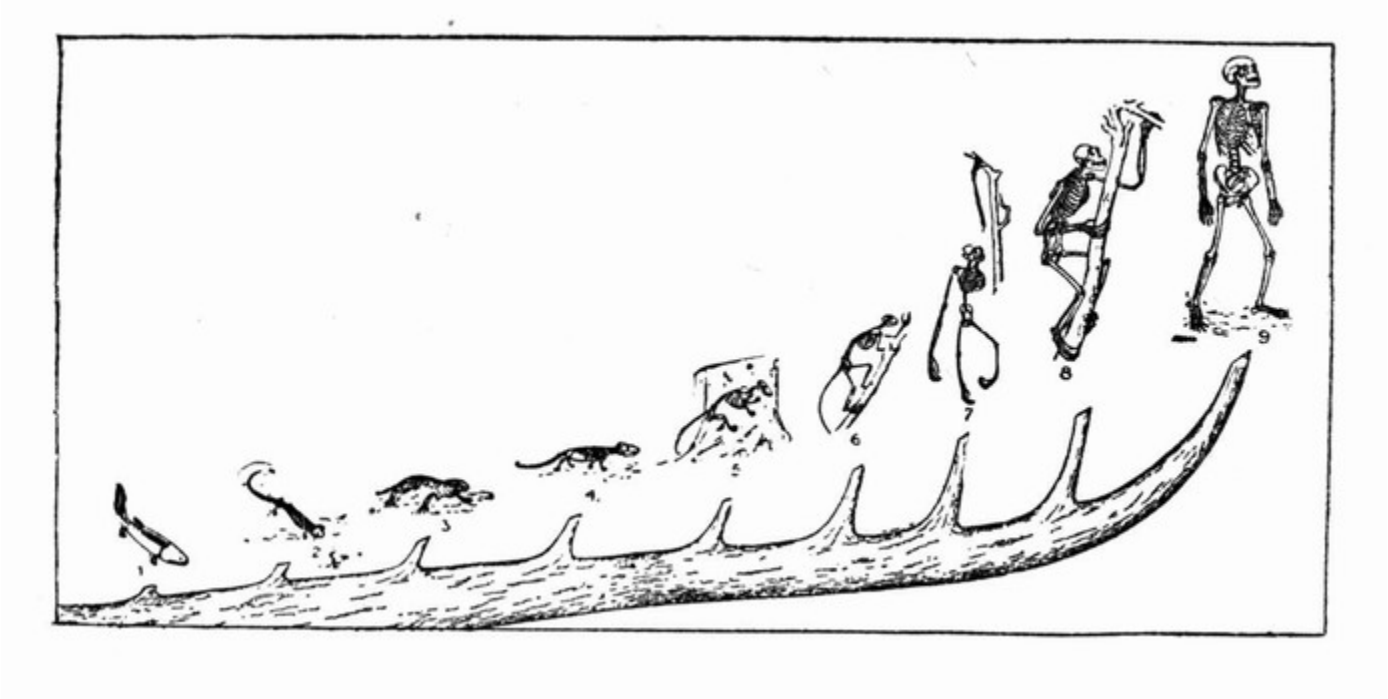
Treatise of the quantification of sustainability and pavements in The Lowlands - *LCA and the bidding process*



Joep Meijer, CEO The Right Environment

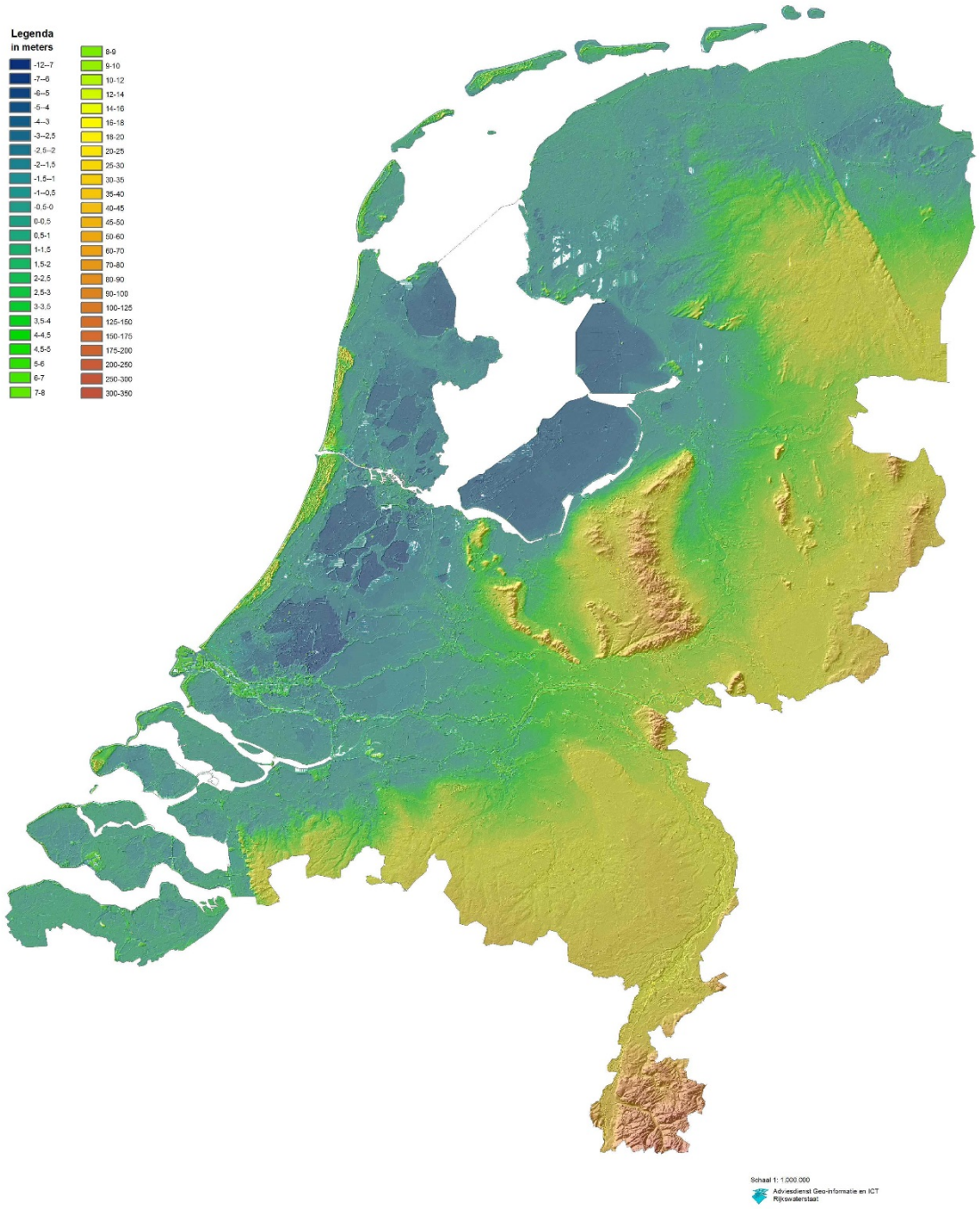

FRIESLAND
NOORD-HOLLAND
DRENTHE
Amsterdam
FLEVOLAND
ZUID-HOLLAND
UTRECHT
OVERIJSSEL
GELDERLAND
ZEELAND
NOORD-BRABANT
Duitsland
LIMBURG
België


