1,000	no data
Hungary	0,020	0,038	0,070
Luxemburg	0,000	0,007	0,007
Netherlands	0,060	0,133	0,100
Norway	0,380	0,540	0,592
Slovakia	no data	no data	0,014
Slovenia	0,000	0,000	0,000
Spain	0,086	0,140	0,140
Sweden	0,500	0,700	0,700
Switzerland	0,870	0,388	no data
Turkey	no data	no data	0,080
USA	69,000	103,000	109,000
Japan	0,152	0,231	0,274
Ontario-Canada	No Data	0,750	0,900
South Africa	0,150	0,150	0,200

REUSE

- Reuse and recycling
- Saves materials
- With lower energy usage,
- leads to CO_2 reduction

The EPD show this in figures

REUSE AND RECYCLING

RECYCLING IN 2015

Country	All available Reclaimed Asphalt in tonnes	% of available reclaimed asphalt used in: Hot Mix Asphalt Production	Warm Mix Asphalt Production	Half Warm Mix Asphalt Production	Cold Recycling**	Unbound Road Layers	Other Civil Engineering Applications	Put to Landfill / Other Applications / Unknown	Applied area in m² of hot mixes of existing asphalt pavement material in-situ / on the road (Remixing, Repaving, Reshaping, Road Stabi etc.)	The amount of "only" reheated (reused) asphalt material in site / on the road (Remixing, Repaving, Reshaping, Road Stabi etc.) in metric tonnes
Austria	1.350.000	45	no data	no data	no data	no data	no data	no data	no data	no data
Belgium	1.352.994	84	no data	no data	no data	no data	no data	no data	no data	no data
Czech Republic	2.000.000	16	no data	no data	30	30	10	24	371.900	no data
Croatia	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Denmark	1.300.000	52	no data	no data	no data	10	no data	33	no data	no data
Finland	1.160.000	100	no data	no data	no data	no data	no data	no data	14.100.000	no data
France	7.000.000	89	no data	no data	no data	no data	no data	no data	928.700	169.172
Germany	11.900.000	90	0	0	0	10	0	0	no data	no data
Great Britain	2.200.000	83		0	0	17	0	0	no data	no data
Hungary	180.000	80	5	0	0	10	0	5	no data	no data
Iceland	15.000	100	0	0	0	0	0	0	60.000	no data
Italy	9.000.000	20	0	0	30	20	0	30	no data	no data
Lithuania	no data***	no data	no data	no data	no data	no data	no data	no data	no data	no data
Luxemburg	200.000	90	0	0	10	0	0	0	no data	no data
Netherlands	4.300.000	70	0	0	10	0	0	20	no data	no data
Norway	932.049	39	no data	no data	no data	61	no data	no data	692.000	no data
Romania	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Slovakia	75.000	98	0	0	1	1	0	0	120.000	14.700
Slovenia	87.000	89	0	0	11	0	0	0	no data	no data
Spain	475.000	94	1	2	0	1	2	0	no data	no data
Sweden	1.600.000	79	0	9	3	0	0	0	4.000.000	320.000
Switzerland	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Turkey	1.220.000	0	0	0	0	98	0	0	no data	no data
USA	69.700.000	81		no data	0	9	2	7	no data	no data

** Cold recycling includes stabilisation with bitumen emulsion, foamed bitumen and/or cement.
*** no data, but all recycled

GREEN PROCUREMENT

National PCR and EPD tools

Reuse

WAM

Environmental criteria in procurement is possible

AGGREGATE INDUSTRY

THANK YOU!

Taking measures for the Worker's Health – Fumes and Dusts

Christine Leroy
USIRF - Routes de France

10th EAPA Symposium on 1 June 2017 in Paris
#EAPASymposium2017

REPORT OF HSE COMMITTEE WORK

- **3 main topics**

to improve preventive measures for workers‘ health :

1. **Bitumen fumes**
2. **Asbestos**
3. **Respirable silica dust**

1 – Bitumen fumes

1- BITUMEN FUMES

- **4 main parts:**

1. After the IARC monography : differentiation between air-rectified and oxidized bitumen

2. Vigilance on several recent studies done on the health of workers in relationship with bitumen fumes

3. A plan for the harmonization and upgrading of equipment (pavers) has been devised;

4. Improvement and standardization of the methods of measures of the exposure on construction site;

1- BITUMEN FUMES

1. After the IARC monography :

Eurobitume and EAPA are still working on the differentiation between air-rectified and oxidized bitumen.

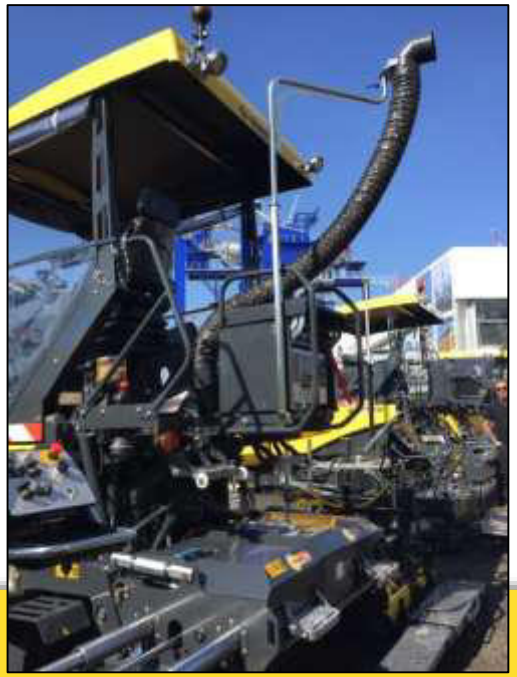
2. Vigilance on several recent studies:

EAPA carefully follows the ongoing reports and releases on the topic e.g. the Norwegian studies (chronic obstruction pulmonary disorder)

1- BITUMEN FUMES

3. About the equipment : the pavers:

- an new annex D to the standard **"ISO 20500 -5 Mobile road construction machinery — Safety — Part 5: Specific requirements for paver-finishers** " about emission reducing device in progress



1- BITUMEN FUMES

4. **Improvement and standardization of the methodology of assessment of the exposure of employees on construction site;**
   - In France, implementation of a “Metropol 123” protocol, which allows the determination of semi-volatile organic compounds, particularly those present in bitumen.

Photos Eurovia

Over 75 roadworks (motorways, car parks, or under tunnels) and more than 250 individual measurements at different work stations (paver and roller drivers, screed men, rakers, etc.).

<u>Conclusions</u>: - efficiency of warm mix asphalt
- efficiency of exhaust system devices on pavers
- no effect of RAP.

1- BITUMEN FUMES

4. Improvement and standardization of the methodology of assessment of the exposure of employees on construction site;

– In Germany, the method used by IFA for years is IFA n°6305 "*Bitumen (Dämpfe und Aerosole, Mineralölstandard)".* This method is based on infrared absorption of the C-H aliphatic wavelength (from 2800 cm^{-1} to 3000 cm^{-1}). Germany has the largest database of exposure on bitumen fumes; a European method will not be possible without the introduction of comparative tests which will, logically, determine a conversion factor.

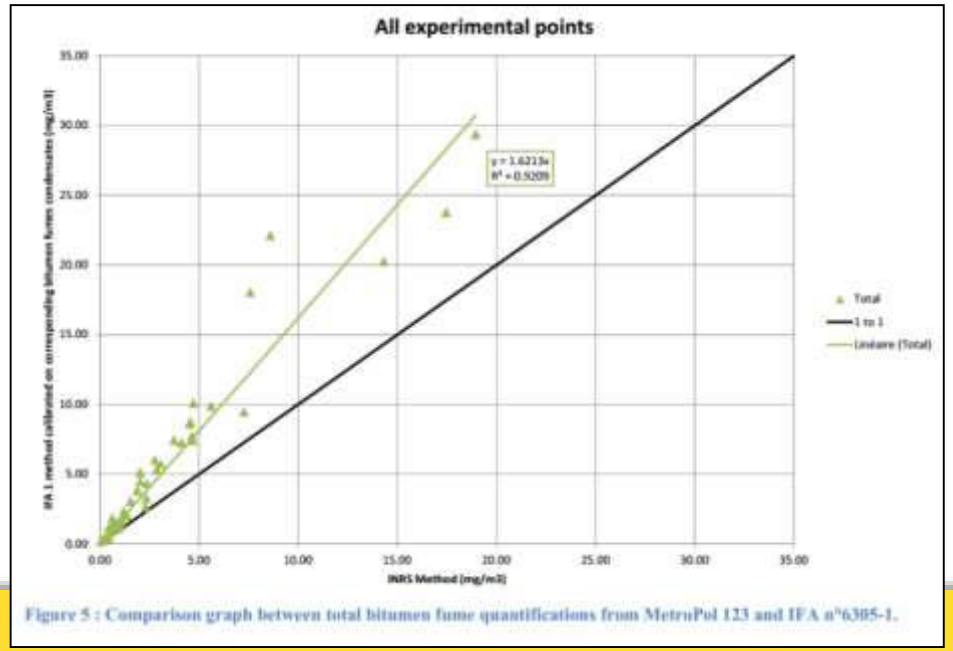


Figure 5 : Comparison graph between total bitumen fume quantifications from MetroPol 123 and IFA n°6305-1.

2 – Asbestos

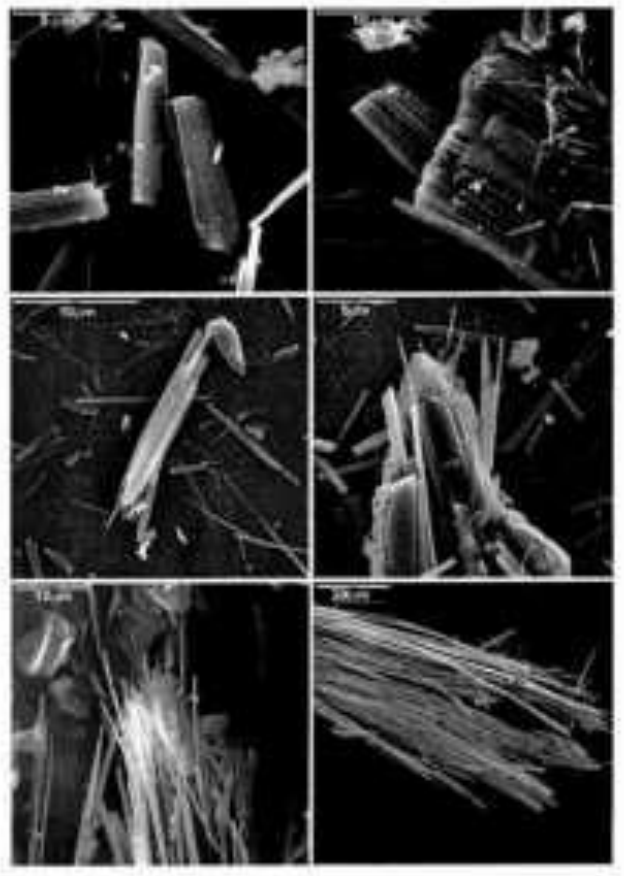
2- ASBESTOS

- **Collection of regulations in different European countries /DIRECTIVE 2009/148/EC:**
  - „…It is also important to prohibit activities which expose workers to asbestos fibers during the extraction of asbestos or the manufacture and processing of asbestos products or the manufacture and processing of products containing intentionally added asbestos fibers, in view of their high and unpredictable level of exposure".
  - In several countries, asbestos (chrysotile) was added at a very low rate to some asphalt mixes in the eighties.
  - Asbestos is defined in several different chemicals : 1 serpentine and 5 amphiboles. Each of them have a asbestiform and a non asbestiform variety, with the same chemical composition.

2- ASBESTOS

- In France, the method to detect asbestos and count the fibers in inhalation exposure is the TEM (transmission electron microscopy). The use of the only TEM doesn't allowed to distinguish asbestiform vs non asbestiform fibers.
- The use of the SEM (scanning electron microscopy) as in Germany is more useful.

- The use of TEM has let to discover in aggregates some cleavage fragments (non asbestiform elements) and ANSES is studying the hazard assessment of cleavage fragments (non asbestiform amphiboles). On the model of EPA, they defined „Elongated Mineral Particles". They decided the impact on health is about the same than asbestos.



Waiting for going ANSES report

3 – Respirable crystalline silica dust

3- RESPIRABLE SILICA DUST

- Member States: alveolar crystalline silica considered as a hazardous chemical agent or as a carcinogen (process generating alveolar crystalline silica dust)
- Many European countries have legislated occupational exposure to crystalline silica: alveolar crystalline silica dust is a carcinogen in the workplace in Belgium, Denmark, Germany (processes), the Netherlands and Sweden

- **Improvement of the political pressure on the new European Commission:**
  - The European Commission published a proposal to amend the Directive on Carcinogens at Work (CMD) on 13 May 2016 proposing to include in Annex I: Work involving exposure to alveolar crystalline silica dust generated by a process of And Annex III: OEL to 0.1 mg / m3 or 0.05 mg / m3.
  - The transposition of this Directive into the Member States will be effective in 2019 at best

3- RESPIRABLE SILICA DUST

- Dust is not all the same! There are different sizes of particles, often referred to as dust fractions. When the dust is inhaled, its area of deposition in the human respiratory system mainly depends on the size of the particles.

- Three dust fractions are defined in European Standard EN 481: the inhalable, thoracic and alveolar dust fractions defined.

- In the case of crystalline silica, it is the alveolar fraction of the dust which is problematic because of its effects on health.

- Alveolar dust can penetrate deep into the lungs. The body's natural defense mechanisms can eliminate much of the inhaled alveolar dust. However, prolonged exposure to excessive levels of dust makes it difficult to remove alveolar dust from the lungs. Dust accumulation can, in the long term, lead to irreversible health effects. Because the effects of crystalline silica on health are related to the alveolar fraction of dust.

3- RESPIRABLE SILICA DUST

- Industry Initiatives ***(contact to UEPG and VESF)***:
  - NEPSI social dialogue agreement based on good practices (aggregates handling and milling process)
    - Vacuum systems on milling machines meet requirements for both silica dust and asbestos.

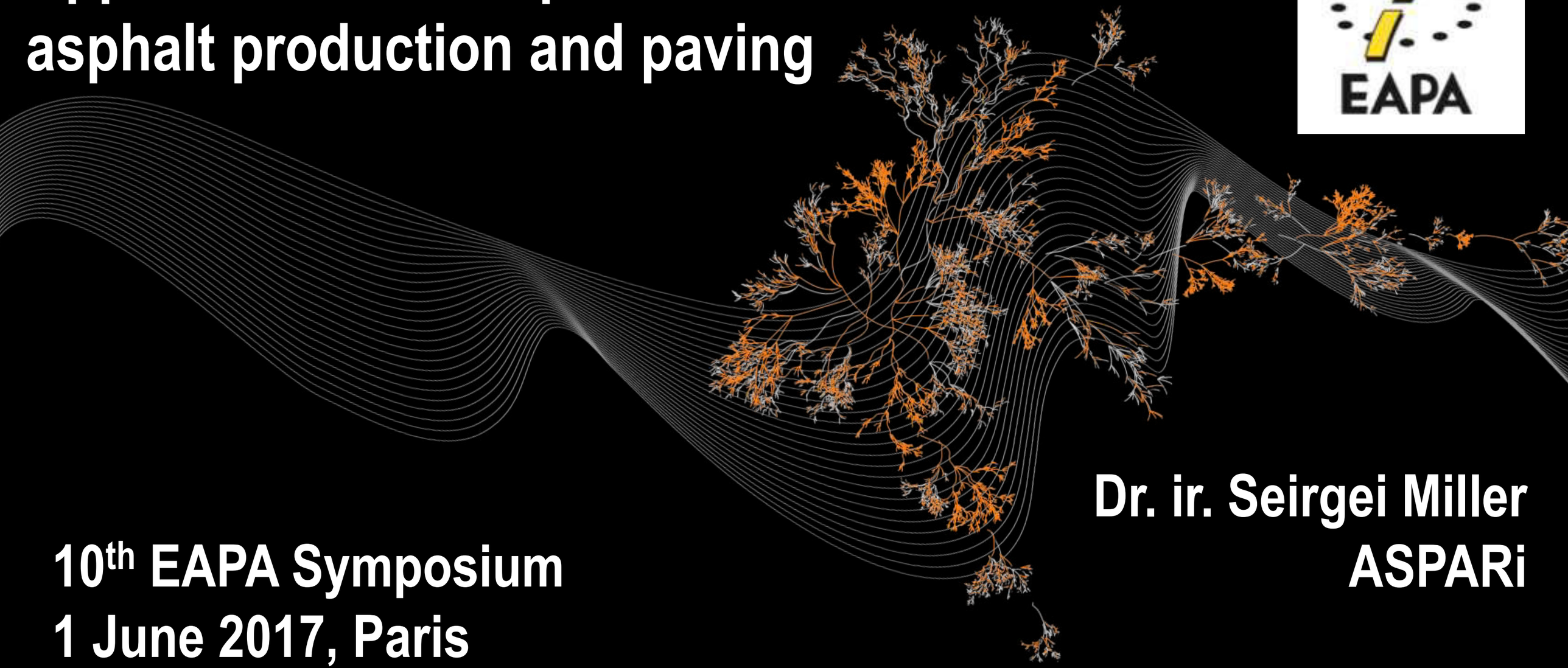
(In Netherlands, vacuum systems are obligatory for front loader milling machines)

Photo RGRA/USIRF

  - A partnership NAPA/NIOSH has lead to produce a methodology to assess the efficiency of the vacuum systems on milling machines. This method is used to start some standardization works.

