

**French Institute
of Science and Technology
for Transport, Development
and Networks**



LCE4ROADS: a new certification system for sustainable roads

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www.lce4roads.eu



IFSTTAR

Introduction

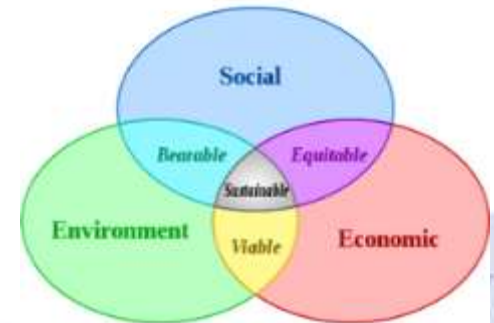
- Several existing assessment system
- Certification (Green Public Procurement): criteria for design, construction and maintenance phases

BUT

- Not covering all phases (use, end of life)
- Not covering all pillars of sustainability

- Barriers to implementation:

- No standards/ regulations (CEN TC350)
- Regional peculiarities
- Road authorities do not like to compare roads
- Costs



Consortium « LCE4ROADS »

Acciona (coordinator)

BASt

CIRCE

Chalmers

ERF

FEHRL

IECA

IFSTTAR

(+ CEREMA Lyon, ECN)

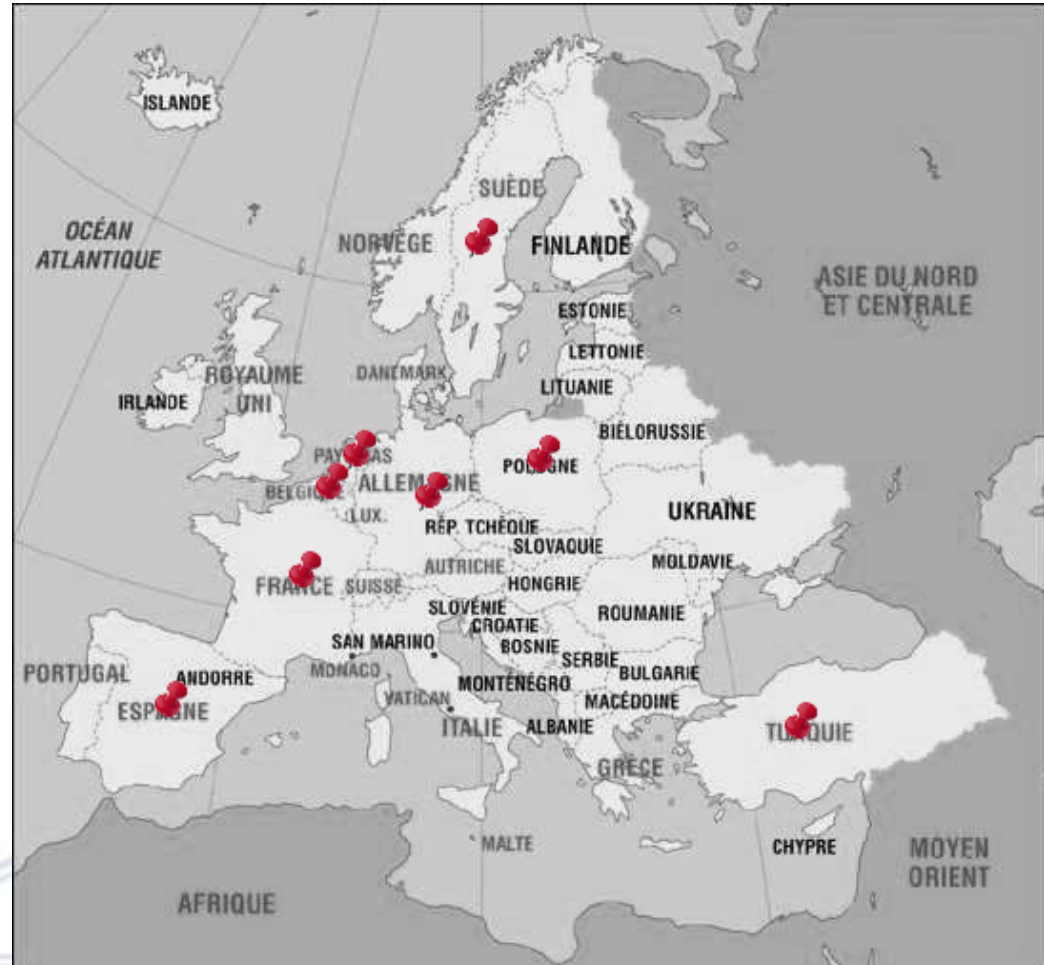
TNO

KGM

AENOR

INVESTTEKO

NAPE SA



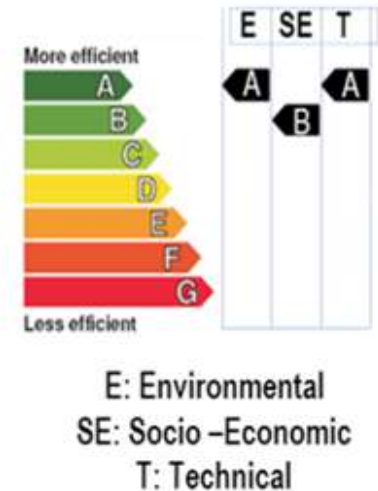
Objectives of LCE4ROADS

Development of a European certification for road infrastructures

Definition of a methodology and key performances indicators based on Life Cycle Assessment approach and existing standards (ISO, EN)

Development of a certification tool and validation on case studies from various European countries

Proposal of guidelines and contribution to European standardization



Framework

- Roads (bridges/tunnels) and consideration of regional peculiarities

Targets

➤ TEN-T network or similar road types

➤ Support GPP

3 moments for the complete/ « light » certification for new/ repaired roads