NETHER
Amsterda
Middelbu
UTREC


Arnhem 20
Apeldoorn 35
Zwolle 76
Doetinchem 48
Utrecht 61
A50


London
Netherland


PANNENKOEKEN
PANNENKOEKEN
PANNENKOEKEN
KEBA


Actueel Hoogtebestand Nederland (AHN)
met reliëf-schaduwwerking
Legenda
in meters
-12--7
-7--6
-6--5
-5--4
-4--3
-3--2,5
-2,5--2
-2--1,5
-1,5--1
-1--0,5
-0,5-0
0-0,5
0,5-1
1-1,5
1,5-2
2-2,5
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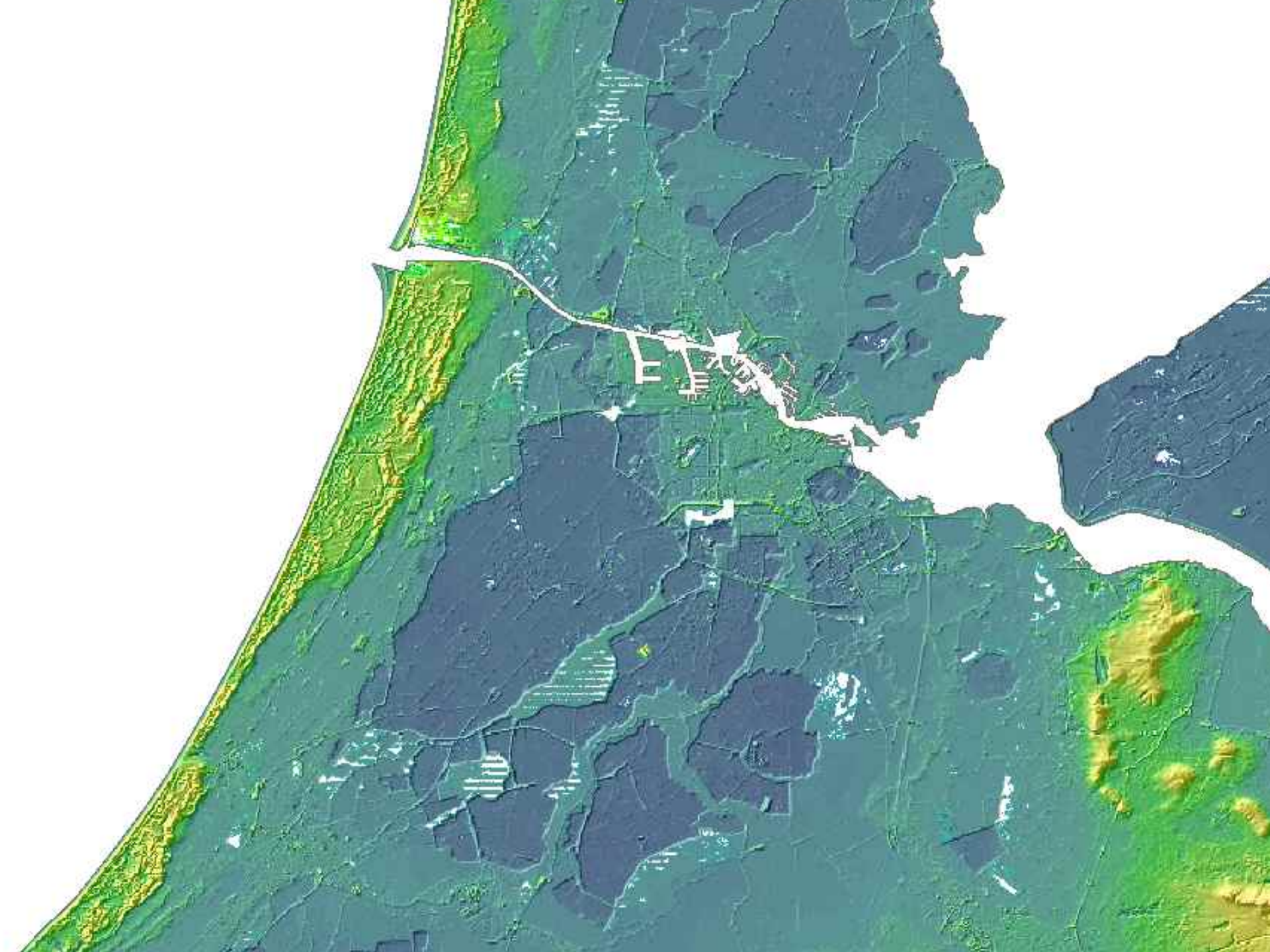
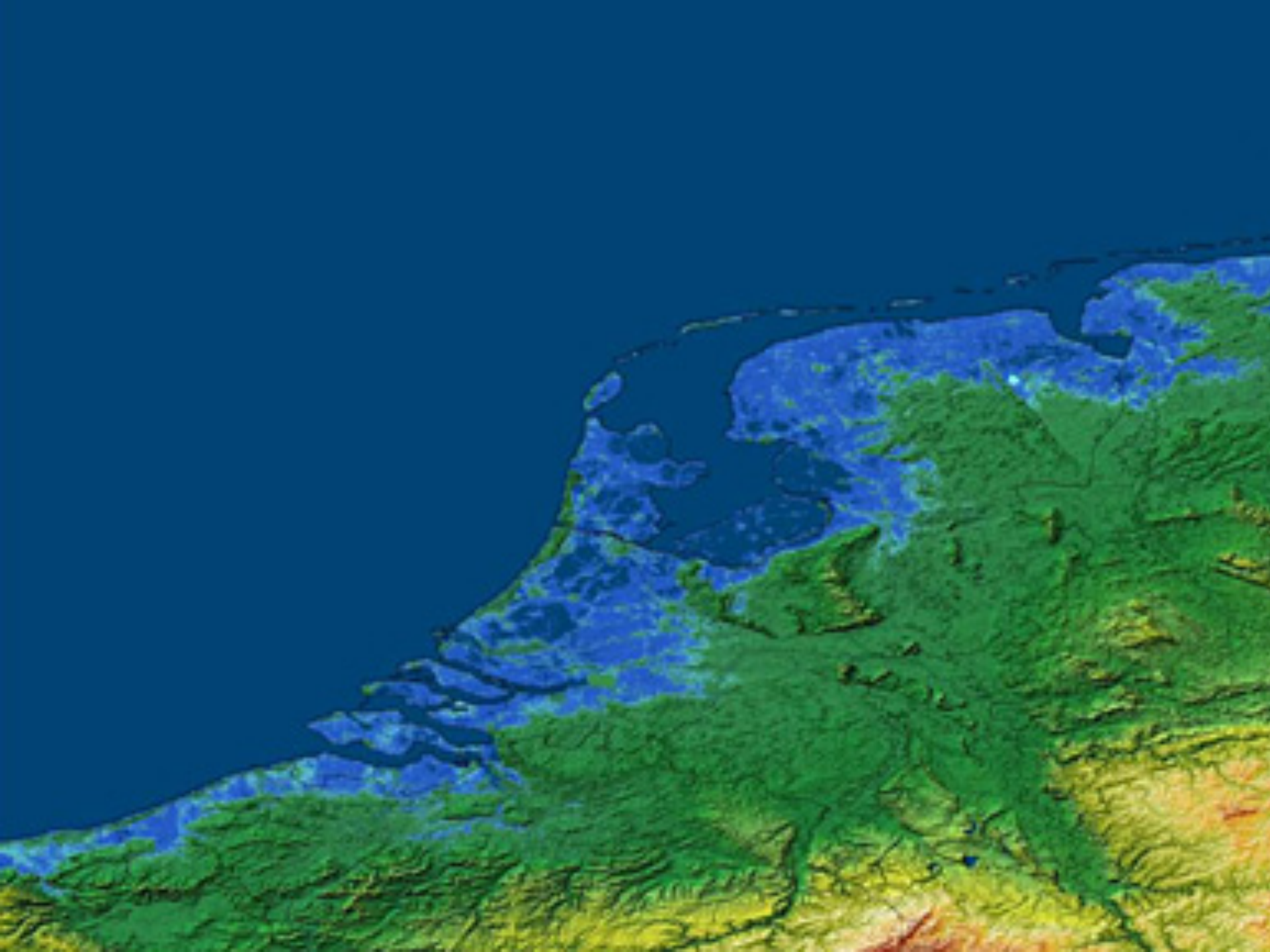
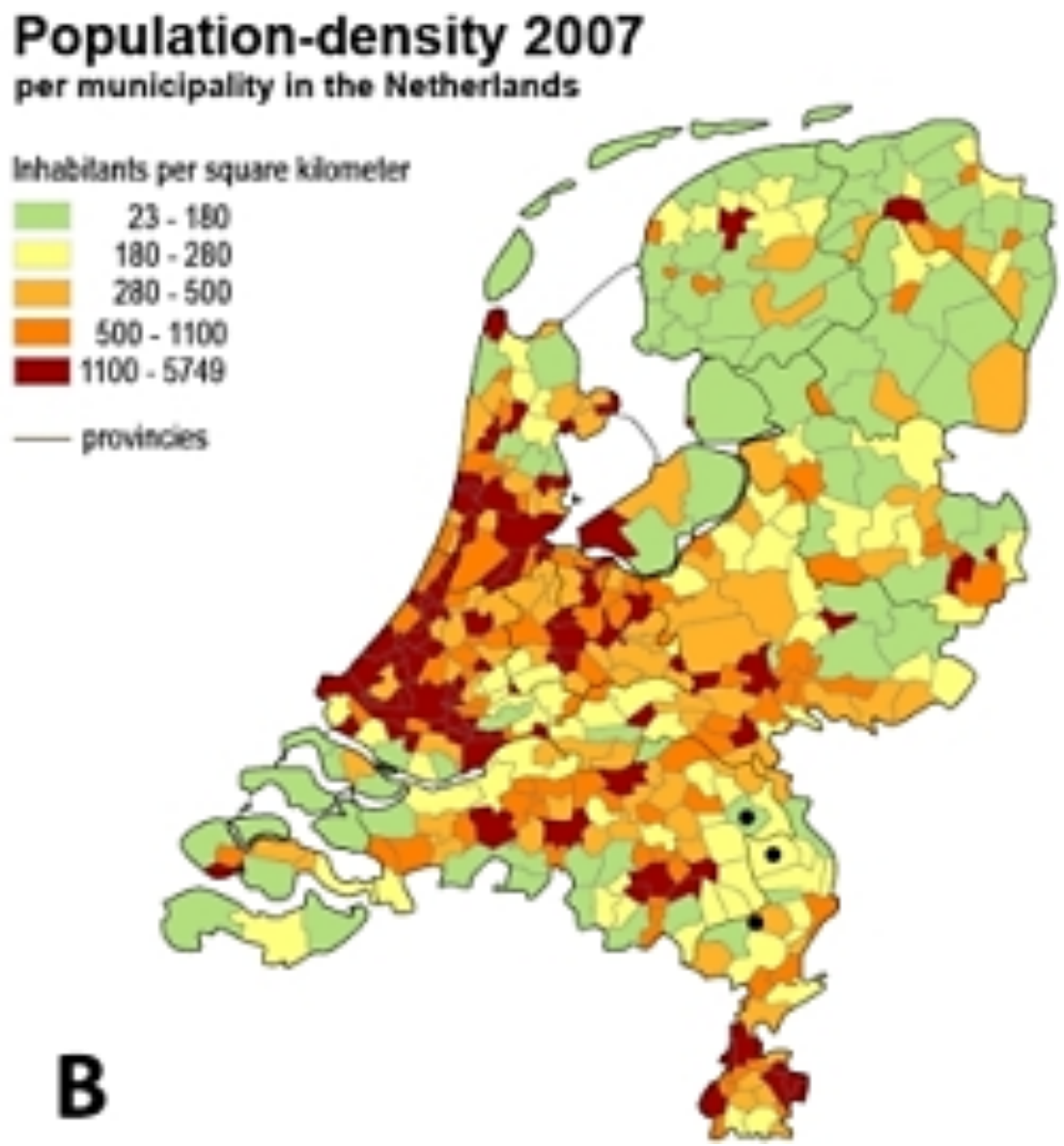
80-90
90-100
100-125
125-150
150-175
175-200
200-250
250-300
300-350
Schaal 1: 1.000.000
Adviesdienst Geo-informatie en ICT
Rijkswaterstaat