Thanks for your attention

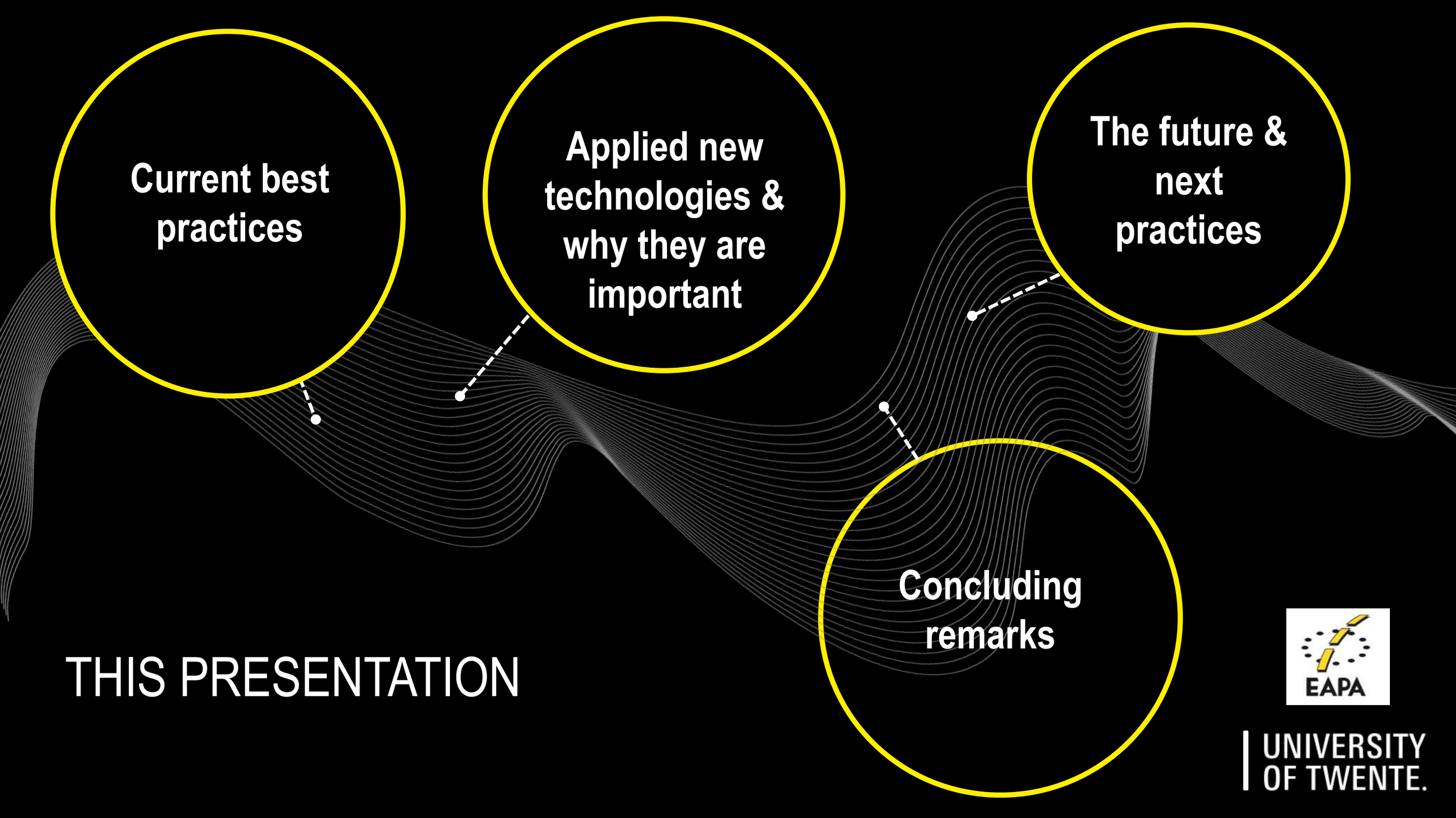
Applied new techniques and outlooks in asphalt production and paving



Dr. ir. Seirgei Miller
ASPARi

10th EAPA Symposium
1 June 2017, Paris

UNIVERSITY OF TWENTE.



THIS PRESENTATION

EAPA

UNIVERSITY OF TWENTE.

BEST PRACTICES & THE IDEAL PROJECT

- Project preparation
- Tendering
- Project planning
- Pavement design
- Paving materials
- Project preparation
- Asphalt production
- Asphalt transport
- Paving
- Compaction
- ……
- ……

Quality

Effeciency

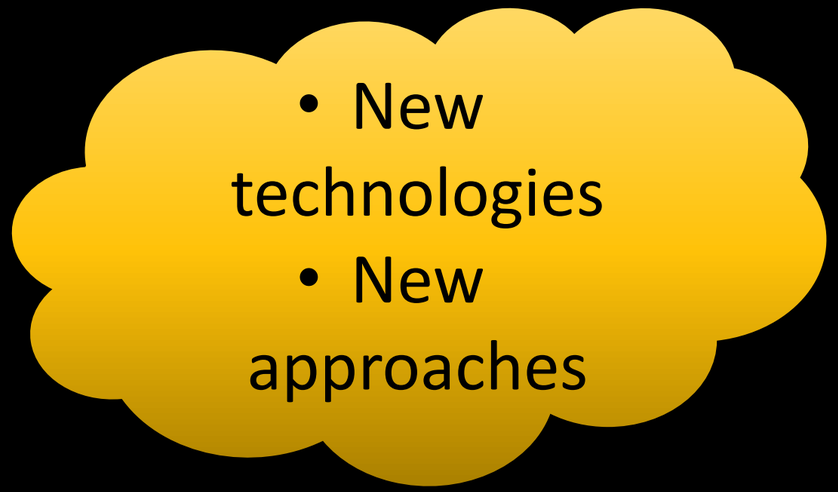
Durability

Reducing costs

Reducing delays

Improving sustainability

THE IDEAL PROJECT speaks to creating and sustaining best practice ….



Let us see if we can be proactive and CREATE NEW PRACTICES

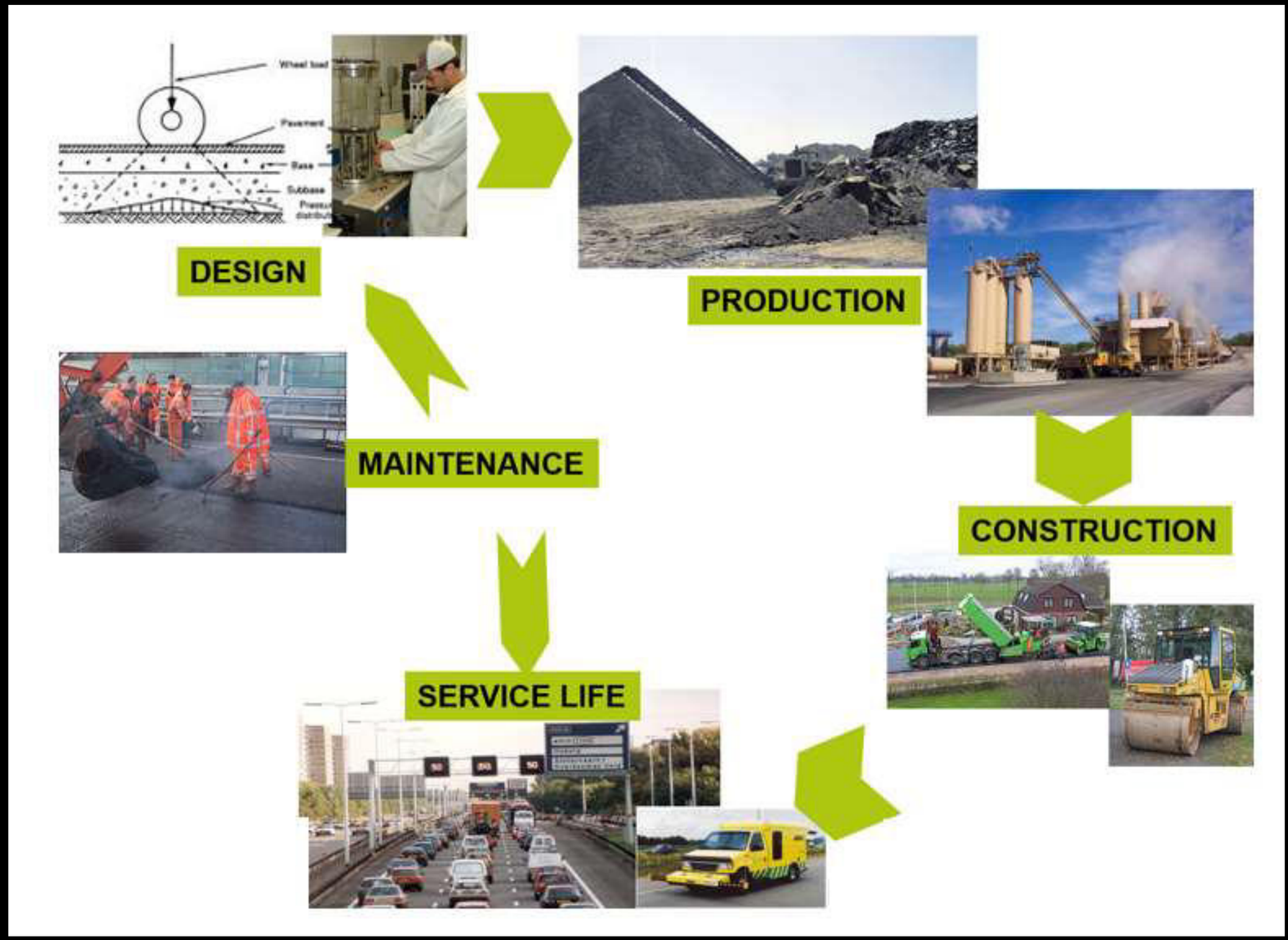
- Explore the role of EAPA
- Explore the role of public clients

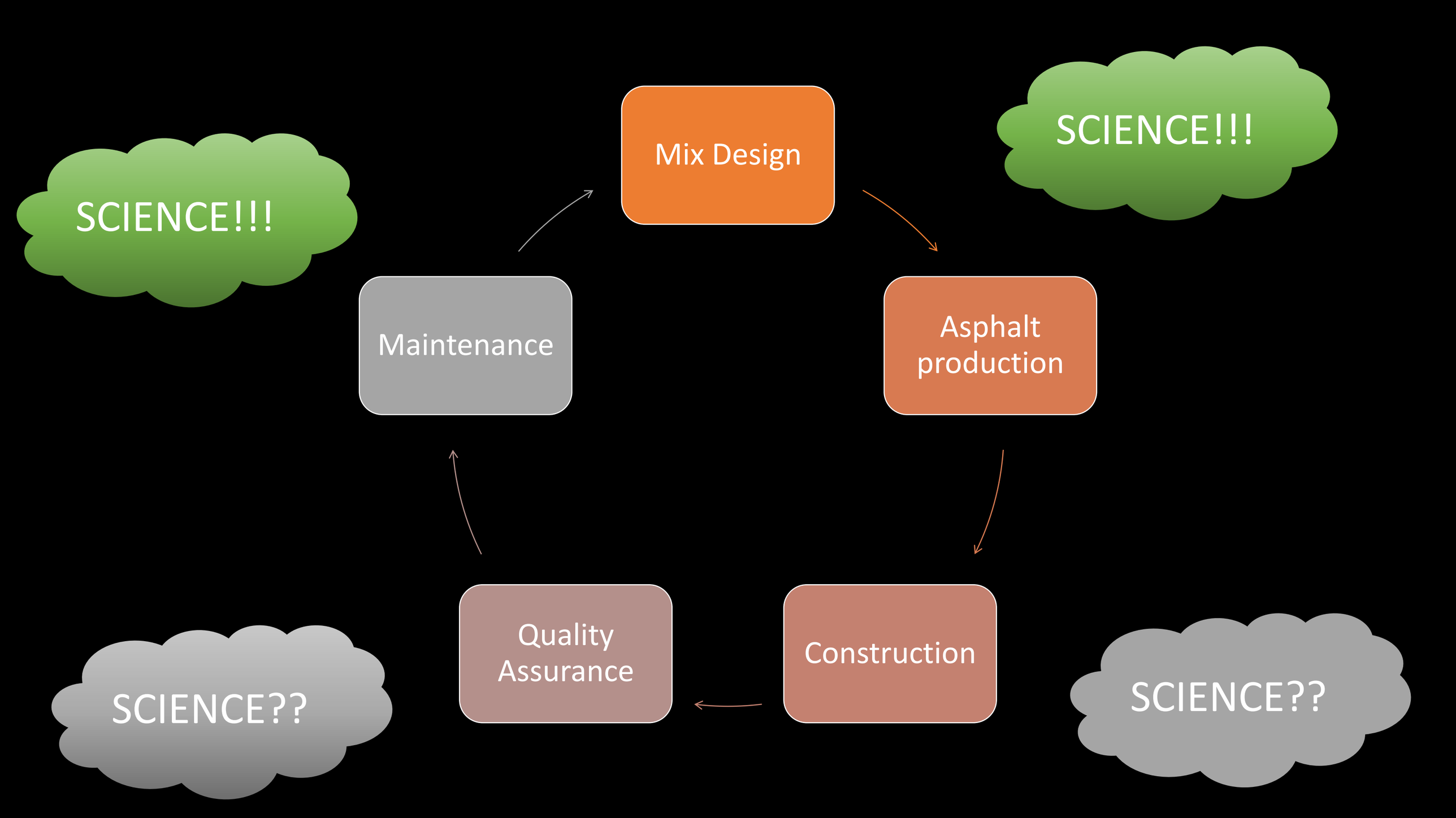
CAUTION
ROUGH
TERRAIN

PARENTAL
ADVISORY
EXPLICIT CONTENT

Our asphalt world …

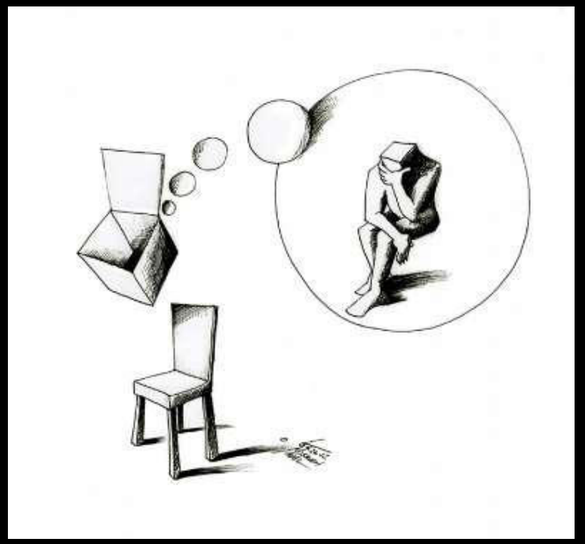
A rather traditional one?




SCIENCE!!!
Mix Design
SCIENCE!!!
Maintenance
Asphalt production
Quality Assurance
Construction
SCIENCE??
SCIENCE??

Guess what ….

- Construction companies are already thinking differently
- Moving away from the traditional
- Pushing boundaries
- Implementing research

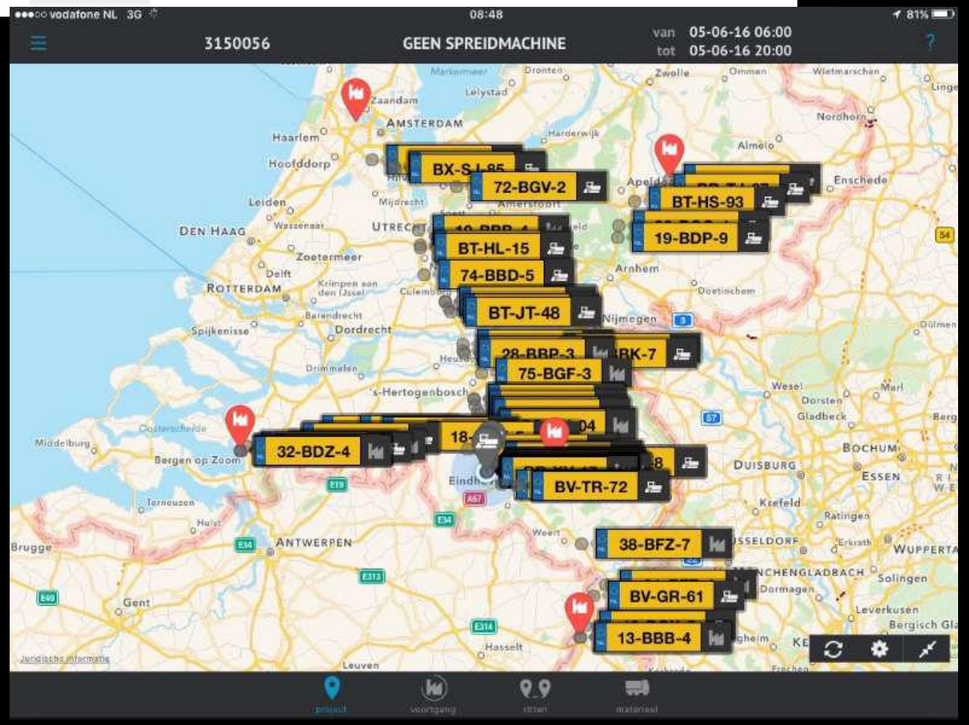


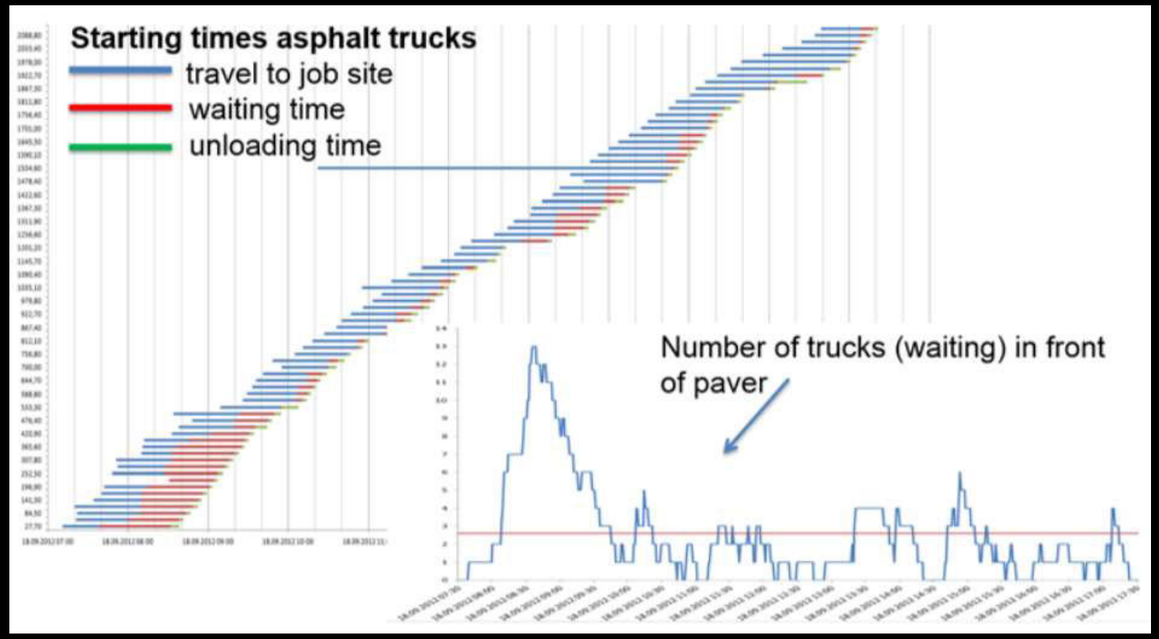
- Asphalt production
- Logistics
- Paving
- Compaction