1. Before construction
2. After construction
3. During use phase (periodicity defined by NRAs)

Phases

- Planning
- Design
- Construction
- Operation
- Maintenance
- End of Life

Domains/Sust. pillars

- Technical
- Environmental
- Social
- Economical

Indicators (1/2)

- Accepted at international level
- Green public procurement
- ISO Standards for LCA (14040-44) and LCC (15686)
 - LCA: GWP (kg eq. CO₂); POCP (kg eq. C₂H₄); AP (kg eq. SO₂); EI (kg eq.(PO₄3-)); EP and TP (kg eq. 1.4-eq DCB)
 - LCC: natural resources costs; construction costs; user costs; maintenance costs; winter maintenance costs; landfilling; etc.
- Aligned with CEN/TC 350 Sustainability in construction works and TC 227 Road materials
 - EN 15804 for construction products (EPD)
 - CEN/TC 350/WG6 for civil engineering works
- Others indicators
 - Comfort, Safety audit (Directive 2008/96EC), mechanical/structural

Indicators (2/2)

- Environmental
 - Resources (raw materials, recycling, energy mix, etc.)
 - GWP
 - *ODP, acidification, eutrophication, toxicity and ecotoxicity, etc.*
- Technical
 - Evenness, Rutting
 - *Modulus (Falling Weighting Deflectometer), Skid resistance, macrotexture*
- Social
 - Safety audits (O/N)
 - Comfort
 - *Noise level decrease due to a pavement surface type*
- Economical: costs (construction, maintenance, users)

Certificate

- Draft of the certificate
- ≈ 30 indicators (mandatory or not)
- Introduction of thresholds values when they exist



LCE4ROADS CERTIFICATE (COMPLETE)