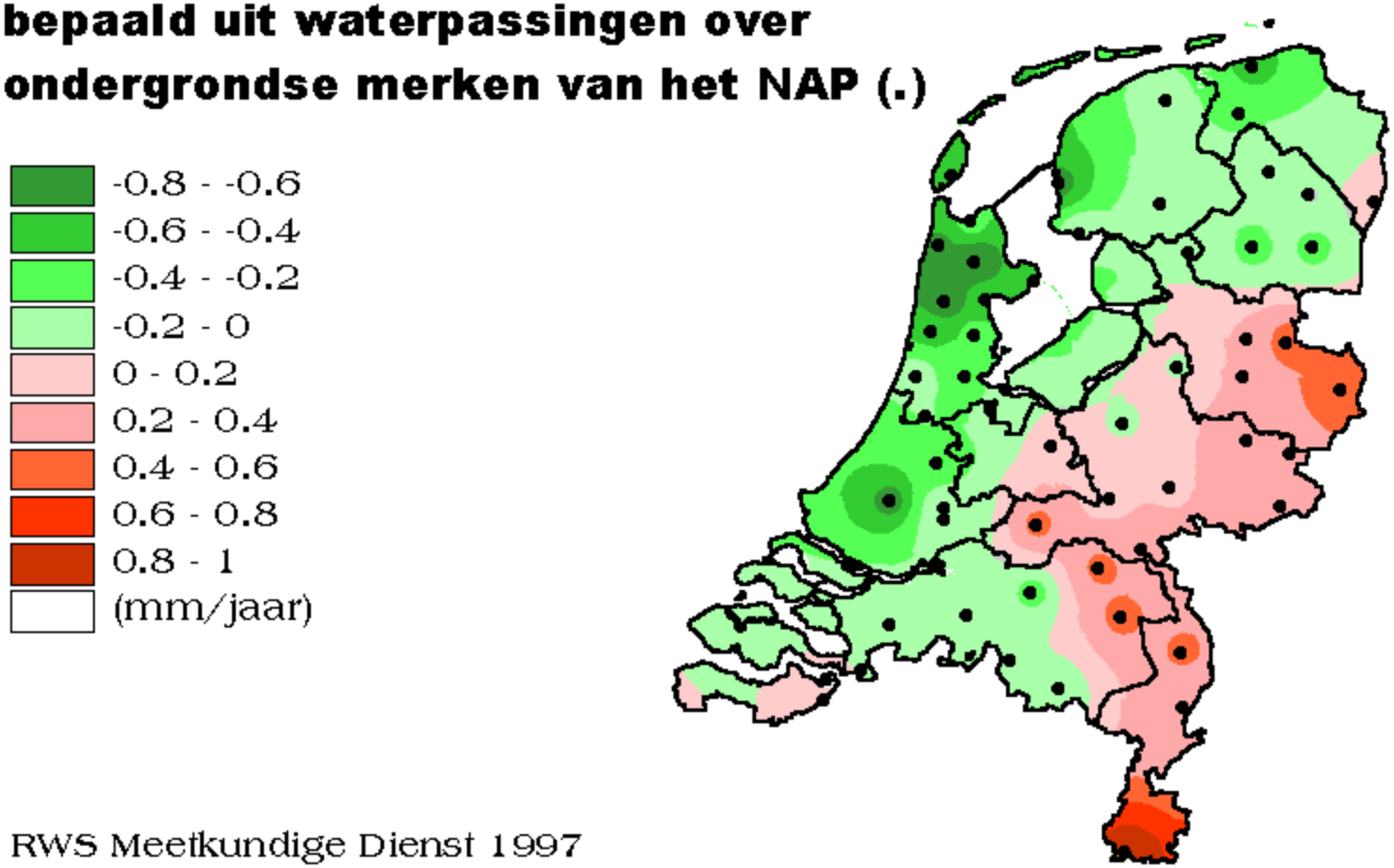






Meijer, LCA and RWS Bidding Process

Vertikale bewegingen Pleistoceen bepaald uit waterpassingen over ondergrondse merken van het NAP (.)



In conclusion

- No foundation, all fluvial sandy soup
- No rock, all import
- Always water concerns
- Movement everywhere
- We all live in the bathtub
- And it is getting worse

But we are smart right?

- Flexible pavements
- Elevated
- Quiet
- Safe
- RAP RAP RAP


Grote Polder
via
Zoeterwoude-Rijndijk
05553/037
ANWB
ma t/m vr
06-19h
km


GOODLOOK
TAXI ADIDON

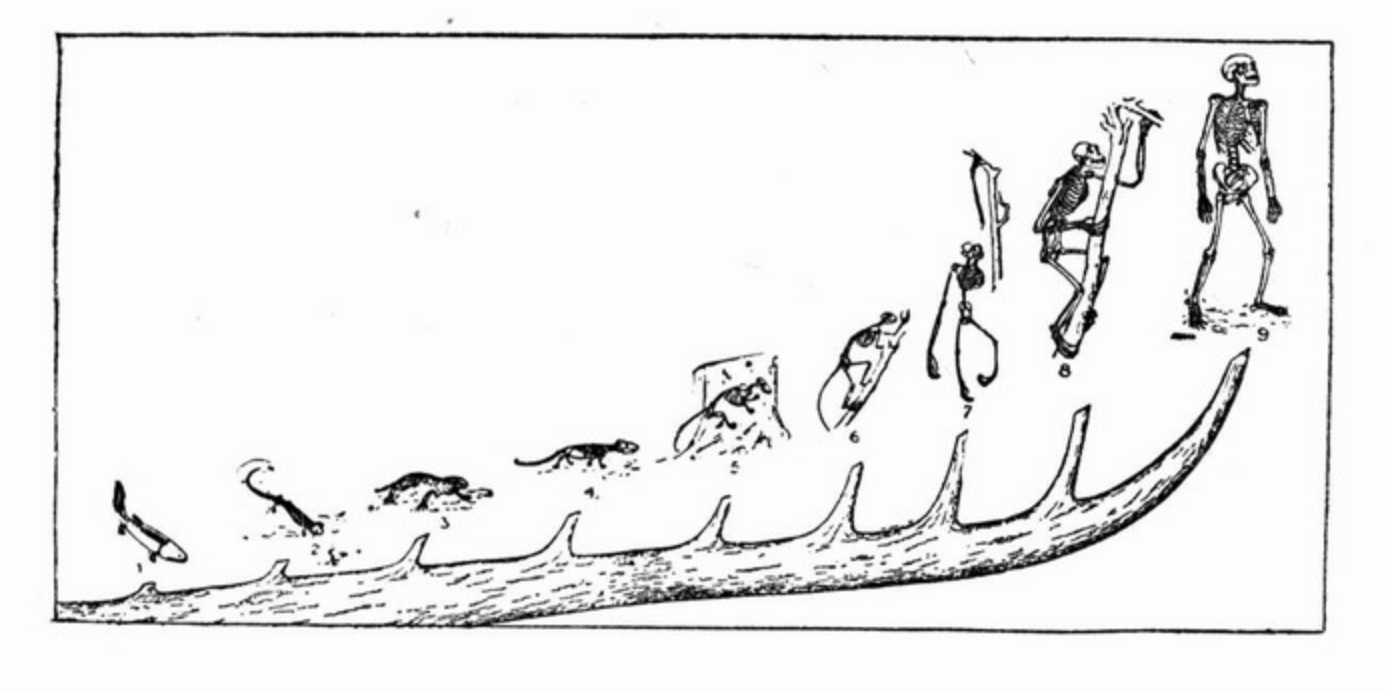
Rijkswaterstaat

- Budget ~ 3.500 MEuro'