- New regulations
- Climate change
- Reduce CO_2 emissions
- Energy usage
- Moisture reduction

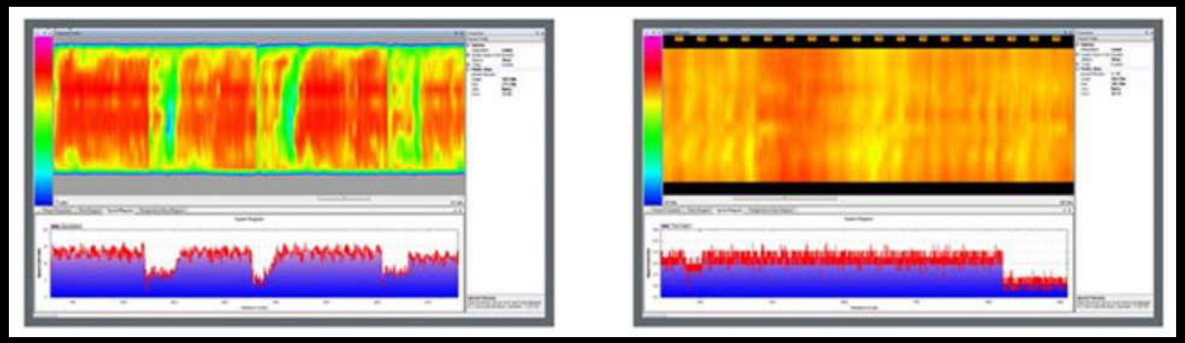
Asphalt
plant design

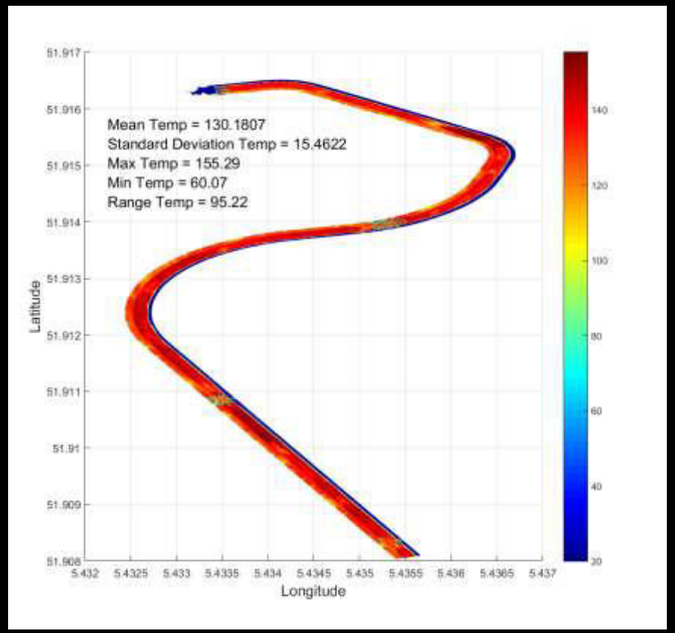
Asphalt transport …



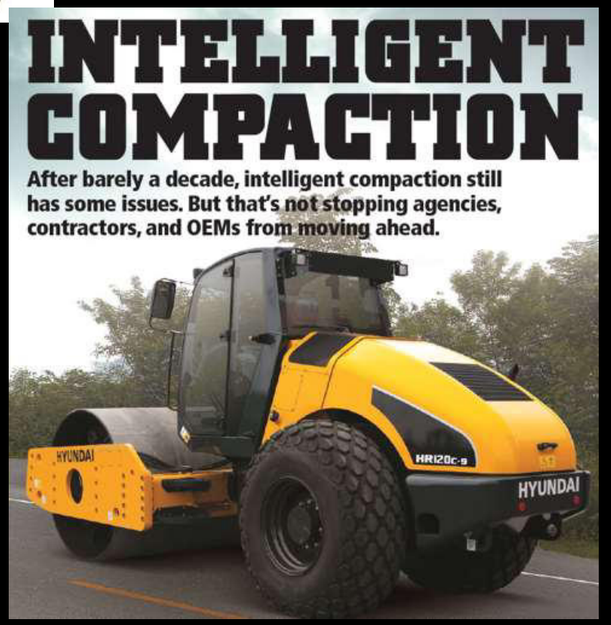


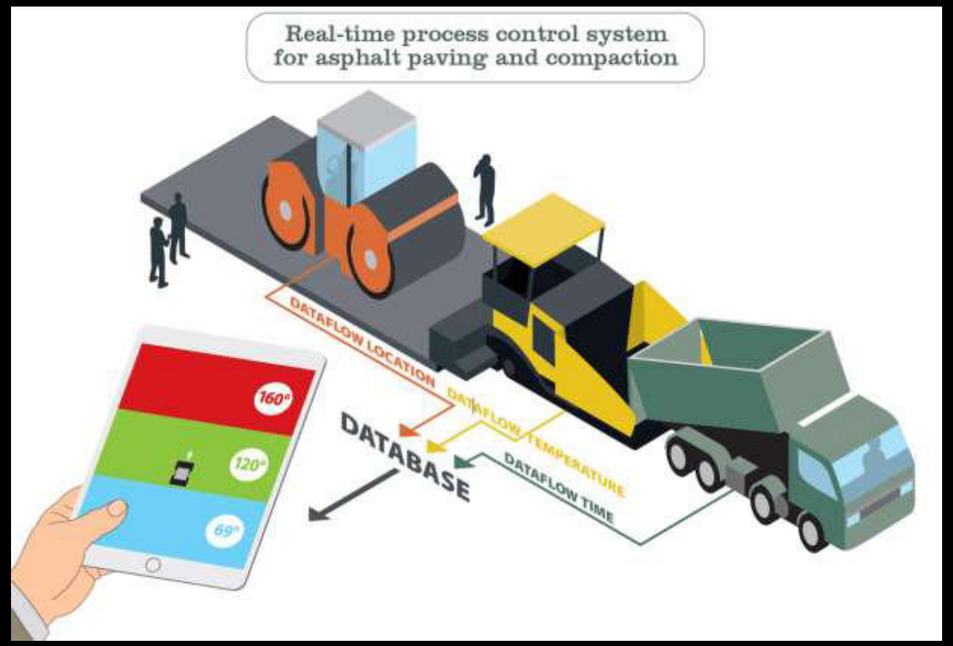
Paving … it's all about TEMPERATURE, TEMPERATURE, TEMPERATURE!!

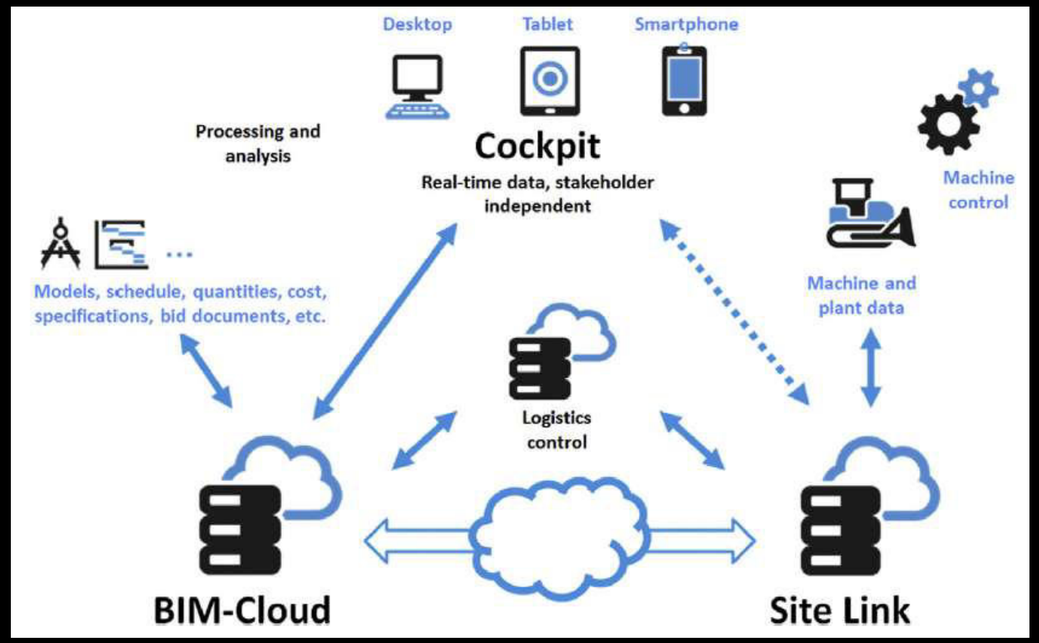


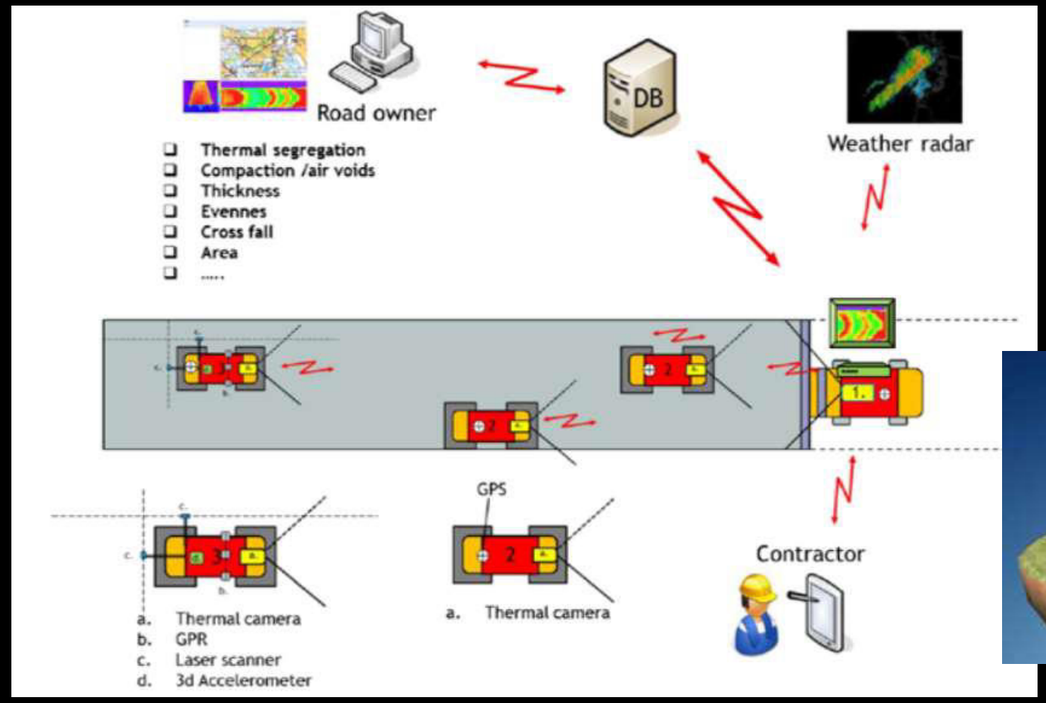


Intelligent Compaction … humble beginnings to this ……..

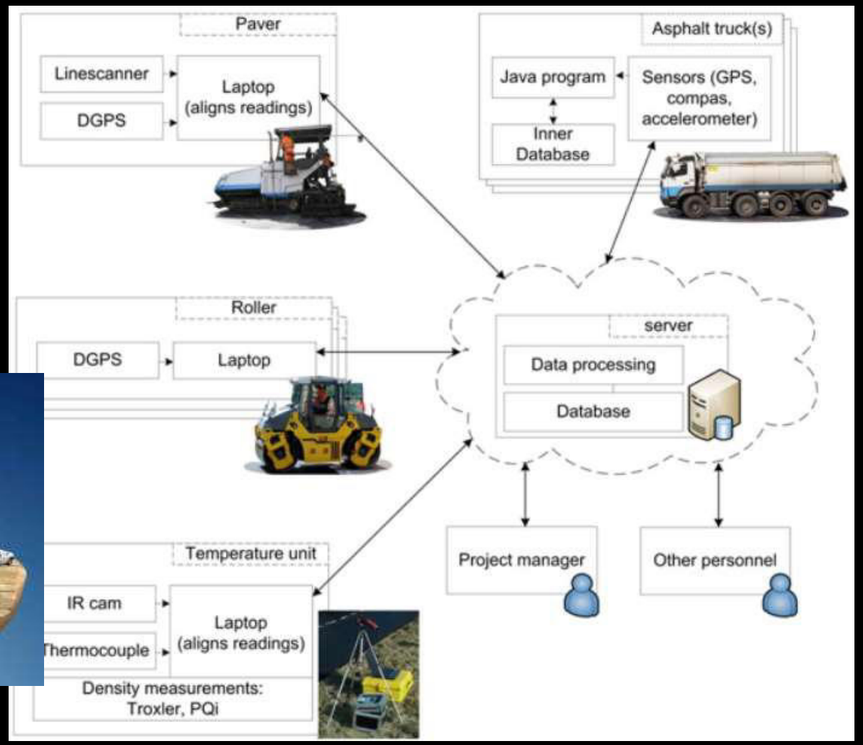








Integrated solutions …



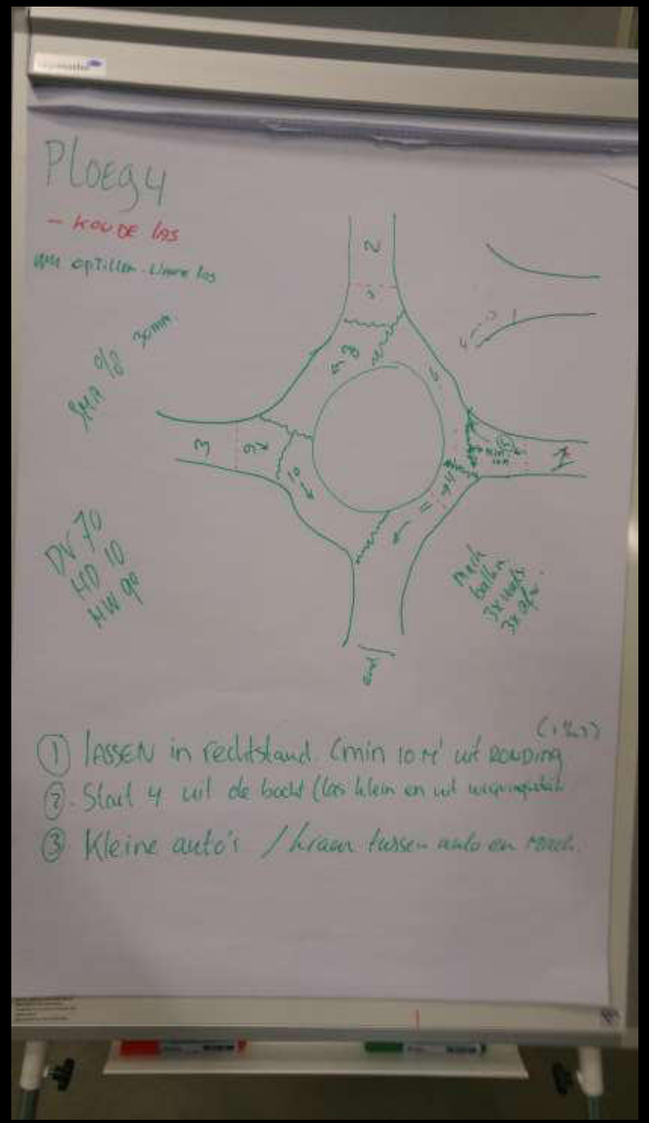
So, I’ve spent some time telling you about current BEST PRACTICE ….

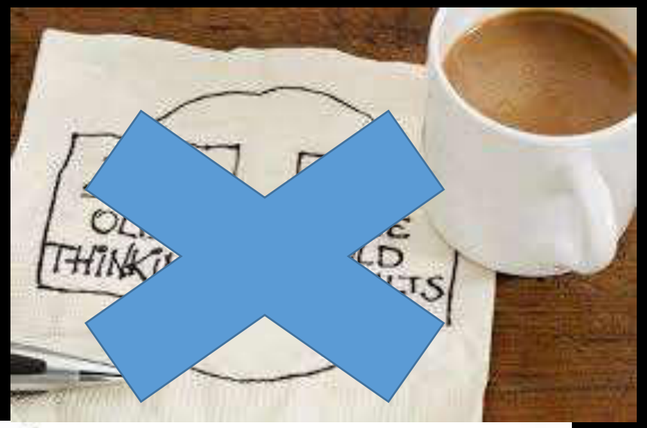
What if we thought about the NEXT PRACTICE …. and for the following to become the NORM rather than the exception????