OPERATIONAL PHASE

CERTIFICATE NUMBER: 1

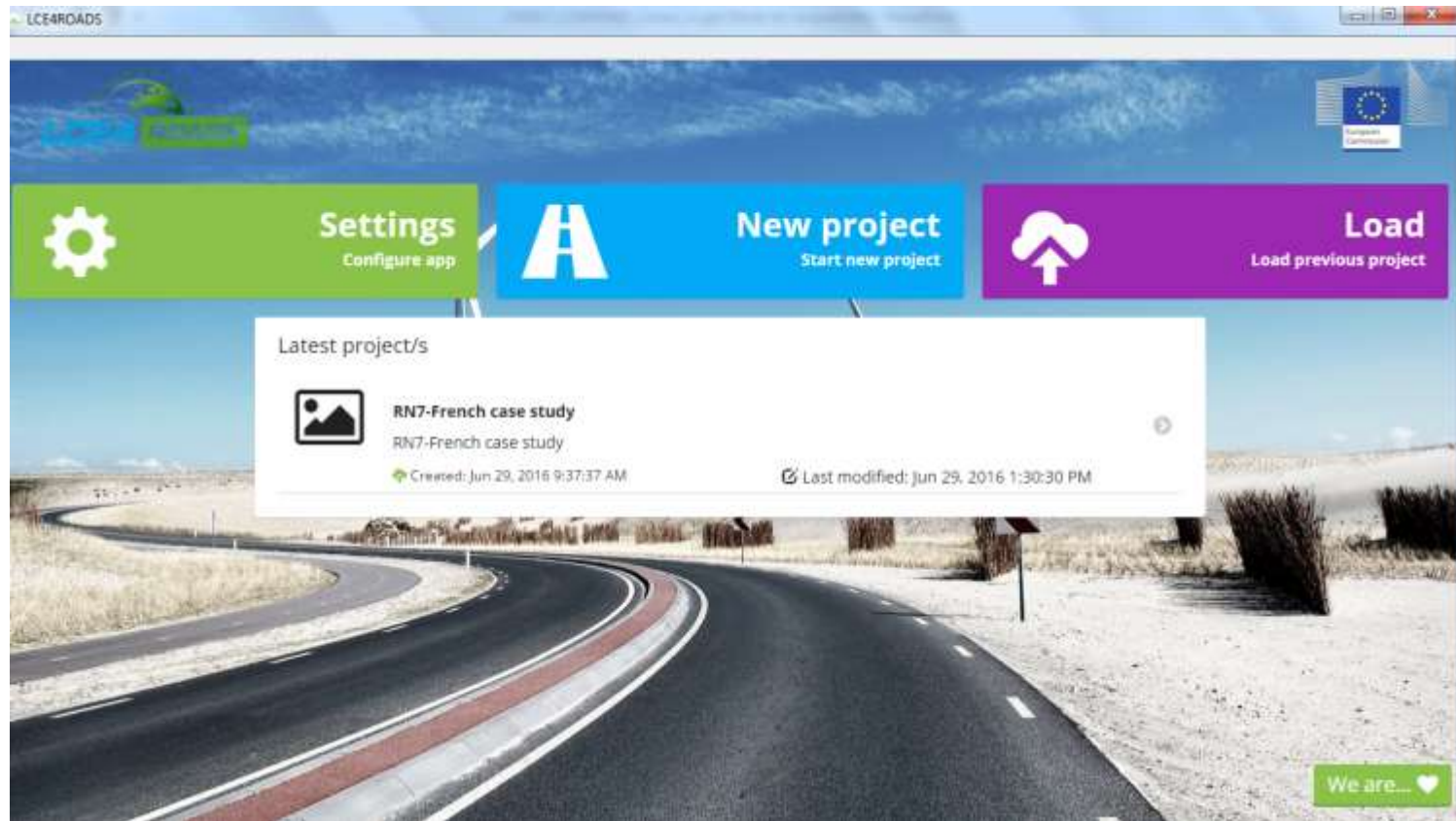
Date: 28.07.2019

ROAD IDENTIFICATION						
Road	Road Name : Gerede-Kizilcahamam Yolu		Traffic and Climate	Annual average daily traffic	4428	
	Road Class			State Road	Percentage of heavy vehicle	59
	KKN0			750-06	Annual average frost days	119
	Kilometre			84+860-86+360	Annual average rainy days	104
	Number of traffic lane		2x2	Pavement Layer Thickness, cm	SMA	4
	Pavement width in one direction		11,3 m		Binder	12
	Year of opening to traffic		2011		CIPR Bituminous base	25
			Granular Base	20		
			Subbase	20		

SUSTAINIBLTY DOMAINS					
ENVIRONMENTAL		SOCIAL			
Material	Virgin aggregate consumption	20736	Safety	Skid resistance	SN ₂
	Material suspected to be recycled	50		Traffic accident rate	-
	Low temperature asphalt, %	13951		Safety audits & safety inspections (Directive 2008/96EC)	No
	Energy demand	2,06E+00		Noise (habitant affection)	-
Impact	Global warming (climate change)	1,32E+06		Noise (wild life affection)	-
	Photochemical Ozone Creation (POCP)	3,96E+02		Tire-road contact noise, dBA	96
	Acidification Potential (AP)	9,73E+03		IRI, m/km	1,05
	Eutrophication Potential (EP)	1,65E+03		Ruth depth, mm	4
	Abiotic Depletion Potential (ADP)	1,79E+04		Traffic congestion mitigation plan	No
	Abiotic Depletion – fossil fuel	9,73E+03		Dust mitigation plan	No
	Toxicity (T)	-			
	Ecotoxicity (ET)	-			