- Management main waterways
  - 3,000 km river banks,
  - 150 locks, 17 weirs
- Management of the main motorways
  - > 3,100 km highways, 15 tunnels, numerous bridges, passovers, etcetera
- Management water systems
  - > 63,000 km^2 water (including North Sea)
  - > Coastal management

Dutch LCA experience

- 1990’s
- 2000’s
- 2010’s



Dutch RWS LCA experience

- 1990's
  - Internal Design Selection: Energy analysis for most environmentally friendly alternative (MMA)
  - Exploration of LCA : optimization of preservation of bridges and material selection for river and coastal defense works
  - External invitation to contractors: what is your sustainability approach as part of the bidding process

Dutch RWS LCA experience

- 2000's
  - LCA for materials becoming available
  - National database NMD established
  - National LCA standard NEN8006:2004 published
  - DuboCalc first version: LCA tool for RWS, internal
  - Innovation programs with pilots, invitation
  - Rise of WMA and WAM foam
  - Rise of RAP

Dutch RWS LCA experience

- 2010's
  - DuboCalc for every design and tender
  - EPD requirement (Dutch MRPI)
  - Contractors and suppliers can provide data, all do through associations, some do individually
  - CO_2-performance for operations of contractors
  - Functional performance specifications
  - Green procurement mandatory
  - Contract term boundaries extend into service life
  - Europe: EPDs EN TC350 WG 6

Green Public Procurement

Rijkswaterstaat Approach

GPP2020, Barcelona November 2013

Leendert van Geldermalsen

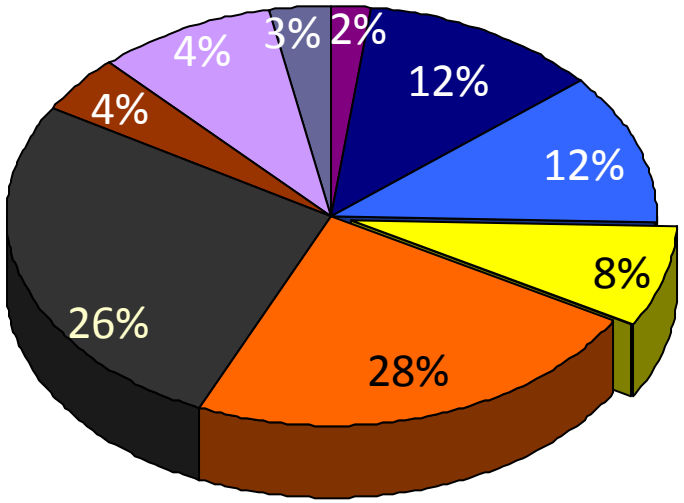
Policy of the Netherlands

- 20 % CO_2 emission reduction in 2020 compared to 1990
- In 2015 all public authorities must apply green procurement on all purchases; 2012 all state agencies

Carbon footprint of Rijkswaterstaat

Total yearly emission is 818 kTonnes CO_2

- Rocks for shore protection
- Inland dredging
- Marine Dredging
- scope 1 and 2 energy use
- Groundworks roadbuilding
- Asphalt
- Road base materials
- Concrete construction
- Steel construction



Meijer, LCA and RWS Bidding Process

Goal of Green Public Procurement

….is….

to use the procurement process to force (or challenge) suppliers and contractors to deliver added value by delivering sustainable products through sustainable working processes and better materials

Focus on:

energy, materials, spatial quality

Boundary conditions:

value for money, life cycle approach

All about the contract

1. Functional Specifications (FS)
   - No specific technology solutions prescribed
2. FS works only with D&C and DBFM contracts
3. Designs evaluated and based on LCC and TCO.
4. National minimum sustainability criteria (types of applications/ materials)
5. Award Most Economically Advantageous Tender (MEAT)
6. Monitized MEAT criteria for sustainability:
   - $C0_2$ Performance ladder
   - DuboCalc

Most Economically Advantageous Tender

Selection based on a combination of bidding price and quality

Procurement procedure:
- the tenderer provides :
  a) the functional specifications
  b) a description of the to be assessed quality aspects
  c) the assessment criteria for the **quality** aspects (SMART)
  d) the calculation procedure to monetize the quality aspects

- the provider submits an offer with:
  a) a description of the solution (e.g. a civil engineering design)
  b) the bidding price
  c) a description of the quality that he promises

- the tenderer
  a) assesses the quality and monetizes the proposed quality
  b) selects the winner by comparing bidding prices minus the monetized quality

monetizing of environmental impacts

Two criteria for the environmental quality of offers will be assessed and monetized:

Performance	**of**	**assessed with**
CO_2 emissions ----------→	working processes	CO_2 performance ladder
Environmental impact----→	the product	DuboCalc

CO_2 performance ladder: what is it?

The CO_2 performance ladder is a tool to assess the efforts of a company to reduce CO_2 emissions caused by the company's activities and processes and grants a rung in ascending order as the efforts are larger.

There are five rungs:

1: The company has identified its energy flows in qualitative terms and has a list of potential options for saving energy and using renewable energy. Internally, the company communicates its policy in relation to energy-saving and renewable energy on an ad hoc basis and is aware of sector and chain-based CO_2 reduction initiatives.

2:The company has quantified its energy flows and formulated a qualitative objective for saving energy and using renewable energy. Internally, the company communicates its energy policy on a structural basis and takes a passive role in at least one sector and chain-based CO_2 reduction initiative.

3:The company has an official CO_2 emissions inventory that has been drawn up in accordance with the ISO (GHG) standard, and which has been verified by an independent organization. The company has quantitative objectives for its own (scope 1 and 2) CO_2 emissions. It communicates – internally and externally – in relation to its CO_2 footprint on a structural basis and actively participates in at least one sector and chain based CO_2 reduction initiative

4:The company has identified its chain emissions in outline terms, and chain analyses have been carried out for two relevant chains. The company has quantitative objectives for its chain emissions. The company is in dialogue with relevant parties (government bodies and social organizations) and can demonstrate its role as the instigator of sector and chain initiatives in the field of CO_2 reductions.

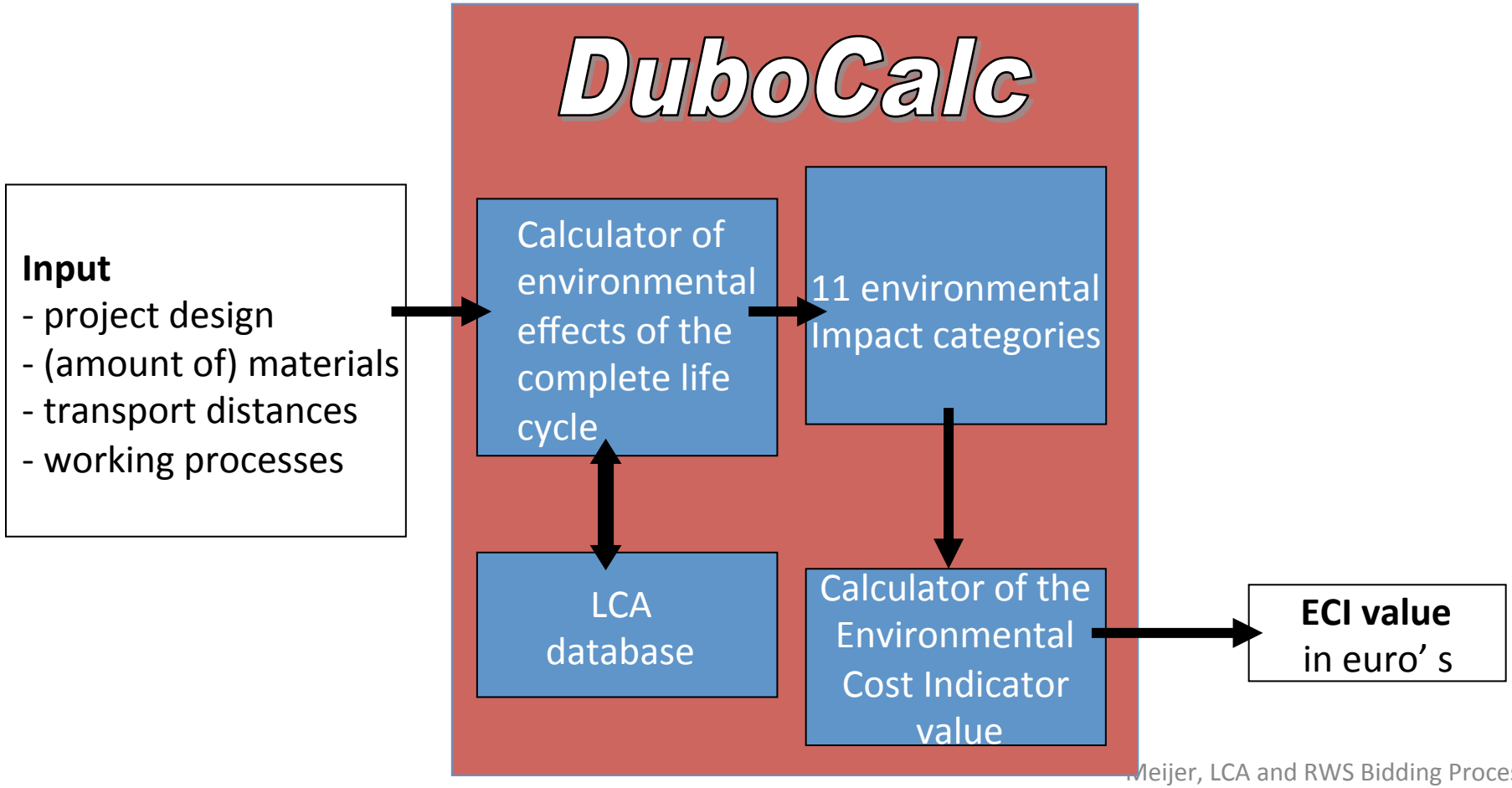
5:The company has a CO_2 emissions inventory of its most important suppliers. The company can demonstrate that the objectives for levels 3 and 4 have been attained. The company is publicly committed to a government or NGO CO_2 reduction program and is able to demonstrate that it is making a relevant contribution to an innovative CO_2 reduction project.