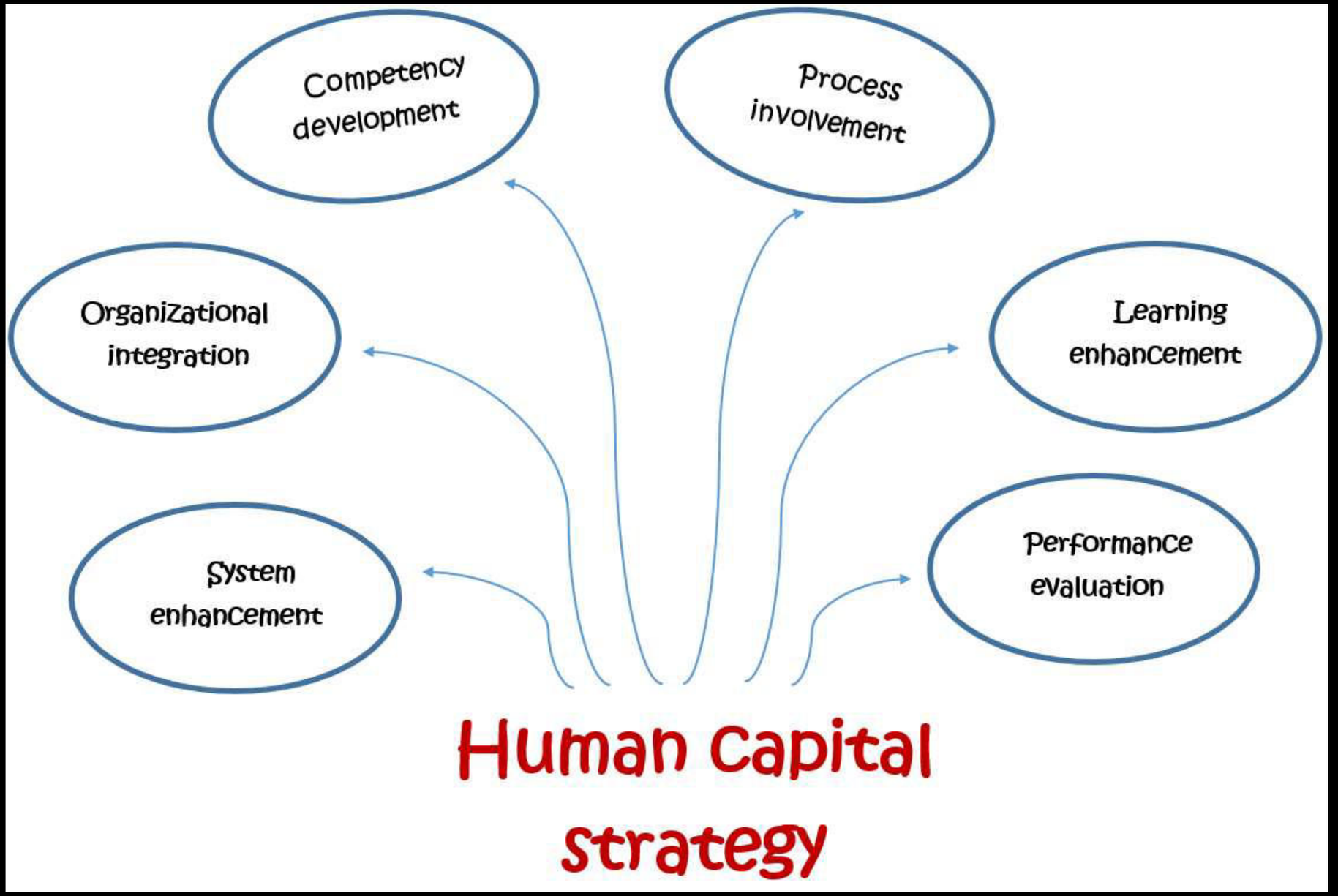
- Artificial Intelligence, machine learning and guided algorithms
- Process control data for compliance testing
- Non-destructive tests for compliance testing
- Using Virtual Reality for training … planning …
- Cloud-based solutions and data analytics

What about our equipment of the future?

Let us dare to do things differently …

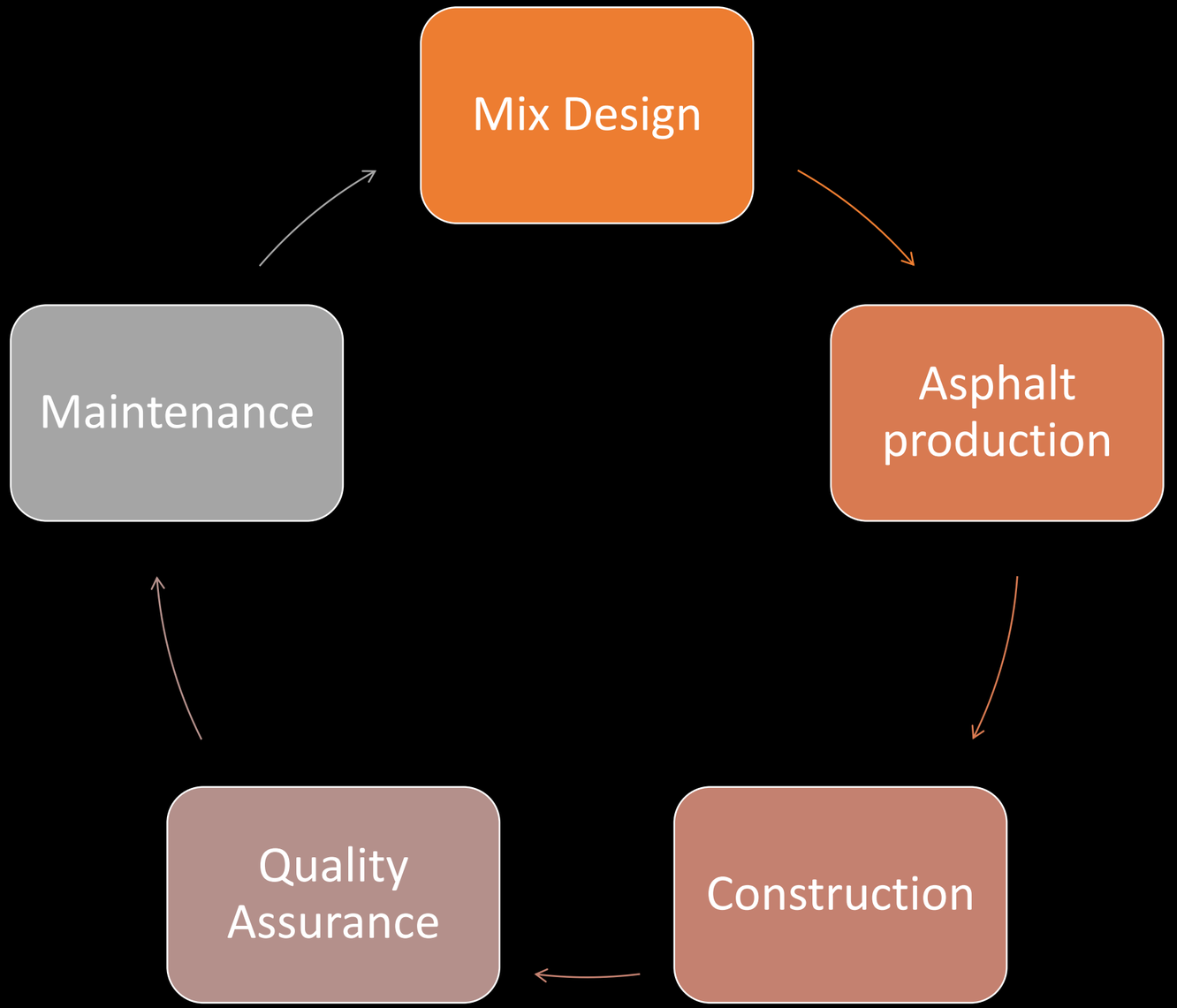


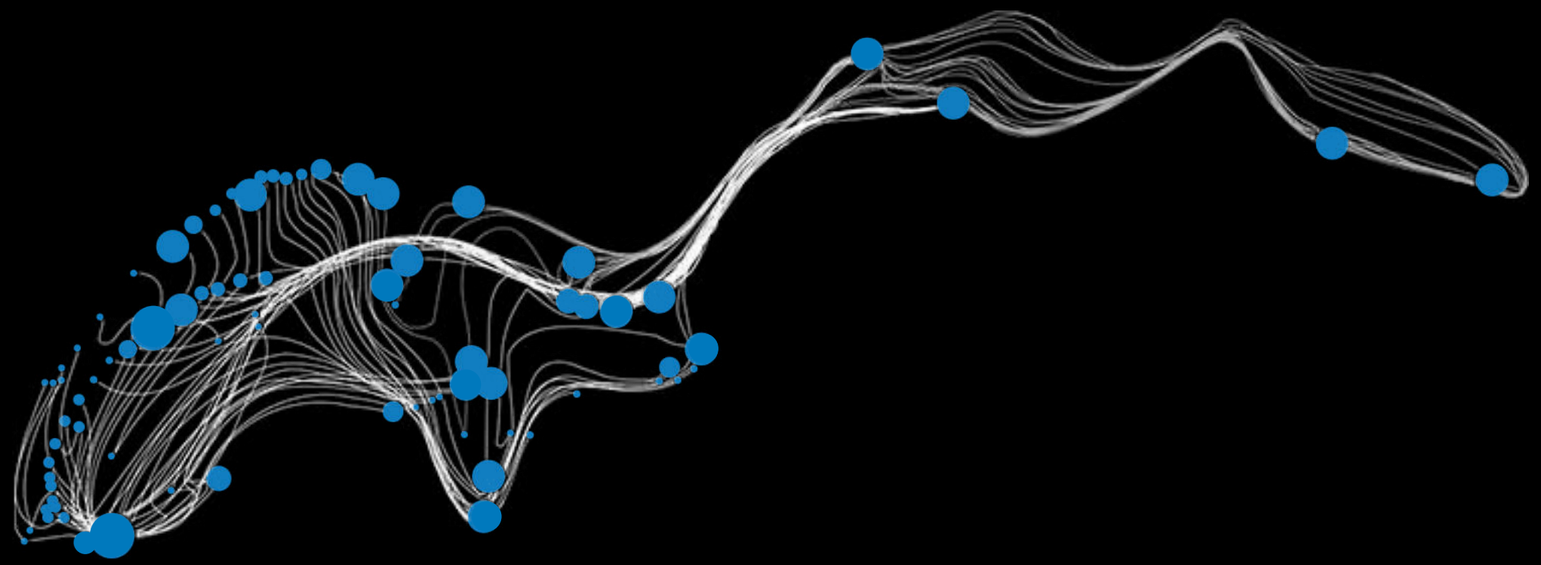


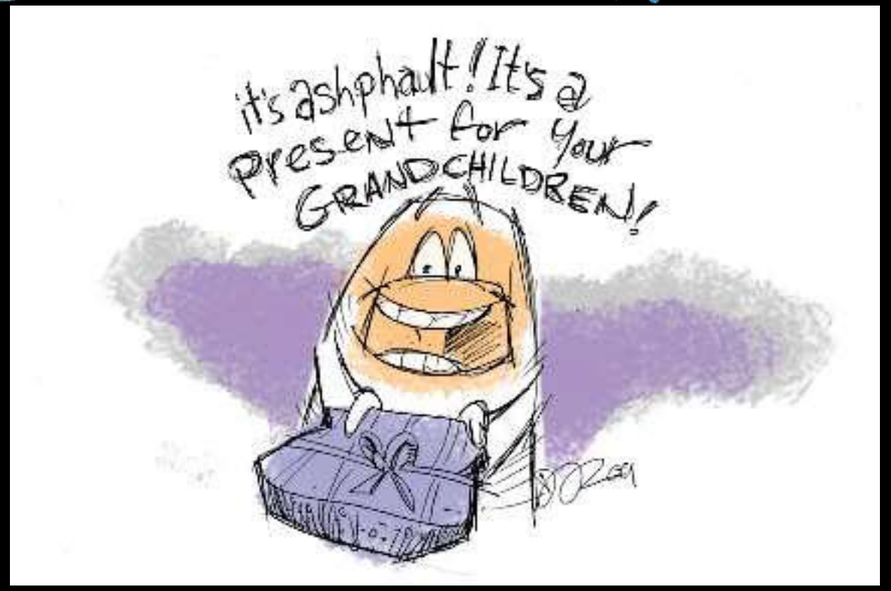

Competency development
Process involvement
Organizational integration
Learning enhancement
System enhancement
Performance evaluation
Human Capital strategy

A SCIENCE-BASED APPROACH

TO THE ENTIRE ASPHALT SUPPLY CHAIN







Thank you for your attention!
Are there any questions?

EAPA

ASPARi

Paving the way forward

BIM based rehab and maintenance process for roads and highways

Manu Marttinen
NCC Industry, Finland

10th EAPA Symposium on 1 June 2017 in Paris
#EAPASymposium2017

CONTENTS

- BIM in general
- Road Rehab Process
  - Case Highway 51 in Finland 2012
- Information Models in Maintenance
  - Case Road 55 in Finland 2014

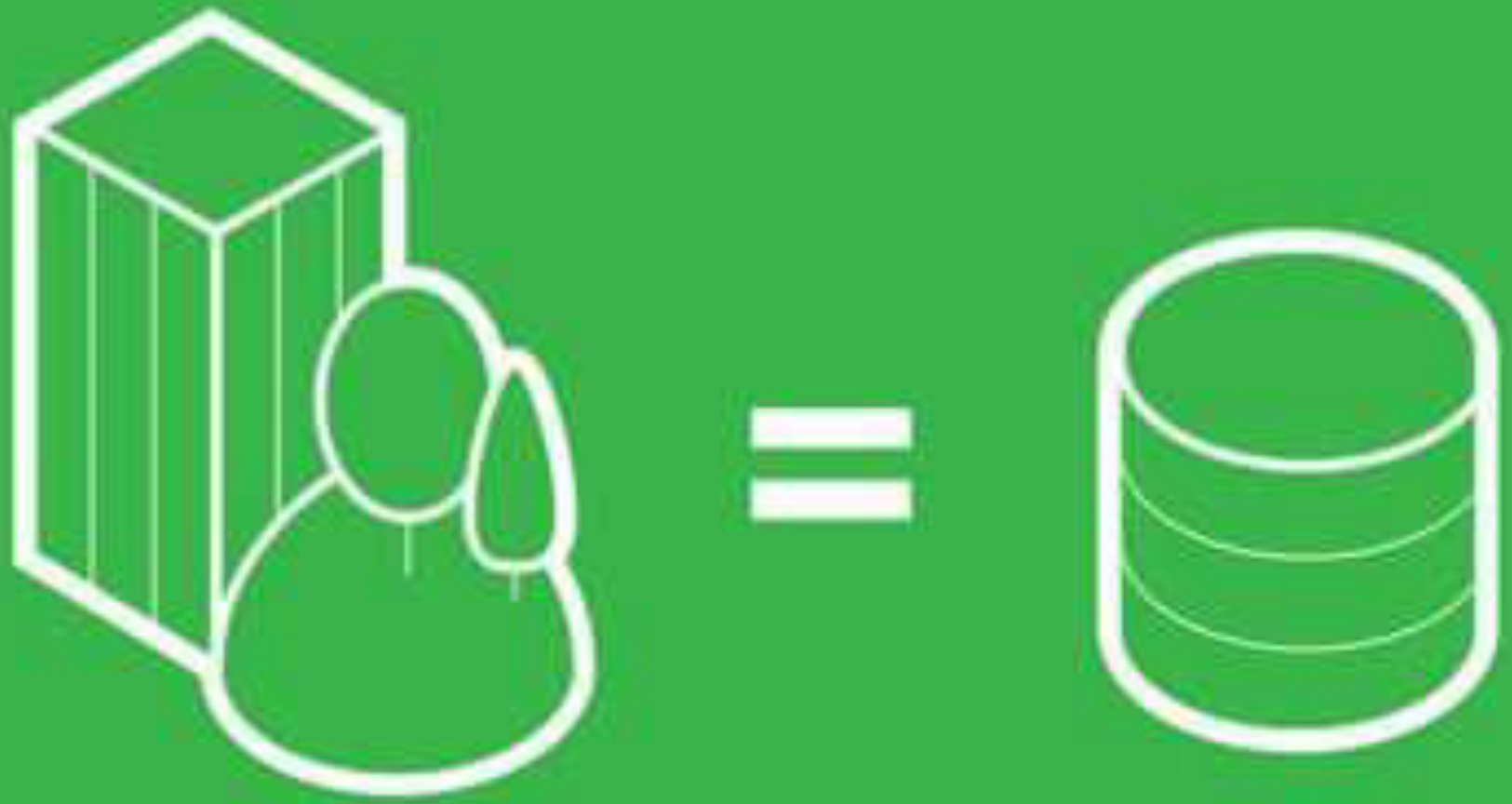
BIM in general

What is desired in a representation?