TECHNICAL		ECONOMICAL		
Analysis period / Life span, years	36	Discount Rate, %	10	
Number of rehabilitation	2	Annual Uniform Costs (x1000 €)	Initial Cost	68,6
Maintenance and rehabilitation plan(M&R)	Yes		Maintenance cost	22,1
Pavement effective modulus, MPa	1005		Rehabilitation cost	65,1
Subgrade modulus, MPa	100		m ² cost	0,04
Maximum allowable IRI, m/km	3,5		Salvage value	60,9
Minimum allowable skid resistance	0,3		User cost and Work zone cost	13076,9
Maximum allowable rut depth, mm	30	User cost (due to increase in IRI)	358,4	

Certification tool



- Developed by CIRCE
- Database adapted to European countries (energy mix, etc.)

www.ifttar.fr

Validation

- Checking of the data consistency (inventories): unitary values (materials) with Ecorce 2, Ecoinvent, NAPE database (Pologne)
- Validation on « simple » case studies
 - 1 km of road
 - 1 t of material, etc.
- Validation on real case studies (1 concrete pavement, 4 asphalt pavements)
 - 2 Turkish projects - KGM
 - 1 Polish projects - INVESTEKO / NAPE
 - 1 Spanish project - IECA
 - 1 French project - IFSTTAR

**6 months of
tests
4 versions
of the tool**

➔ Comparison with Ecorce 2 and Sima-Pro tools

European standardization

- AENOR
 - Liaison with TC350 « sustainability in construction » and TC227 « road materials »
- CWA (CEN Workshop Agreement):
 - Definition of a set of indicators to assess sustainability of road infrastructure and materials
 - Panel of international experts to analyse working drafts

14/12/15: Starting meeting (Madrid)

3/03/16: 2nd workshop (Bruxelles)

15/04/16: 3rd workshop (Brux./Mad.)

22 et 23/09/16: 4th workshop (Leiden)

**Public enquiry
(2/06 au 2/08/16)**

➔ CWA 17089:2016 Indicators for the sustainability assessment of roads (Nov. 2016)

Twinning with USA

- Scanning tours in USA (FHWA, VTTI), Europe (ACCIONA, BASt, etc.)
 - Exchanges on certification systems (Greenroads)
 - Comparison of existing systems and tools to assess environmental impacts
 - Collaboration on rolling resistance modelling

➔ Presentation at « TRB2017 » (Washington, USA)

Santos J., Thyagarajan S., Keijzer E., Fernando Florez R., Flintsch G. (2017), *Comparison of life cycle assessment tools for road pavement infrastructures*, Transportation Research Record: Journal of the Transportation Research Board, Vol. 2646, p. 28-38.

➔ Presentation at « Pavement Life-Cycle Assessment Symposium 2017 » (Champaign, USA)

Santos J., Thyagarajan S., Keijzer E., Fernando Florez R., Flintsch G. (2017), *Pavement life cycle assessment - a comparison of American and European tools*, In : Pavement Life-Cycle Assessment Symposium 2017, Champaign, Illinois, USA.

Conclusion

- FP7 EU Project (2013 – 2016)
- Final seminar in Brussels: 17/11/2016

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- 75% of the reports are public and available online
- Guideline to implement the methodology and validated tool with database adapted to European peculiarities
- Support innovation (new products, materials, etc.)
- Valorisation of the tool and certification methodology: on-going discussion between partners

Thank you for your attention

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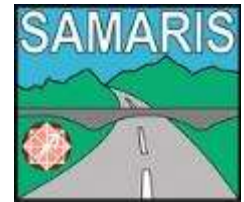
France

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Existing European Evaluation Systems for Roads



MIRIAM



PERFORMANCE INDICATORS
www.isstar.fr

US Evaluation Systems for Roads



THE ENVISION™ RATING SYSTEM



Certification scope

- Dedicated to TEN-T road network or roads with similar characteristics (geometry, traffic, etc.)
- Road submitted to safety audits (Directive 2008/96EC)



Certification moments