CO_2 performance ladder: how is it used?

- The bidder chooses the level of ambition (rung 1, 2, 3, 4 or 5)
- each rung yields 1% reduction of the submission price
- RWS assesses MEAT quality criteria and calculates the corrected bidding price and selects the winner
- The measures corresponding to the ambition of the winner become performance requirements of the contract
- The contractor shows that the performance is delivered

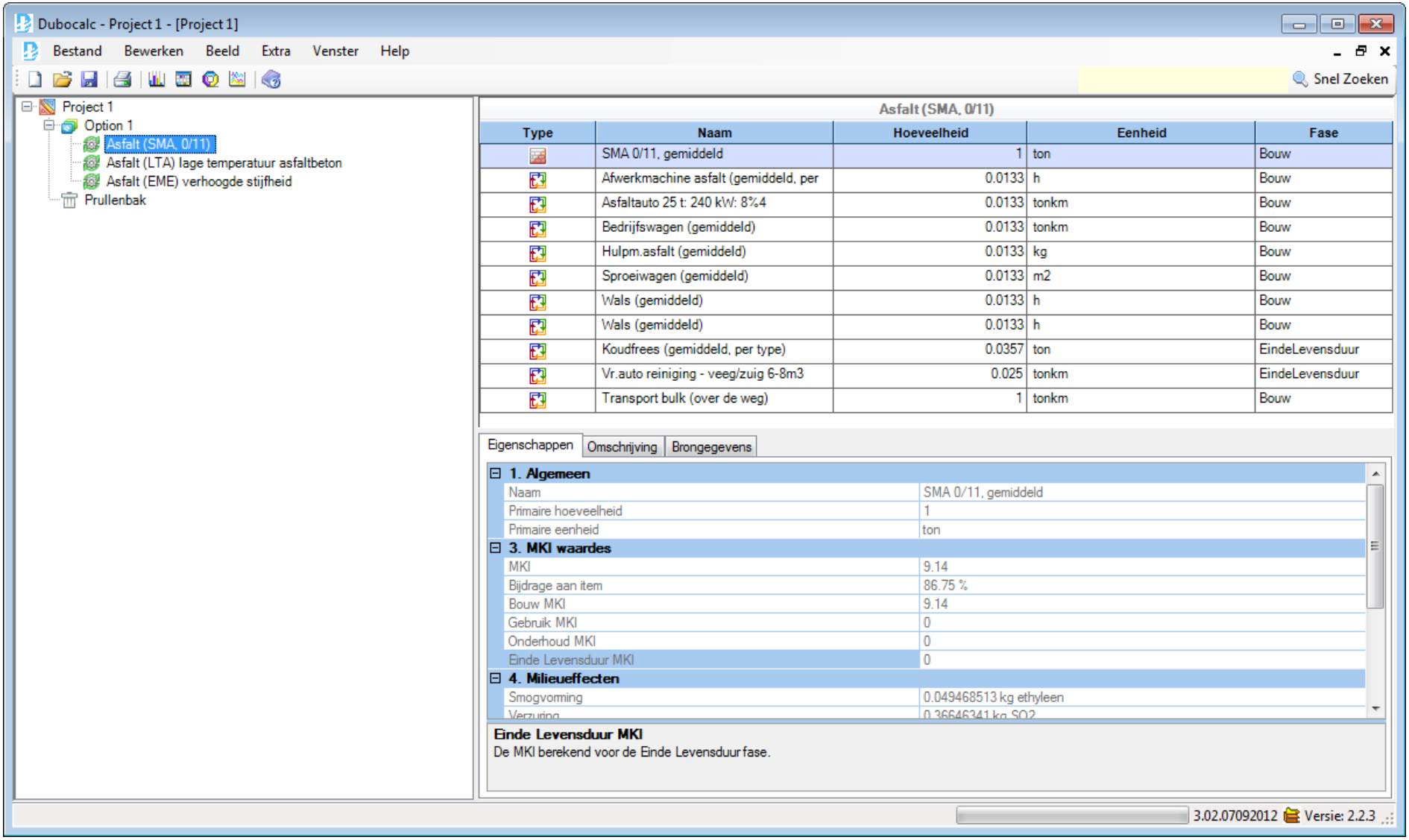
DuboCalc: what is it?

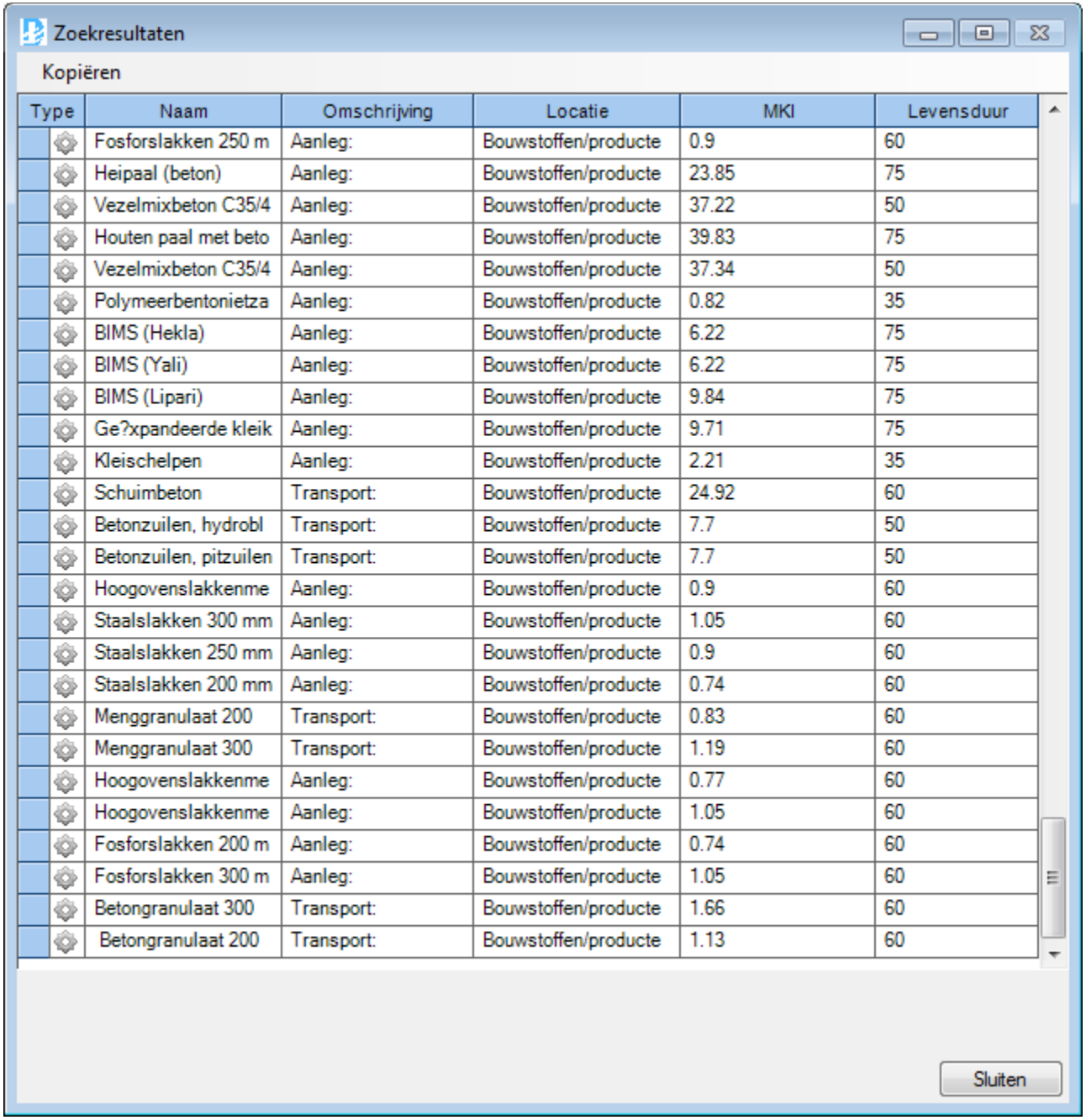
DuboCalc is a tool to assess and monetize environmental impacts of a product/design based on life cycle analysis



Optimization with DuboCalc based on….