Vishal Singh
Assistant Professor
Department of Civil and Structural Engineering, Aalto University

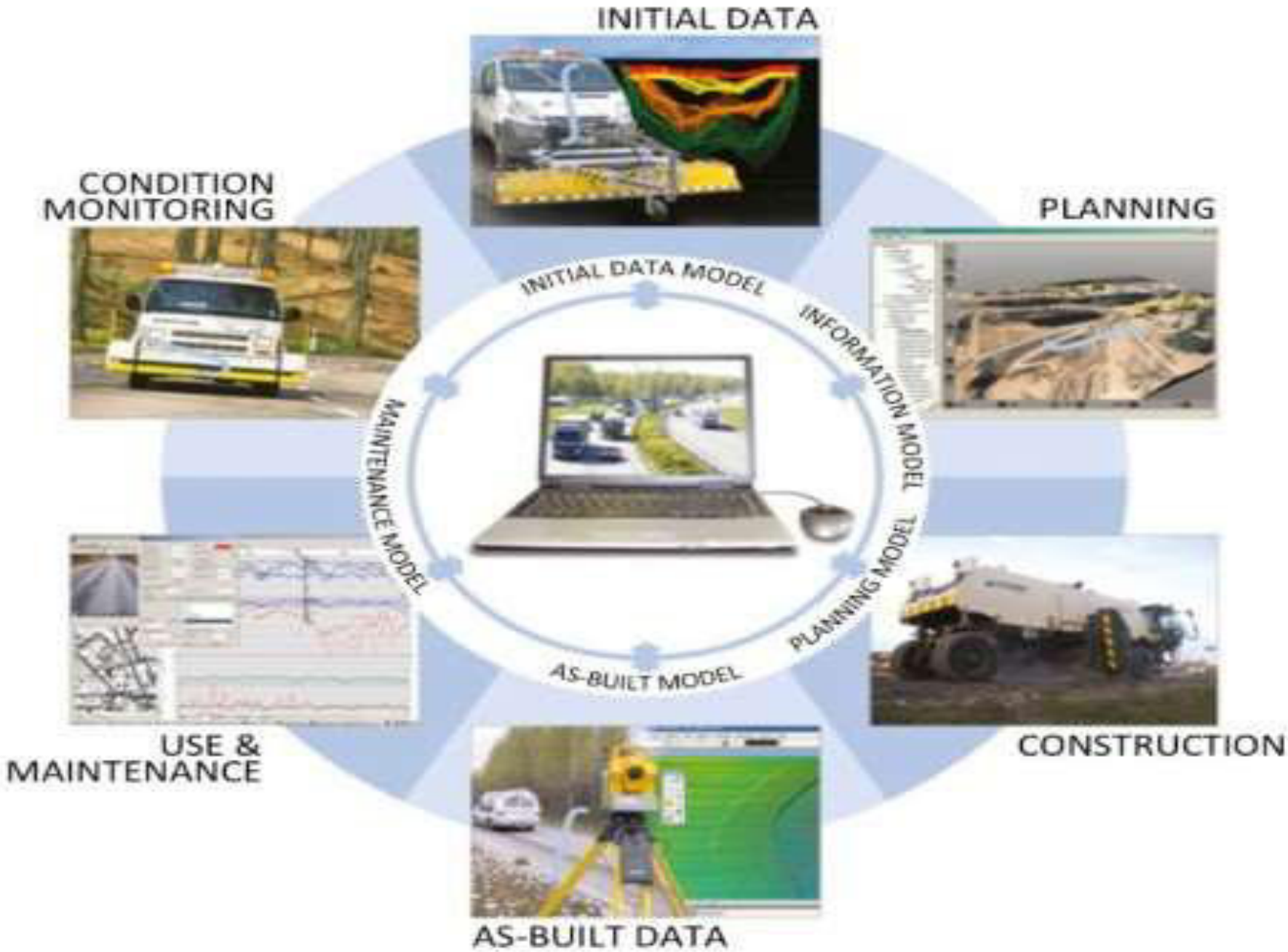
Building Information Model ??

Building Information Model ??



BIM = data

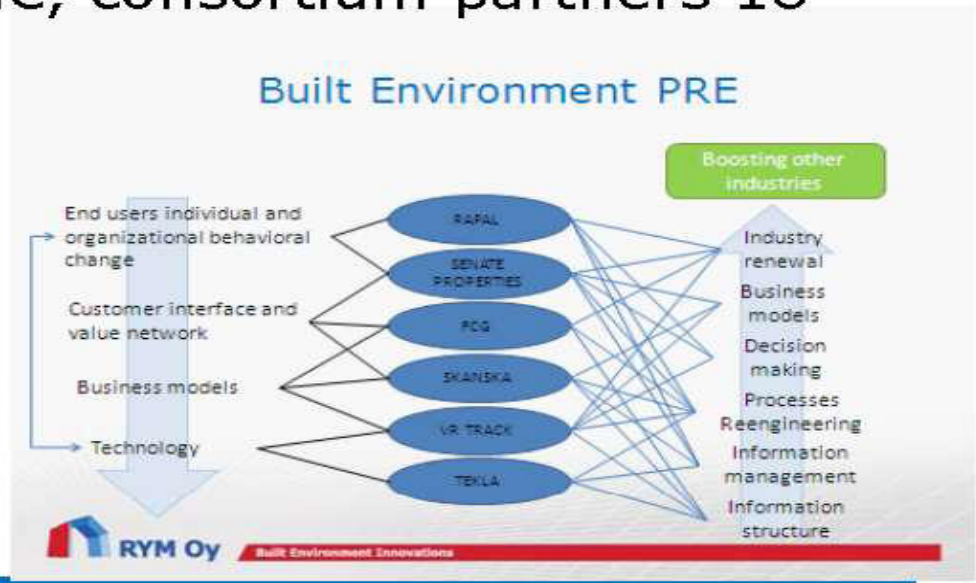
Why we are using BIM?


INITIAL DATA
CONDITION MONITORING
PLANNING
INITIAL DATA MODEL
INFORMATION MODEL
MAINTENANCE MODEL
PLANNING MODEL
AS-BUILT MODEL
USE & MAINTENANCE
CONSTRUCTION
AS-BUILT DATA

Kimmo Laatunen
VR Track Oy

Built Environment PRE and Infra FINBIM

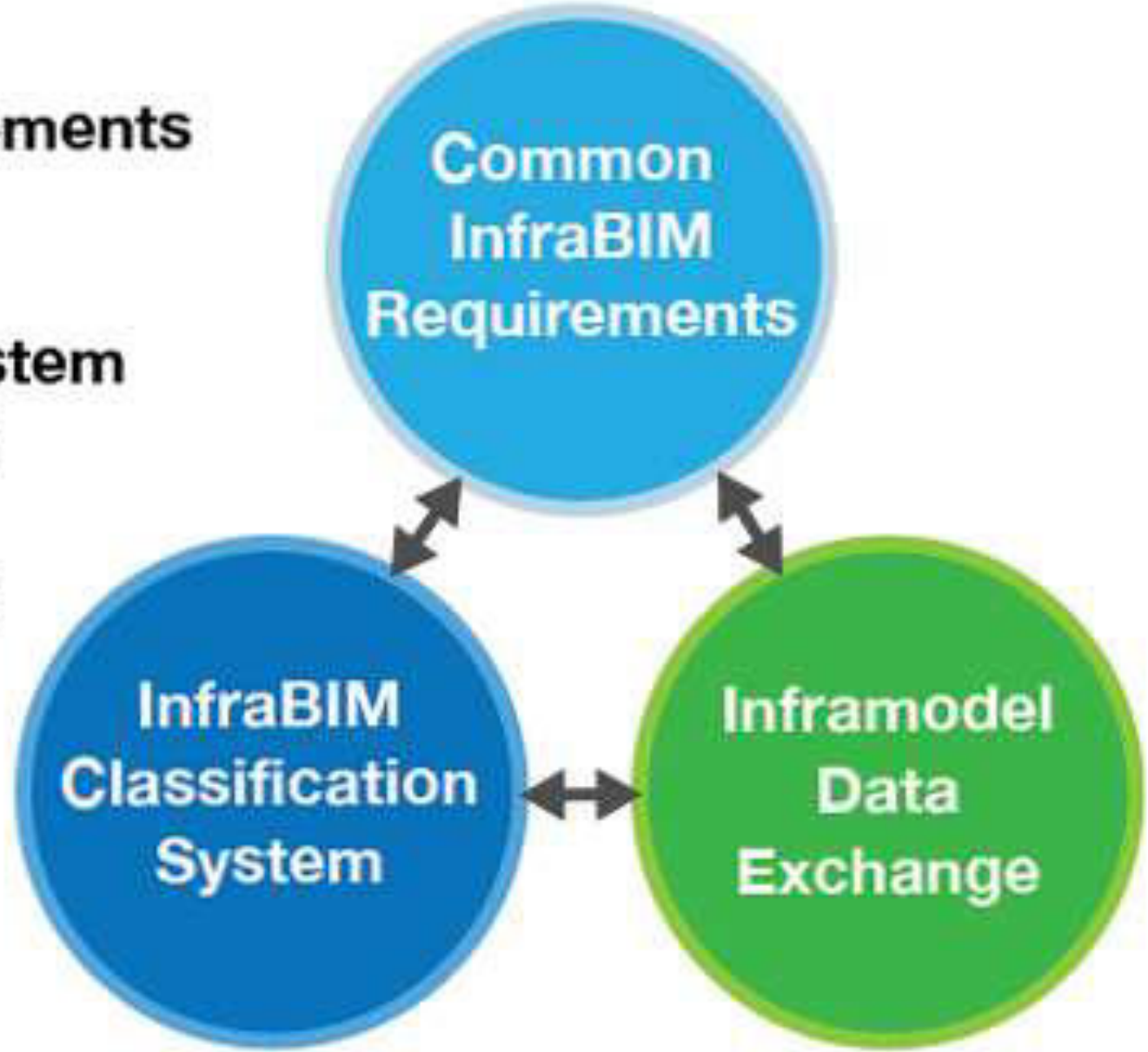
- Aim of PRE is to "promote BIM" in Building and Infra Construction areas
- PRE Program period 1.11.2010–31.12.2013
- PRE total budget is 21 M€, 37 industrial and 6 research partners
- Infra FINBIM is one of the six PRE work packages
- Infra FINBIM budget is about 6 M€, consortium partners 18



Common InfraBIM Requirements
- What and how to model

InfraBIM Classification System
- Infrastructure classification

Inframodel Data Exchange
- Inframodel3
  - Definition
  - Guidelines for use



Road Rehab Process
Case Highway 51 in Finland 2012

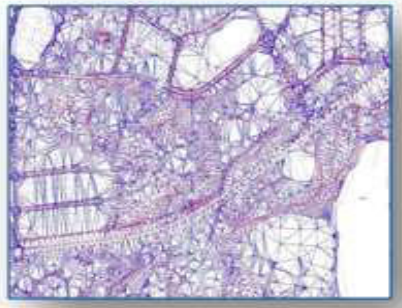
Maintenance BIM 2012: Highway 51 pavement rehabilitation pilot

- Old two-lane road will be part of a four–lane highway
- Aim to reconstruct wearing course by milling and paving
- Construction project along a very busy road
- Laser scanned and GPR measured model in 3D rehabilitation design
- Measurements, modelling and repair planning and cutting executed May-Aug 2012
- Destia & NCC Roads Oy