- Design and construction
  - Material choice, material quantities and transport distance
- Use
  - Energy use of the civil work
- Maintenance
  - Lifespan and replacements


Dubocalc - Project 1 - [Project 1]
Bestand
Bewerken
Beeld
Extra
Venster
Help
Snel Zoeken
Project 1
Option 1
Asfalt (SMA, 0/11)
Asfalt (LTA) lage temperatuur asfaltbeton
Asfalt (EME) verhoogde stijfheid
Prullenbak
Asfalt (SMA, 0/11)
Type
Naam
Hoeveelheid
Eenheid
Fase
SMA 0/11, gemiddeld 1 ton Bouw
Afwerkmachine asfalt (gemiddeld, per 0.0133 h Bouw
Asfaltauto 25 t: 240 kW: 8%4 0.0133 tonkm Bouw
Bedrijfswagen (gemiddeld) 0.0133 tonkm Bouw
Hulpm.asfalt (gemiddeld) 0.0133 kg Bouw
Sproeiwagen (gemiddeld) 0.0133 m2 Bouw
Wals (gemiddeld) 0.0133 h Bouw
Wals (gemiddeld) 0.0133 h Bouw
Koudfrees (gemiddeld, per type) 0.0357 ton EindeLevensduur
Vr.auto reiniging - veeg/zuig 6-8m3 0.025 tonkm EindeLevensduur
Transport bulk (over de weg) 1 tonkm Bouw
Eigenschappen
Omschrijving
Brongegevens
1. Algemeen
Naam SMA 0/11, gemiddeld
Primaire hoeveelheid 1
Primaire eenheid ton
3. MKI waardes
MKI 9.14
Bijdrage aan item 86.75 %
Bouw MKI 9.14
Gebruik MKI 0
Onderhoud MKI 0
Einde Levensduur MKI 0
4. Milieueffecten
Smogvorming 0.049468513 kg ethyleen
Einde Levensduur MKI
De MKI berekend voor de Einde Levensduur fase.
3.02.07092012
Versie: 2.2.3



Type	Naam	Omschrijving	Locatie	MKI	Levensduur
	Fosforslakken 250 m	Aanleg:	Bouwstoffen/producte	0.9	60
	Heipaal (beton)	Aanleg:	Bouwstoffen/producte	23.85	75
	Vezelmixbeton C35/4	Aanleg:	Bouwstoffen/producte	37.22	50
	Houten paal met beto	Aanleg:	Bouwstoffen/producte	39.83	75
	Vezelmixbeton C35/4	Aanleg:	Bouwstoffen/producte	37.34	50
	Polymeerbentonietza	Aanleg:	Bouwstoffen/producte	0.82	35
	BIMS (Hekla)	Aanleg:	Bouwstoffen/producte	6.22	75
	BIMS (Yali)	Aanleg:	Bouwstoffen/producte	6.22	75
	BIMS (Lipari)	Aanleg:	Bouwstoffen/producte	9.84	75
	Ge?xpandeerde kleik	Aanleg:	Bouwstoffen/producte	9.71	75
	Kleischelpen	Aanleg:	Bouwstoffen/producte	2.21	35
	Schuimbeton	Transport:	Bouwstoffen/producte	24.92	60
	Betonzuilen, hydrobl	Transport:	Bouwstoffen/producte	7.7	50
	Betonzuilen, pitzuilen	Transport:	Bouwstoffen/producte	7.7	50
	Hoogovenslakkenme	Aanleg:	Bouwstoffen/producte	0.9	60
	Staalslakken 300 mm	Aanleg:	Bouwstoffen/producte	1.05	60
	Staalslakken 250 mm	Aanleg:	Bouwstoffen/producte	0.9	60
	Staalslakken 200 mm	Aanleg:	Bouwstoffen/producte	0.74	60
	Menggranulaat 200	Transport:	Bouwstoffen/producte	0.83	60
	Menggranulaat 300	Transport:	Bouwstoffen/producte	1.19	60
	Hoogovenslakkenme	Aanleg:	Bouwstoffen/producte	0.77	60
	Hoogovenslakkenme	Aanleg:	Bouwstoffen/producte	1.05	60
	Fosforslakken 200 m	Aanleg:	Bouwstoffen/producte	0.74	60
	Fosforslakken 300 m	Aanleg:	Bouwstoffen/producte	1.05	60
	Betongranulaat 300	Transport:	Bouwstoffen/producte	1.66	60
	Betongranulaat 200	Transport:	Bouwstoffen/producte	1.13	60

The 11 environmental parameters of DuboCalc

- Global warming
- Ozone layer depletion
- Human toxicity
- Fresh water ecotoxicity
- Marine ecotoxicity
- Terrestrial ecotoxicity
- Photochemical oxidation
- Abiotic depletion
- Depletion of fossil energy carriers
- Eutrophication
- Acidification

Damage ($) per parameter

Environmental parameter	Equivalent unit	Amount	Price [€/unit]	Costs [€]
• Climate change	CO_2 eq	5,8 eq	€ 0,05	€ 0,29
• Ozonlaagaantasting	CFK-11 eq	etc	€ 30,--	etc
• Humane toxiciteit	1,4-DCB eq		€ 0,09	
• Ecotoxiciteit, aquatisch (zoetwater)	1,4-DCB eq		€ 0,03	
• Ecotoxiciteit, aquatisch (zoutwater)	1,4-DCB eq		€ 0,0001	
• Ecotoxiciteit, terrestrisch	1,4-DCB eq		€ 0,06	
• Fotochemische oxidantvorming (smog)	C_2H_2 eq		€ 2,--	
• Verzuring	SO_2 eq		€ 4,--	
• Vermesting	PO_4 eq		€ 9,--	
• Uitputting van abiotische grondstoffen	Sb eq		€ 0,16	
• Uitputting van fossiele energiedragers	Sb eq		€ 0,16	
Total ECI value				sum

DuboCalc

- MKI and environmental impact categories
- Per material and process
- Life cycle data assigned to material
- Based on National database
- Abundance of secondary resources
- Simple project evaluation based on material list

DuboCalc: how can it used

1) Process requirement: optimized design
2) Optimization and verification
3) Minimum requirement (ECI-value).
4) Award aspect in MEAT. Lowest combined bid value and MEAT value