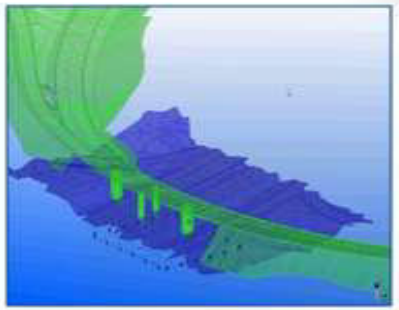
Road rehab process model

GPR & Core samples

Mobile Mapping Trimble MX8



Point cloud processing, Terrasolid

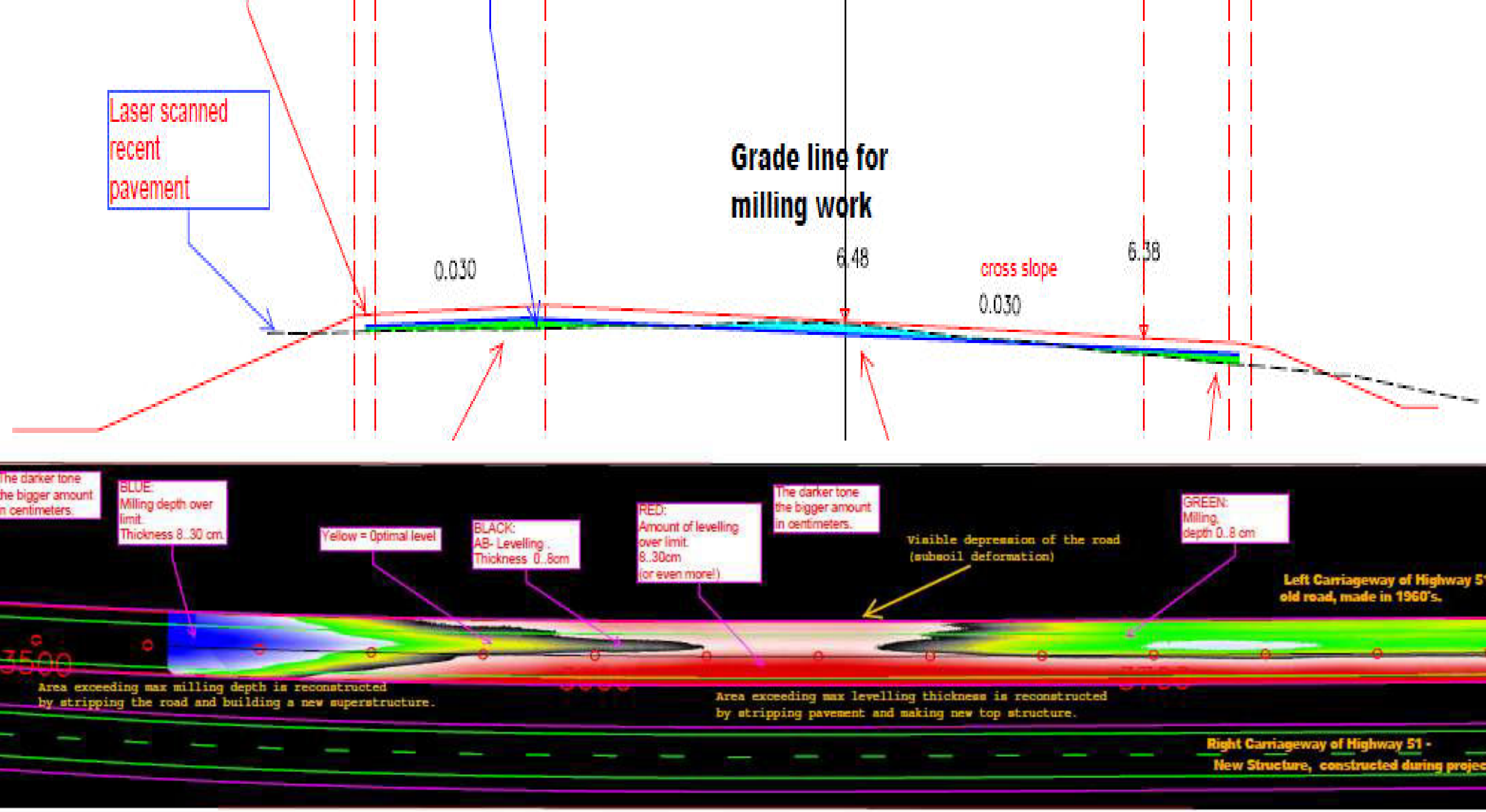


Terrain model (TIN) creation, Tekla Civil

Alignment design and optimization, Tekla Civil

Alignment export in VGP and line format

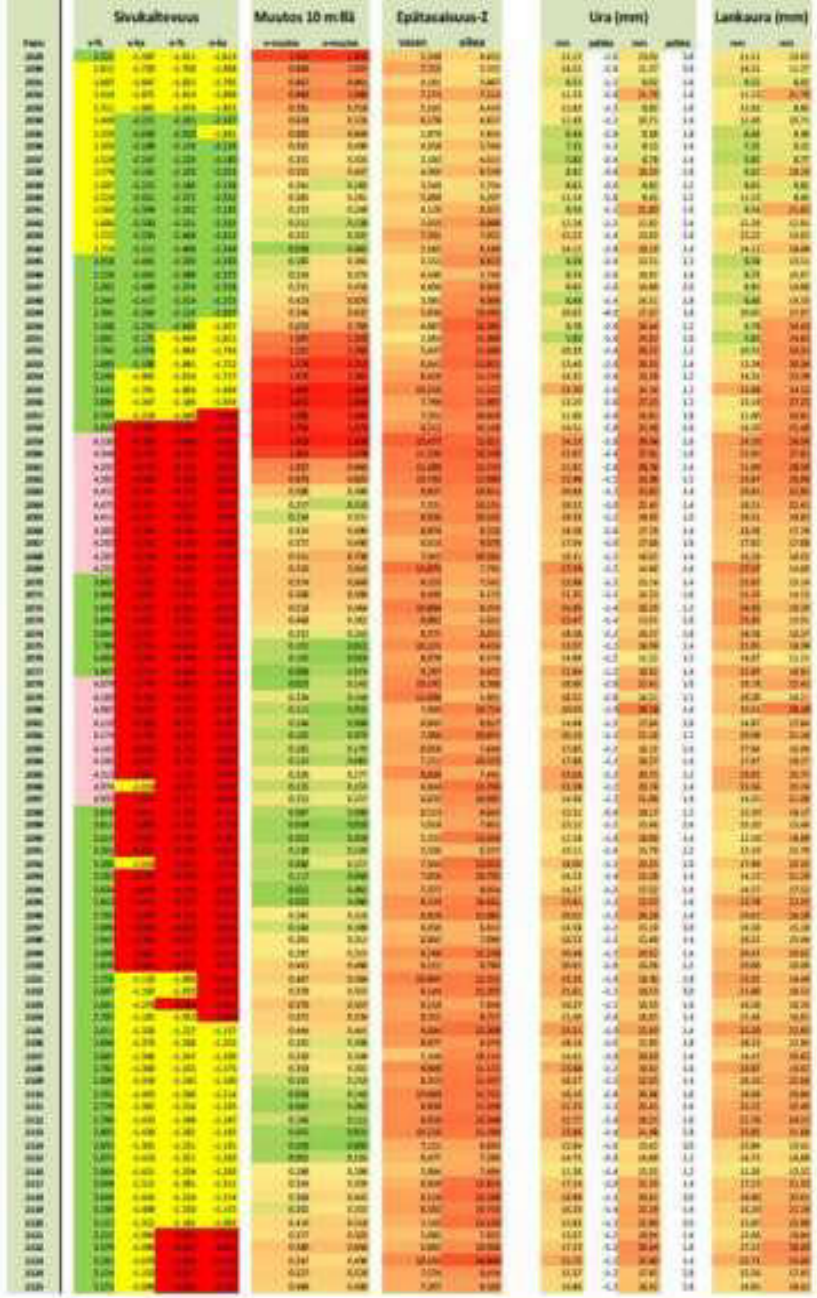
BC-HCE, Export in binary to GCS900

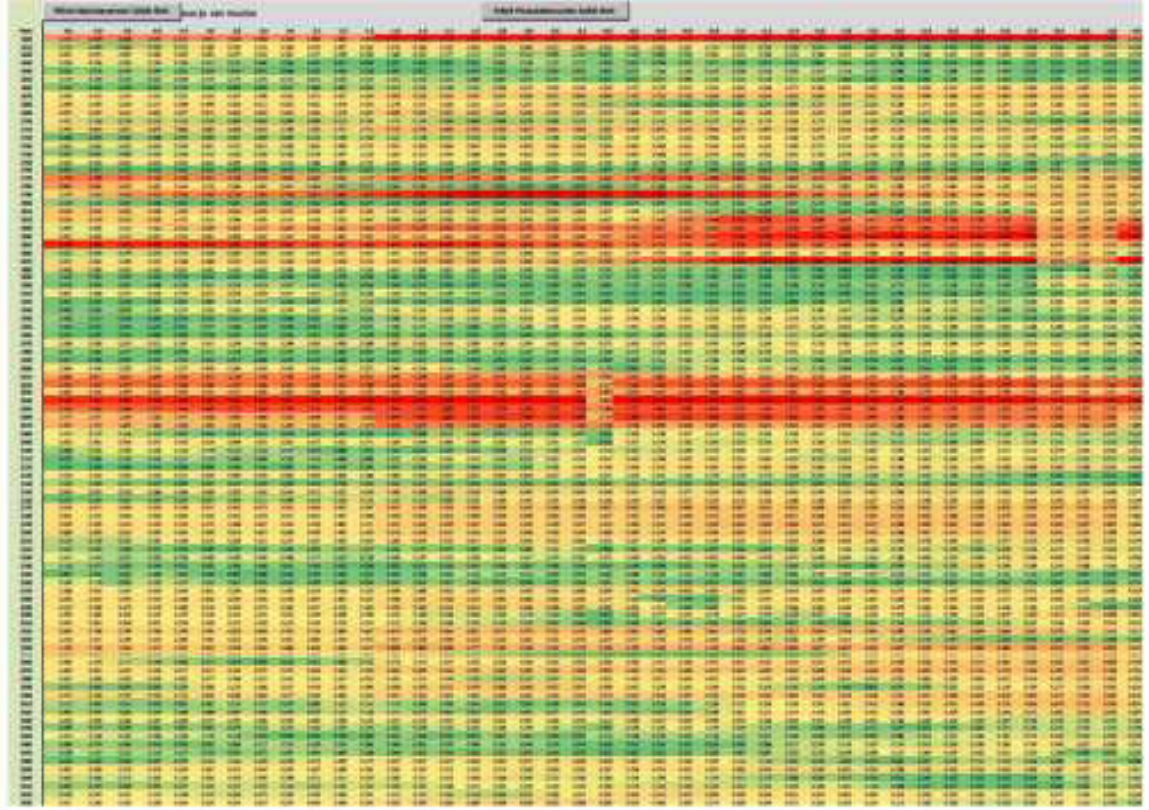

Laser scanned recent pavement
Grade line for milling work
0.030
6.48
cross slope
0.030
6.38
The darker tone the bigger amount in centimeters.
BLUE:
Milling depth over limit.
Thickness 8..30 cm.
Yellow = Optimal level
BLACK:
AB- Levelling .
Thickness 0..8cm
RED:
Amount of levelling over limit.
8..30cm
(or even more!)
The darker tone the bigger amount in centimeters.
Visible depression of the road (subsoil deformation)
GREEN:
Milling,
depth 0..8 cm
Left Carriageway of Highway 5
old road, made in 1960's.
Area exceeding max milling depth is reconstructed by stripping the road and building a new superstructure.
Area exceeding max levelling thickness is reconstructed by stripping pavement and making new top structure.
Right Carriageway of Highway 51 -
New Structure, constructed during projec

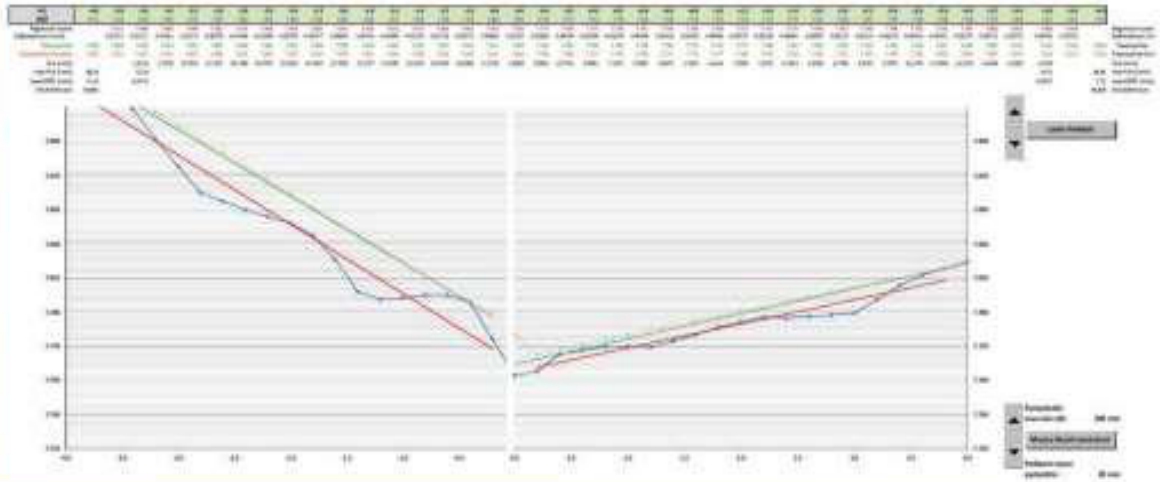
Information Models in Maintenance
Case Road 55 in Finland 2014

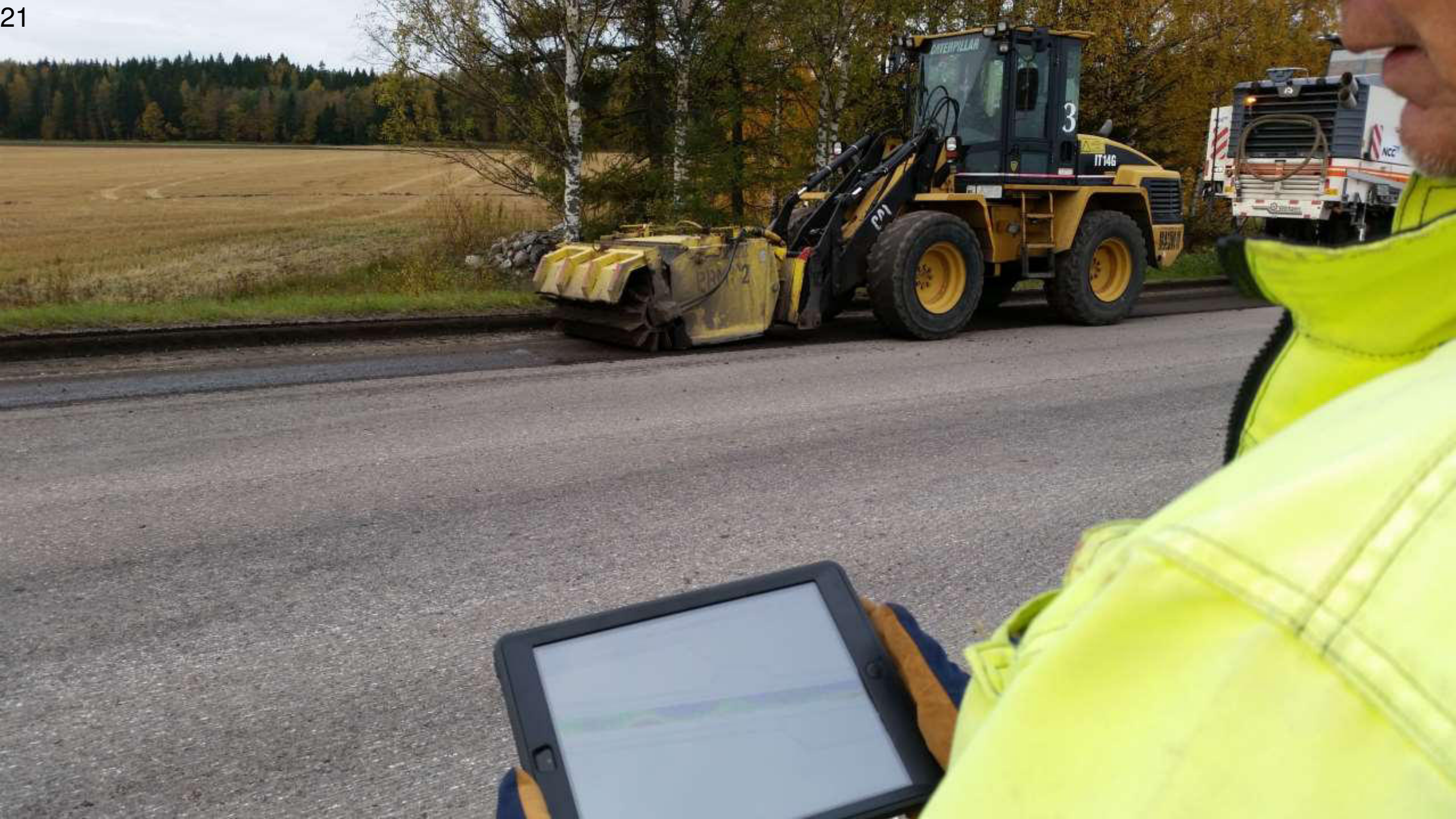
22 2 1647/4660
+147
-253
60
KV: Spray 1,5mm

Sivukaltevuuden itseisarvot
11/200
11/400
11/600
0.5
0.7
3.2
3.3


Sivukaltevuus
Muutos 10 m:llä
Epätasaisuus-Z
Ura (mm)
Lankaura (mm)