DuboCalc: how is it used

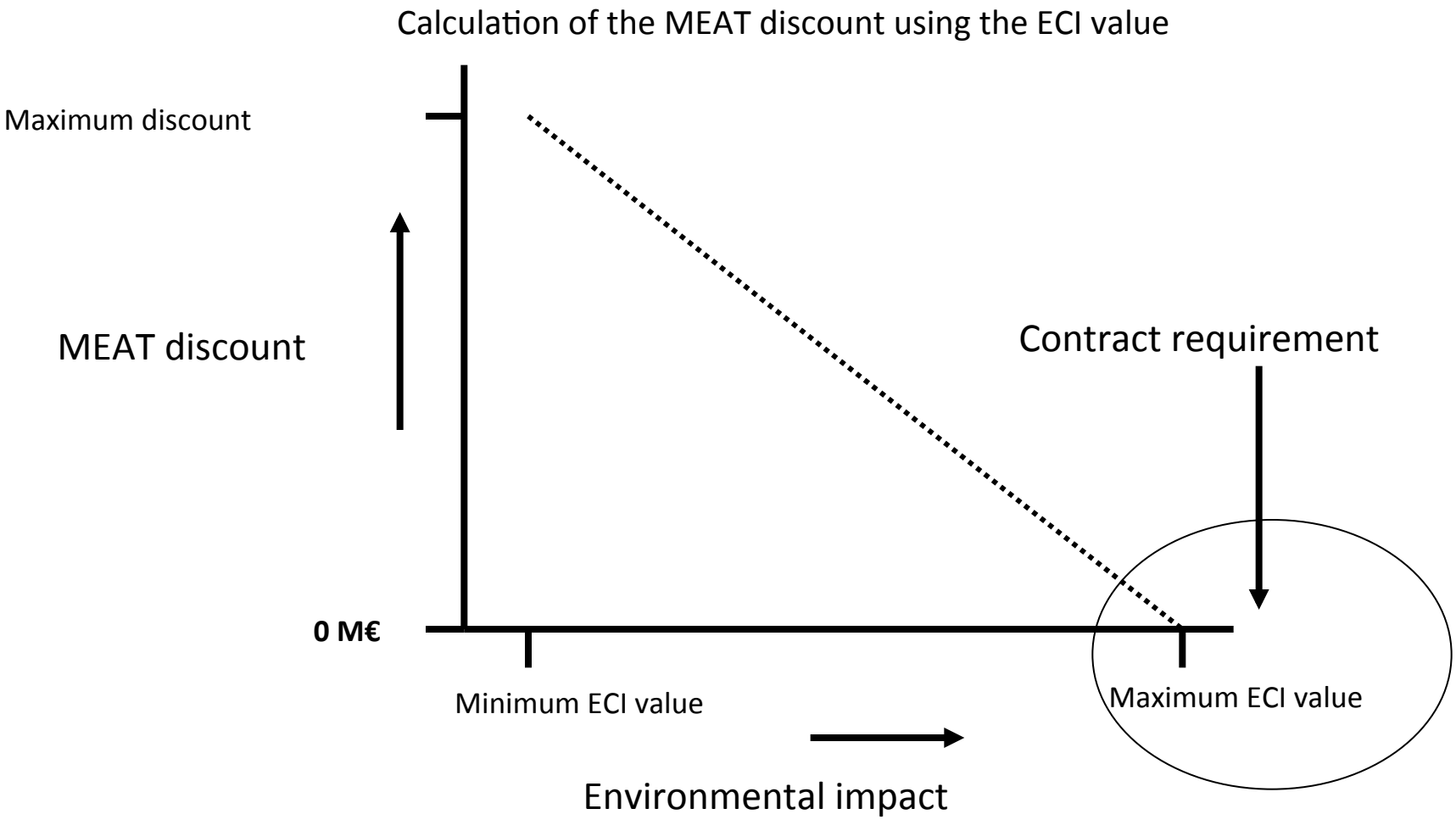
… in the procurement procedure:

- the tenderer provides :
  a) the functional specifications including a maximum ECI value
  b) the DuboCalc assessment tool
  c) a description of how to use DuboCalc as a design tool
  d) the calculation procedure to monetize the ECI value

- the provider submits an offer with:
  a) a description of the solution (e.g. a civil engineering design) which is optimized using DuboCalc as a design tool
  b) the bidding price
  c) the ECI value that is calculated with DuboCalc

- the tenderer
  a) monetizes the ECI value as described in the tender document
  b) selects the winner by comparing bidding prices minus the monetized ECI value

DuboCalc: how is it used



Meijer, LCA and RWS Bidding Process

Calculation of the corrected bidding price

Bidder

- offers the CO_2 pl rung and ECI value,
- Reports this when registering

Provider

- Compares the biddings as follows:

(Bidding price) – (%bidding advantage CO_2 pl rung) –

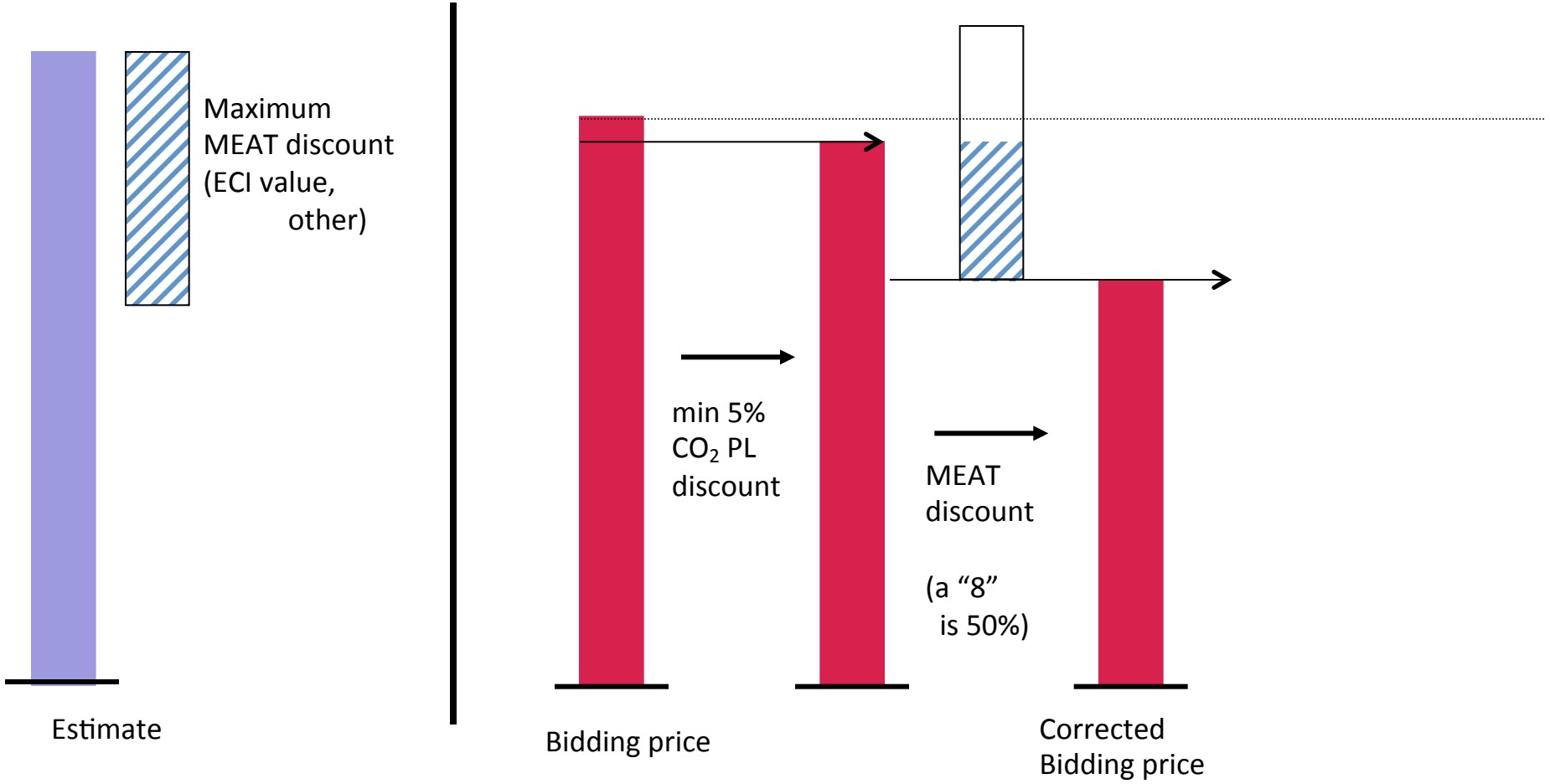
(MEAT ECI value) – (other MEAT-values) = **Corrected Bidding Price**

The project is awarded to the bidder with the lowest Corrected Bidding Price

CO_2 pl and ECI value become contract requirements

- CO_2 Awareness certificate to be shown after a year
- ECI value to be shown at delivery

Estimate, Bidding price, CO_2 PL-advantage, MEAT en Selection



DuboCalc in 2011 en 2012 in 5 projects

• Maasvlakte – Vaanplein	1.100 M€
• Lunetten - Veenendaal (A12)	210 M€
• Rearranging Channel Zuidwillemsvaart	200 M€
• 'Haak' around Leeuwarden South	65 M€
• Renovation N61 Hoek – Schoondijke	60 M€

Example: Renovation N61 Hoek - Schoondijke

Example Renovation N61 Hoek - Schoondijke

Example Renovation N61 Hoek - Schoondijke

Example Renovation N61 Hoek Schoondijke

Example Renovation N61 Hoek Schoondijke

Example Renovation N61 Hoek Schoondijke

Example Renovation N61 Hoek Schoondijke

Project	Dijkversterkingen Zeeland
Werkzaamheden	Maart - november 2012 (Stavenissepolder) Maart - november 2013 (Sint Philipsland) Maart - november 2013 (Krabbendijke)
Contractvorm	Engineering & Construct (E&C)
Gebruikte duurzaamheidsinstrument	DuboCalc en CO_2-Prestatieladder
Resultaat duurzaamheid	• Toepassing innovatieve dijkbekleding met 30 procent minder beton (Stavenissepolder) • 50 procent betere milieuprestatie betonzuilen (Sint Philipsland en Krabbendijke)