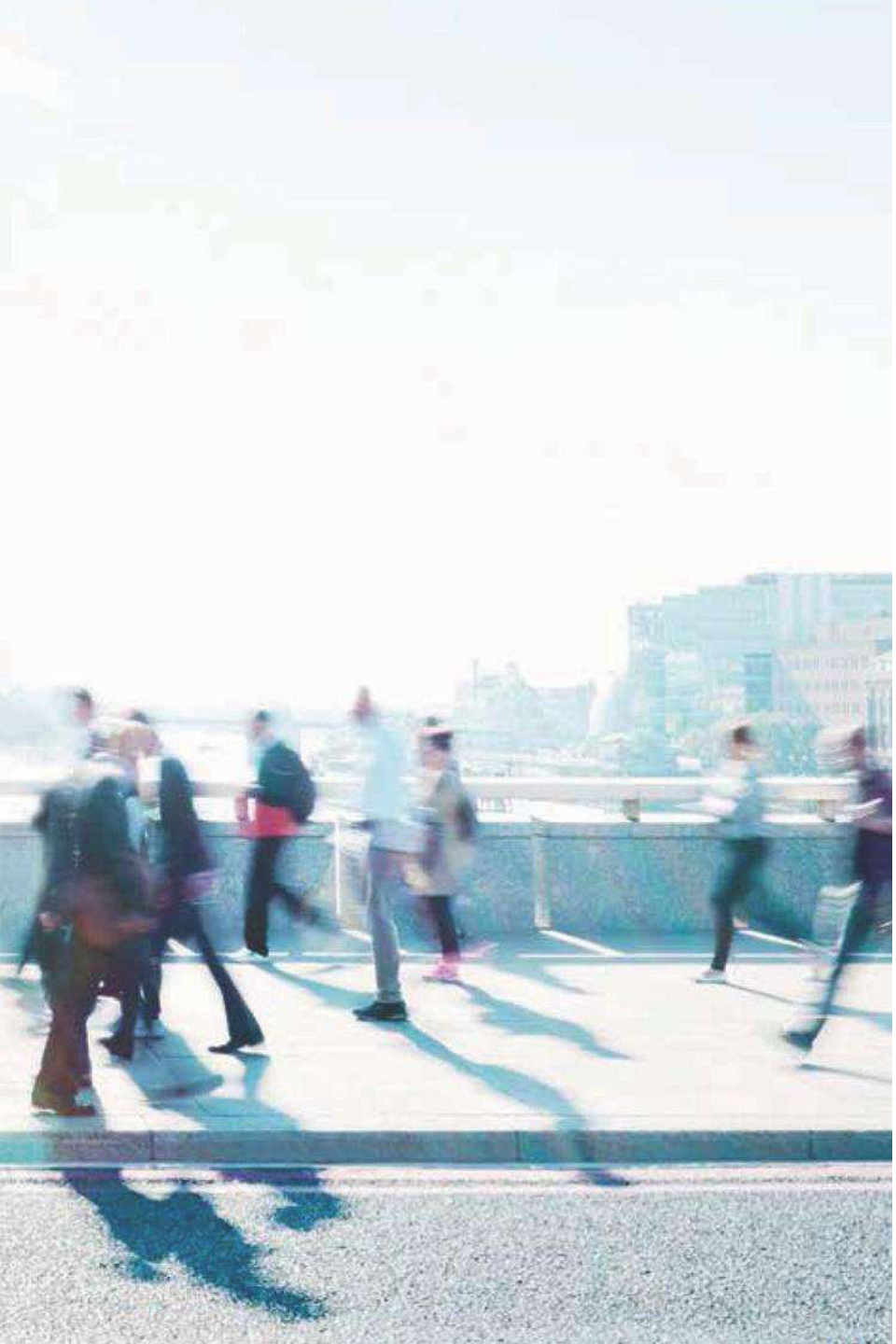





CATERPILLAR
3
IT14G
NCC

2200
2100

NCC



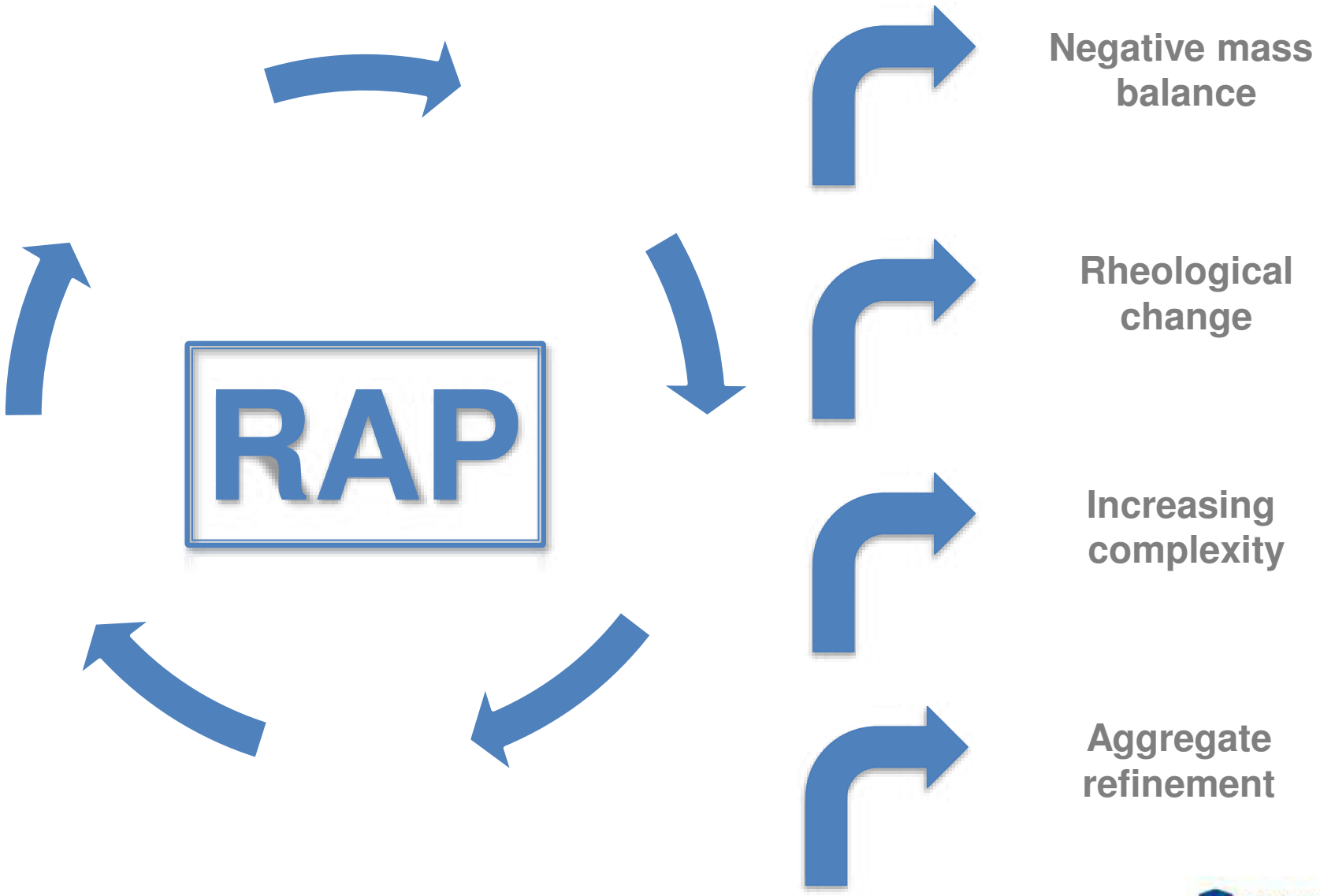
REJUVENATORS FOR ASPHALT MIXES

Knut Johannsen

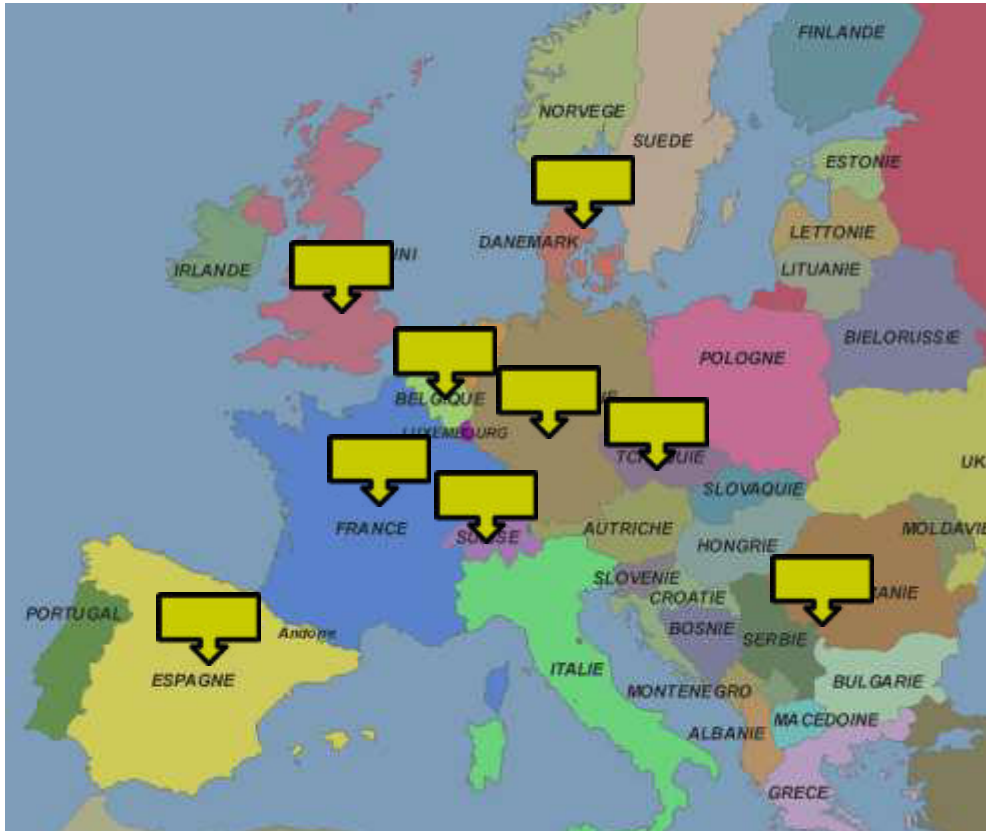
EAPA Symposium 2017, Paris

EUROVIA
VINCI

STATUS QUO „RAP“



RESEARCH ON THE TOPIC



Re - Road

AllBack2Pave

BioRePavation

AlterPave

Source:
Ch. Leroy, USIRF

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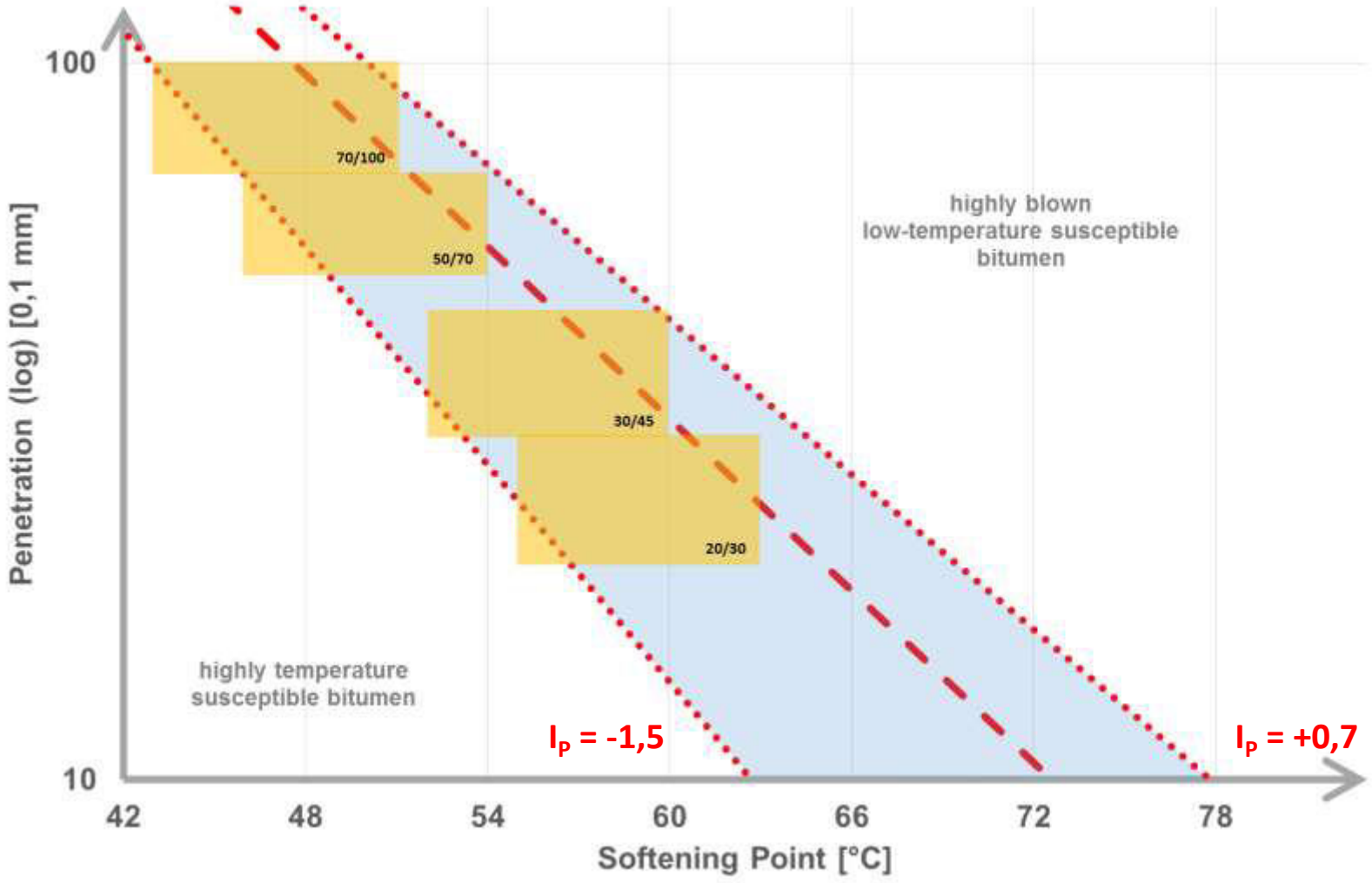
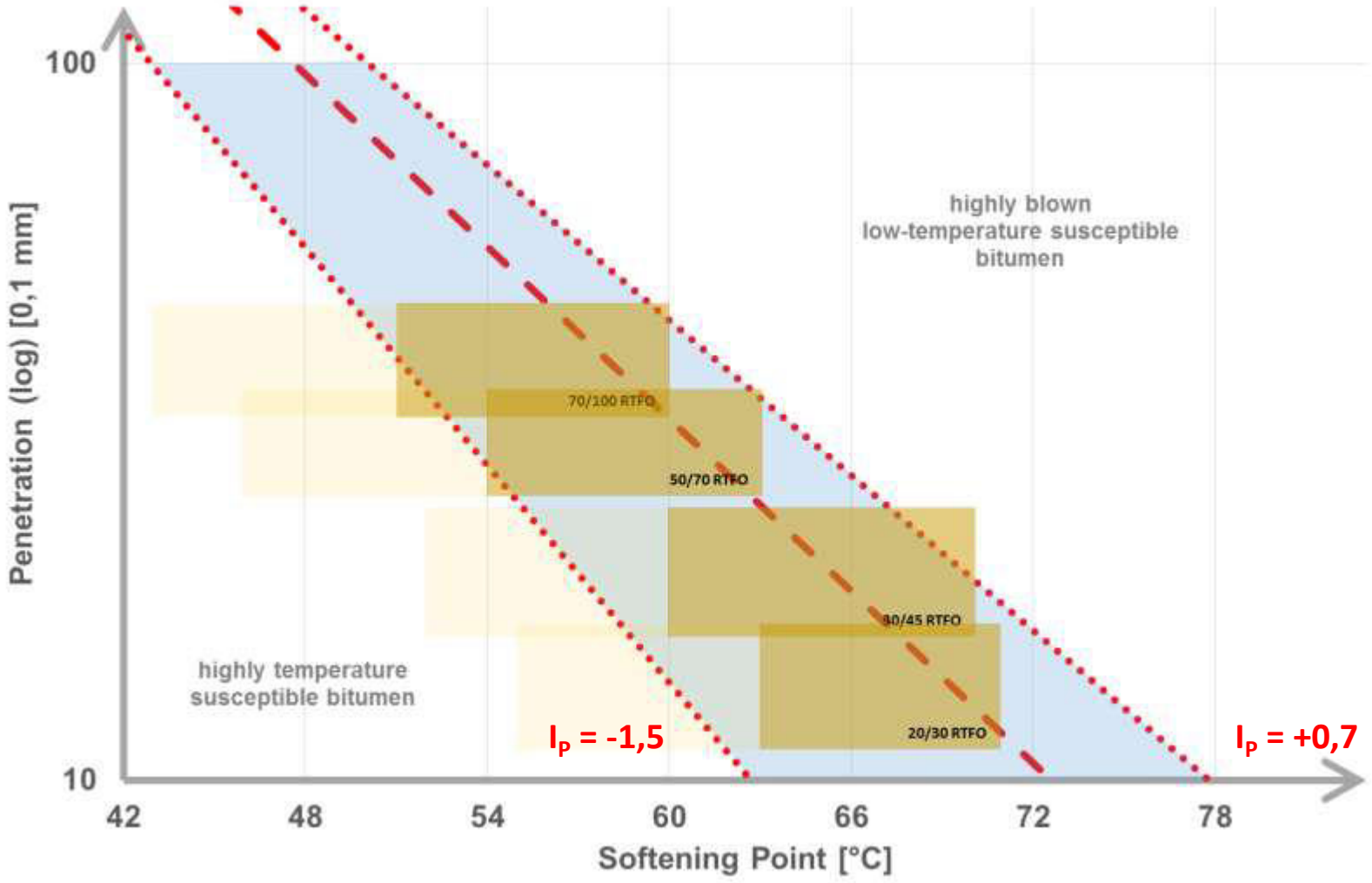
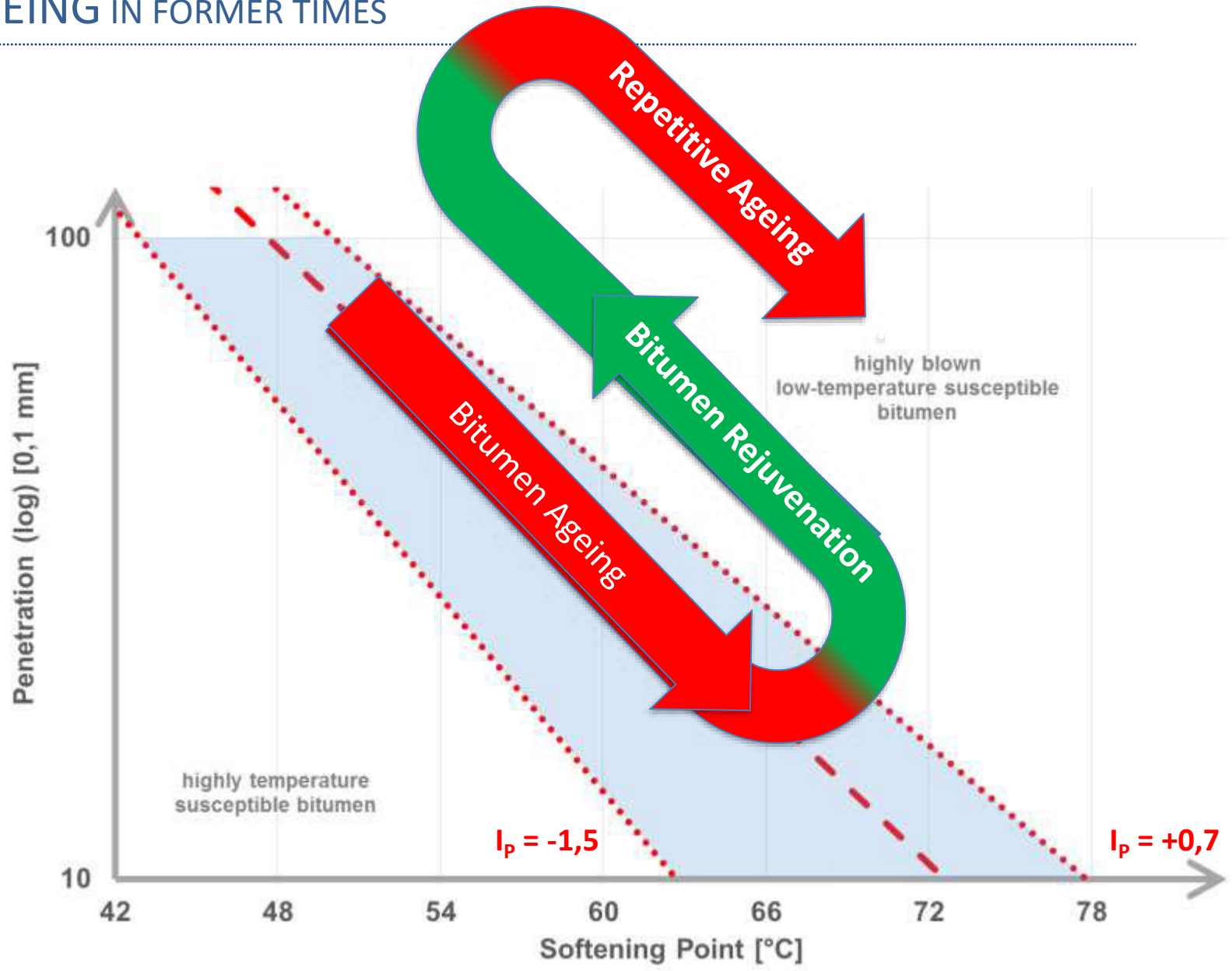
AGEING IN FORMER TIMES