Example Renovation N61 Hoek Schoondijke

Object	**Scope**
Road pavement -foundation -interlayers -top layer	-All new pavement constructions (from foundation to top layer) within the limits of the N61 system - Removal of pavement material with destination outside the limits of the N61 system
Earth moving	To deliver volumes of sand/soil and remove volumes of raw material within the limits of the N61 system with origin and destination outside the limits of N61 system
Protection rail system	To build all new protection rail system within the limits of the N61 system
Lighting	Installations of all Public Lighting Of all 6 roundabouts as defined in the component specification for Public Lighting

Example Renovation N61 Hoek Schoondijke

Estimated building costs: **60 million euro's**

MEAT criteria in tender document

Criterium	**Subcriterium**	**Maximum quality value (€)**
1. External affairs management	1.1 Hindrance and traffic flow 1.2 Vulnerable traffic participants 1.3 Planning and phasing	**4 million** **3 million** **3 million**
2. Sustainability	Environmental quality (ECI value (DuboCalc)	**2 million**

Example Renovation N61 Hoek Schoondijke

By the numbers…

Total amount intended for the project		M€ 110 (includes purchase of land, et cetera)
Estimate for civil constructions	M€ 60	
Maximum MEAT amount	M€ 2	
Other MEAT amounts	M€ 8	

Upper level ECI value	M€	8 (MEAT-amount M€ 0)
Lower level ECI value	M€	6 (MEAT amount M€ 2)

Maximum added sustainable value	M€	2
[the part contributed by the CO_2	M€	0,8 (= 15,8 kiloton CO_2)]

<u>The Winner</u>		
The Bidding Price of the Winner :	M€	55
CO_2 PL discount of the Winner 5%	M€	2,75
ECI value is M€ 6,5 -> the discount	M€	1,5
Other MEAT discounts	M€	5

Corrected bidding price	M€	45,75

Results N61 CO_2-PL and DuboCalc

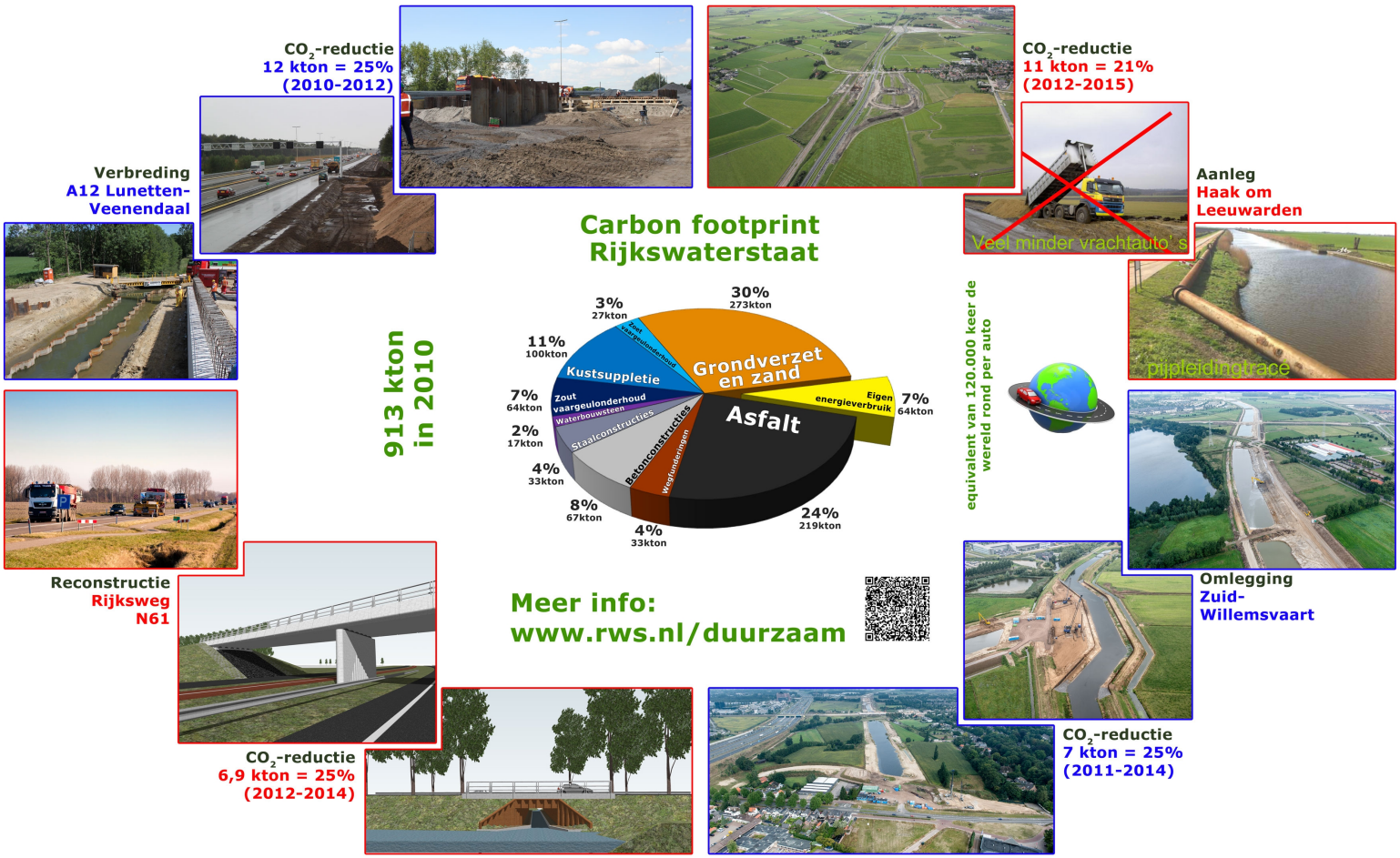
Bid	% value of CO_2-PL	EMVI-DuboCalc (€)
1	5	2,0 M€ (MKI=6,0 M€)
2	5	2,0 M€ (MKI= 6,0 M€)
3	5	1,71 M€ (MKI= 6,29 M€)
4	5	1,49 M€ (MKI= 6,51 M€)
5	5	2,0 M€ (MKI = 6,0 M€)
6	5	2,0 M€ (MKI = 6,0 M€)

Project	Reconstructie N50 tussen Ramspol en Ens, waaronder aanleg nieuwe Ramspolbrug
Start werkzaamheden	Juni 2011
Einde werkzaamheden	Januari 2014
Contractvorm	Design & Construct (D&C)
Gebruikte duurzaamheidsinstrument	Functionele eis
Resultaat duurzaamheid	Energieneutrale brug

Project	Wegverbreding A12 tussen Lunetten en Veenendaal
Start werkzaamheden	Januari 2011
Einde werkzaamheden	Augustus 2013
Contractvorm	Design, Build, Finance & Maintain (DBFM)
Gebruikte duurzaamheidsinstrument	DuboCalc
Resultaat duurzaamheid	25 procent betere milieuprestatie ten opzichte van conventioneel ontwerp

10-10 DAG VAN DE DUURZAAMHEID

DIT DOET RIJKSWATERSTAAT IN PROJECTEN



Meijer, LCA and RWS Bidding Process

Lessons learned : DuboCalc…

- presents the project manager quantified emission reductions
- should be applied to larger and more important projects, where it leads to more significant results.
- is useful for the contracting authority to improve the quality of the terms and conditions of the contract
- requires expertise (environment, materials and civil engineering) and customization, improper use inevitably can lead to failure
- is only useful provided there is a design stage
- as a MEAT criterion challenges the market to design better
- when used by RWS and other contracting authorities, creates innovation and cost reductions for the market

User experience

Bidders were not put off by being asked to use the DuboCalc software, in fact many expressed eagerness and enthusiasm to apply the tool.

RWS received feedback that it was an ‘eye opener’ for some designers to realize that DuboCalc leads to better designs, not only from an environmental point of view, but also in terms of cost reductions.

Duurzaam GWW

Green Deal Duurzaam GWW

- Rijkswaterstaat
- ProRail
- Defensie
- DLG (EL&I)
- Waterschappen (HD, RL)
- Provincie Gelderland
- Gemeente Rotterdam
- I&M Directie Duurzaamheid
- Agentschap NL
- Bouwend Nederland
- NL ingenieurs
- CROW
- SBRCUR
- MKB infra
- Uneto-VNI

Duurzaam GWW

Starting points Green Deal Duurzaam GWW

- Integrate from the start of the planning process
- Focus on where most gains can be made (Quality)
- Room for innovation using performance vs prescriptive approach
- Use a commonly agreed and consistently applied set of tools

Information

- CO_2 Performance Ladder
  www.SKAO.nl

- DuboCalc
  www.Rijkswaterstaat.nl/Duurzaam/duurzaaminkopen

  An English introduction:
  http://www.youtube.com/watch?v=cAaL4FfBQNc

  Instructions for use of DuboCalc:
  http://www.youtube.com/watch?v=LJY9QzxlW2w&feature=related


Questions?