AGEING IN FORMER TIMES

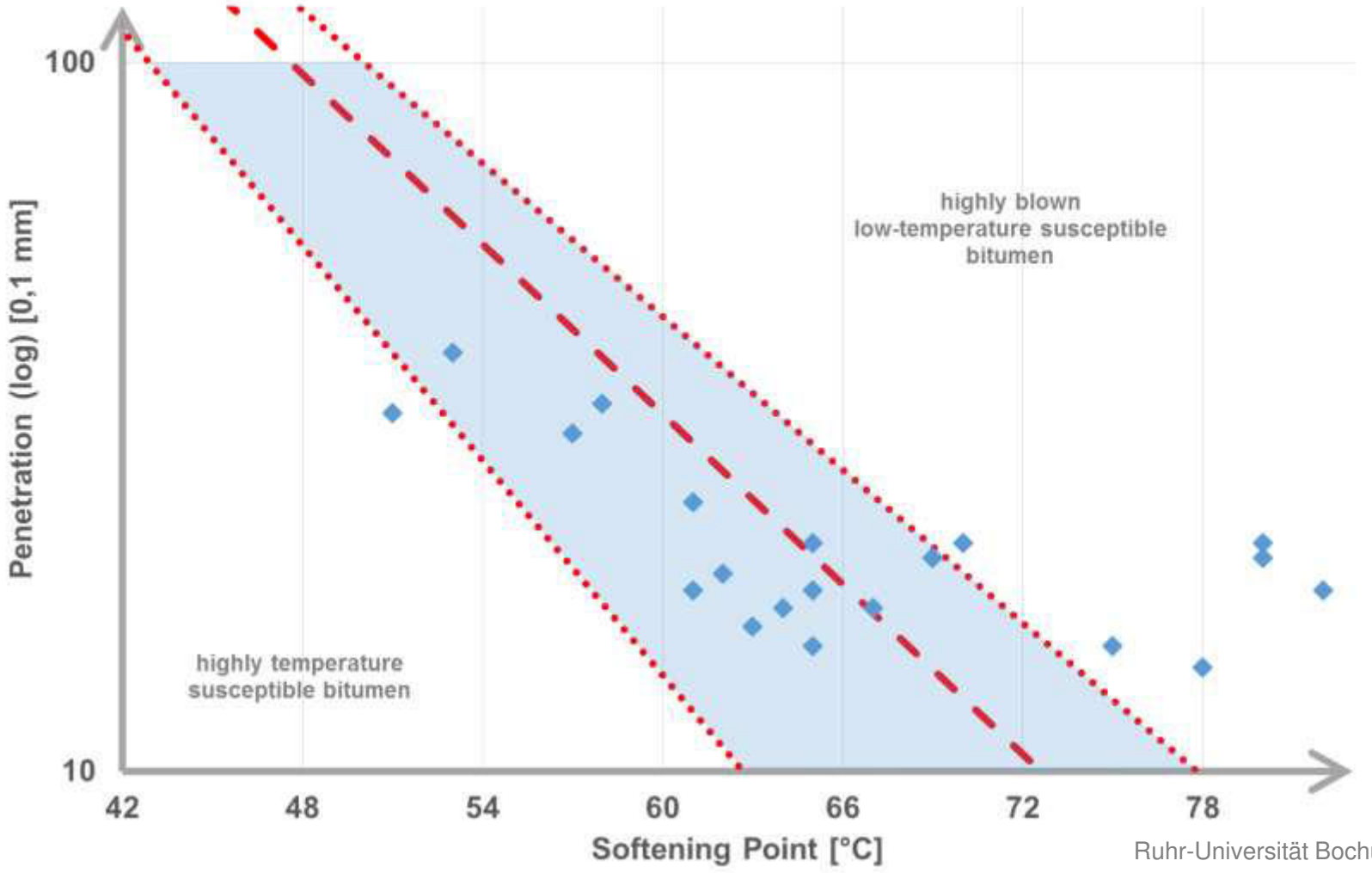


AGEING IN FORMER TIMES



AGEING IN FORMER TIMES

Variety of RAP



Data:
Ruhr-Universität Bochum, LVW

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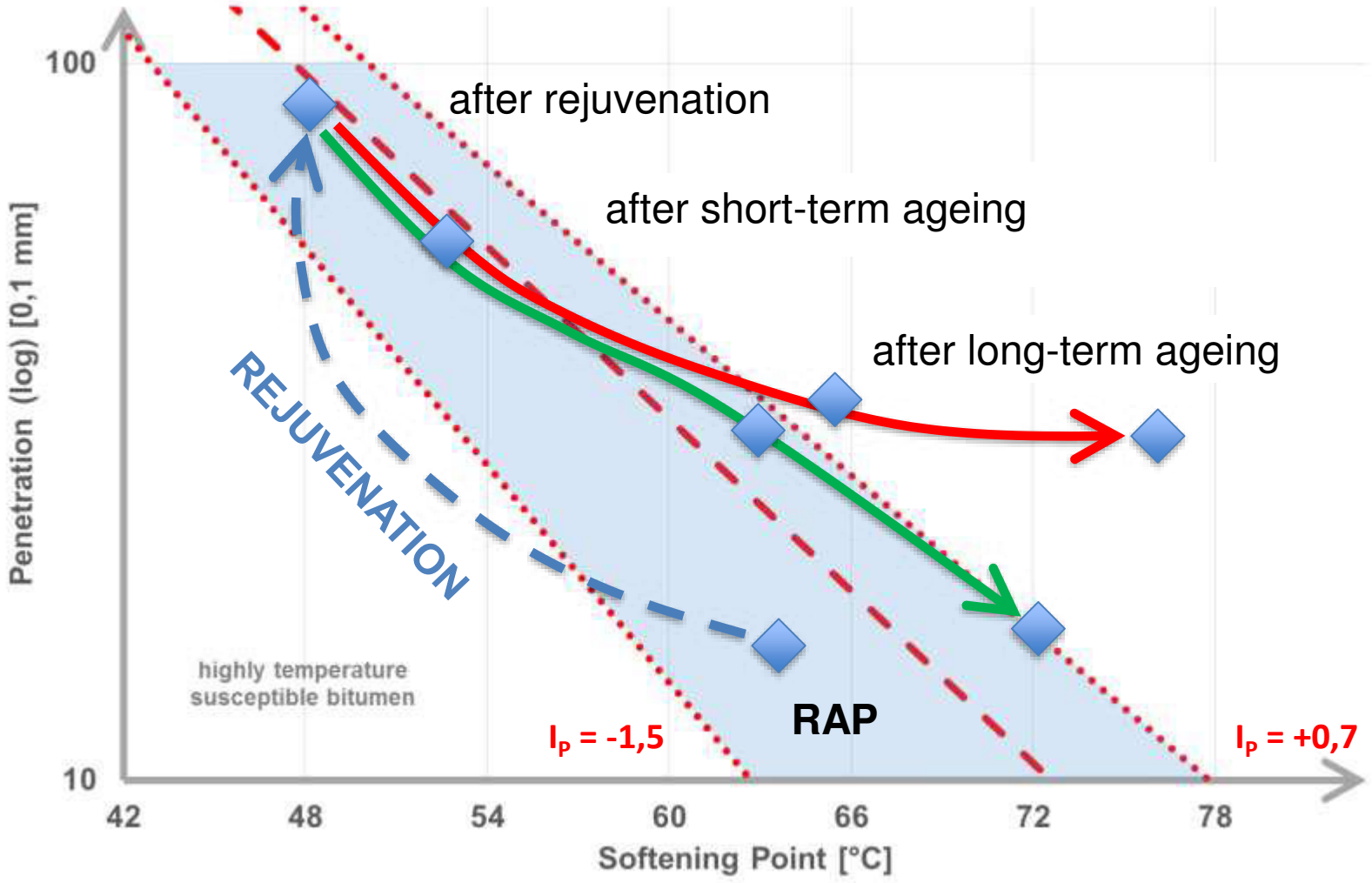
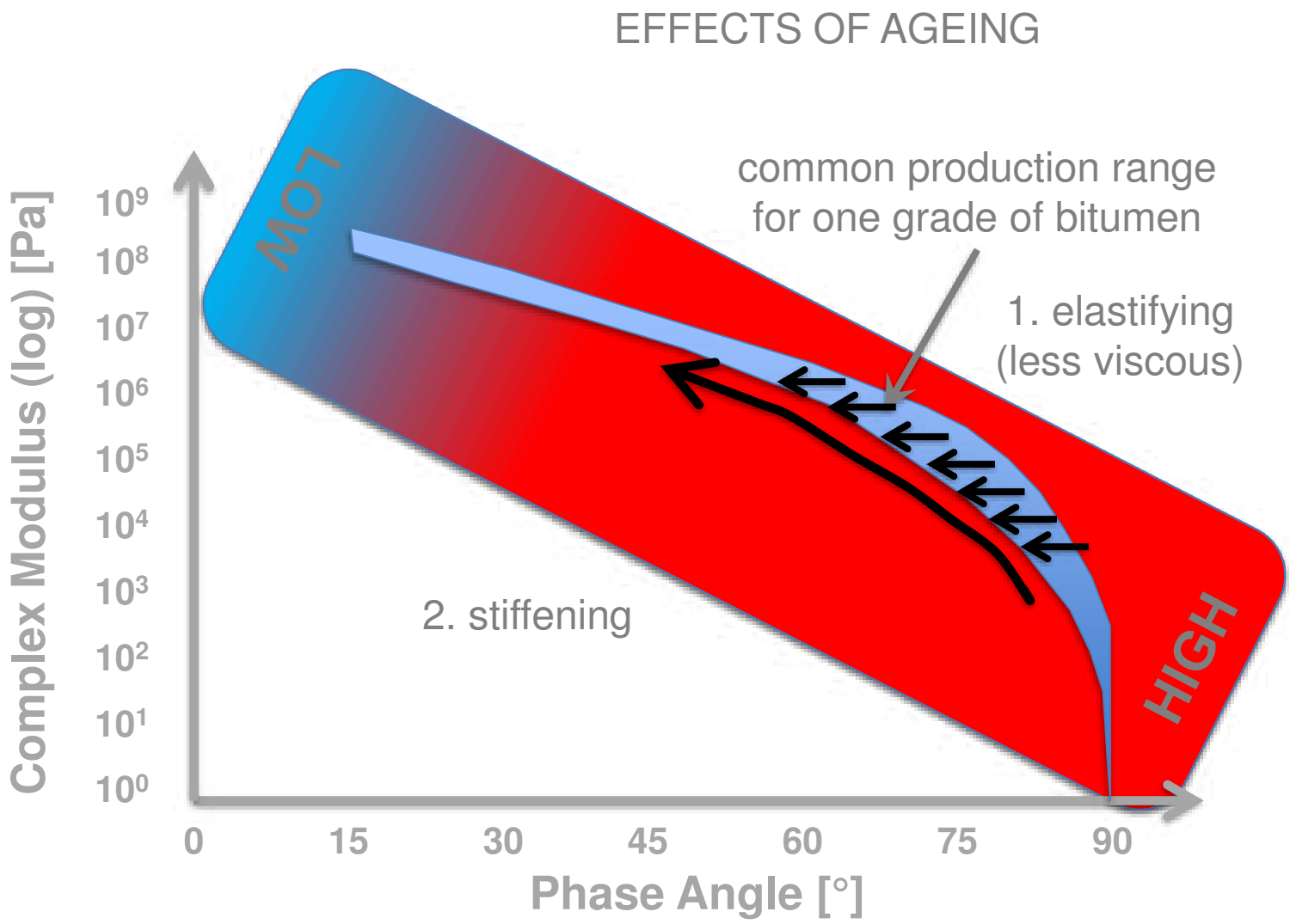
AGEING IN FORMER TIMES

Variety of Rejuvenators



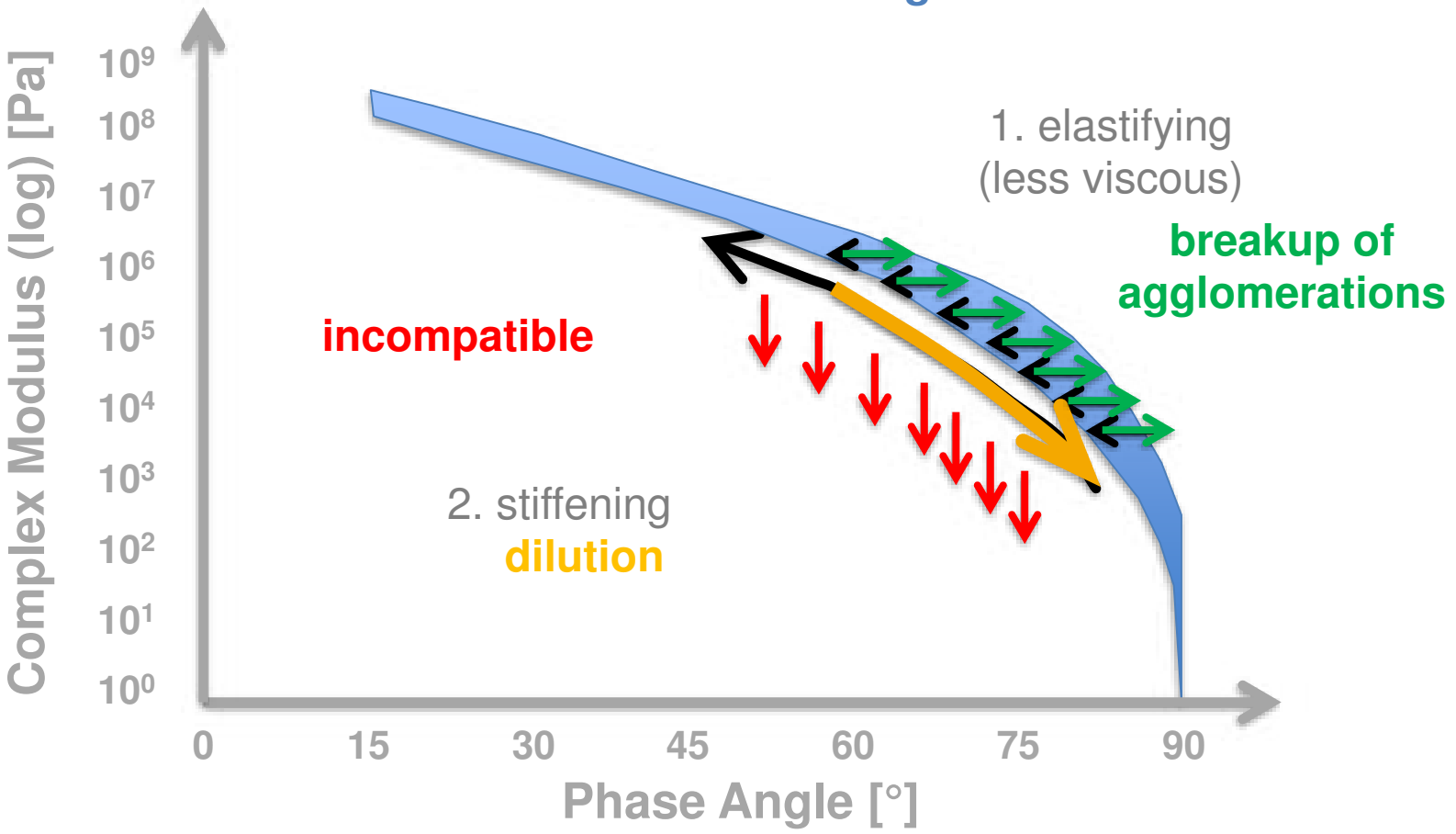
AGEING TODAY



AGEING TODAY

EFFECTS OF REJUVENATION

There is no healing for oxidation.

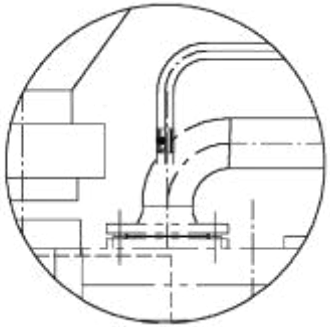


EQUIPMENT CHALLENGES

What is the right amount of dosing?

What is the right way of dosing?

— onto the RAP pile
— into the bitumen tank
— directly to the pug mill
— into the parallel drum
— inline to the bitumen
— …?



Pictures:
Arizona Chemicals
Amman Group
Benninghoven

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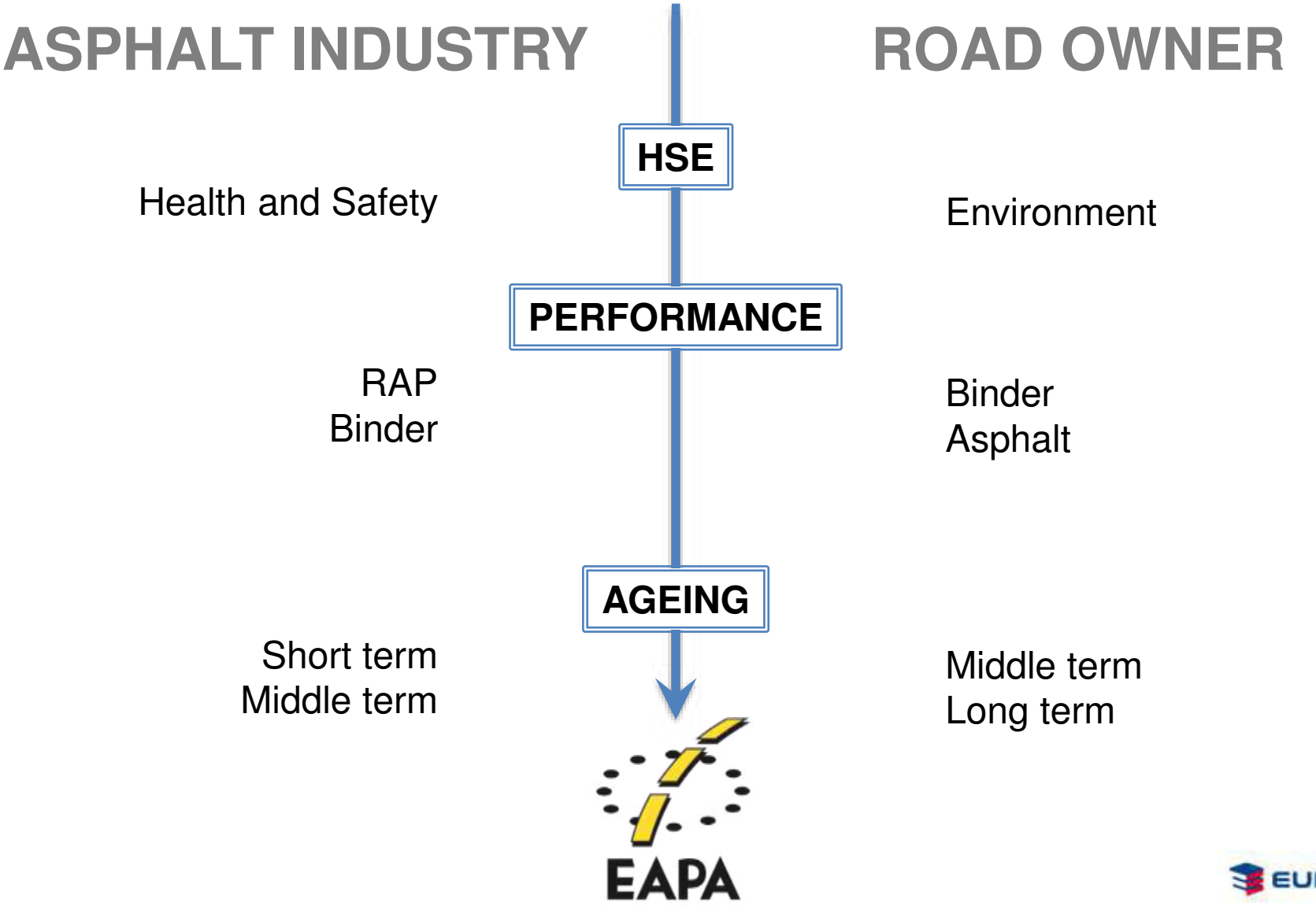
FUTURE SPECIFICATIONS



THANKS FOR YOUR ATTENTION