Life-Cycle Engineering for Roads

(LCE4ROADS / ECOLABEL)

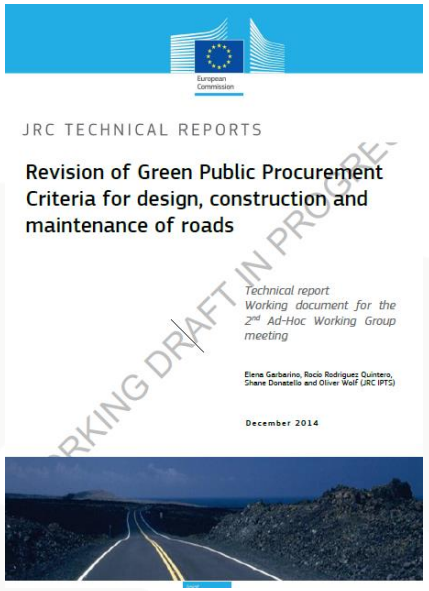
Fatma Orhan
Turkish General Directorate of Highways (KGM)
LCE4ROADS SC member

What is a Green Public Procurement?

How to implement it for the design, construction and maintenance of roads?

GPP and Certification Systems

EU-JRC: Draft of the Green Public Procurement Criteria for Design, Construction and Maintenance of Roads



Selection criteria on the competency of the construction / maintenance / rehabilitation contractors:

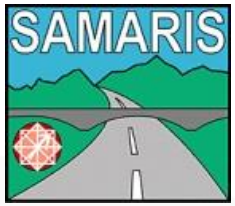
"The purchasing and use of low environmental impact construction materials and verification of their performance. Supply chain management to ***ensure compliance with any relevant road assessment and certification systems****, for example CEEQUAL or Greenroads. Experience with LCA and LCC tools";*

What is a sustainable road?

Sustainability Certifications for Buildings

- LEED (USA)
- BREEAM (UK)
- GREEN (GBC)
- DGNB (Germany)
- HQE (France)
- SBTool (Canada)
- Open House
- Ecohomes
- etc.

Existing Evaluation Systems for Roads in Europe



…what´s about in the USA?

Greenroads™

THE ENVISION™ RATING SYSTEM

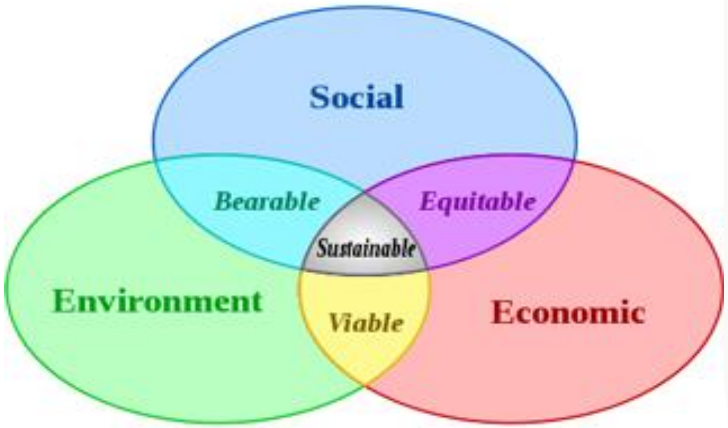
INVEST
ECONOMIC • SOCIAL • ENVIRONMENTAL

Gaps…barriers to innovation and implementation

Not covering all phases

PLANNING → DESIGN & CONSTRUCTION → OPERATION (Use) → MAINTENANCE → END OF LIFE

…or all sustainability pillars



Gaps…barriers to innovation and implementation

- **No Standards or regulations:**
  Framework for sustainability assessment under development in CEN/TC350.
- **No Regional peculiarities**
  Energy mix (key for LCA), different regulations and testing methods,
- **Road Authorities do not like to compare roads**
- **Costs**

LCE4ROADS

What are we developing?

"Life Cycle Engineering approach to develop a novel EU-harmonized sustainability certification system for cost-effective, safer and greener road infrastructures"

….AS PART OF THE FORMER FP7 ECOLABEL PROJECT

LCE4ROADS

In LCE4ROADS we are developing a new, holistic and EU-harmonised Sustainability Certification System for roads, integrating by a Life Cycle Engineering (LCE) all the sustainability pillars and road phases.

- **Useful for contractors, engineering companies.**
- **Useful for NRAs**
- **Useful to foster GPP and PPI**
- **Useful for users, society and the environment**
- **Useful for certification bodies**

LCE4ROADS

ROAD CONSTRUCTION, MAINTENANCE OR REHABILITATION PROJECT

Certificate

1. Light	2. Complete
Requirement 1	Requirement 1
Requirement 2	Requirement 2

E: Environmental

SE: Socio Economic

T: Technical

GREENER, SAFER AND COST EFFECTIVE ROAD INFRASTRUCTURES

LCE4ROADS: Main Concepts

LCE4ROADS will be pavements focussed
(including subgrade, and not related to structures earthworks).

Targets

- TEN-T network and similar types of roads.
- Support GPP and PPI

3 certification moments for new and existing roads

- 1 Before construction
- 2 After construction
- 3 During the operation phase. NRAs will fix periodicity.

Phases

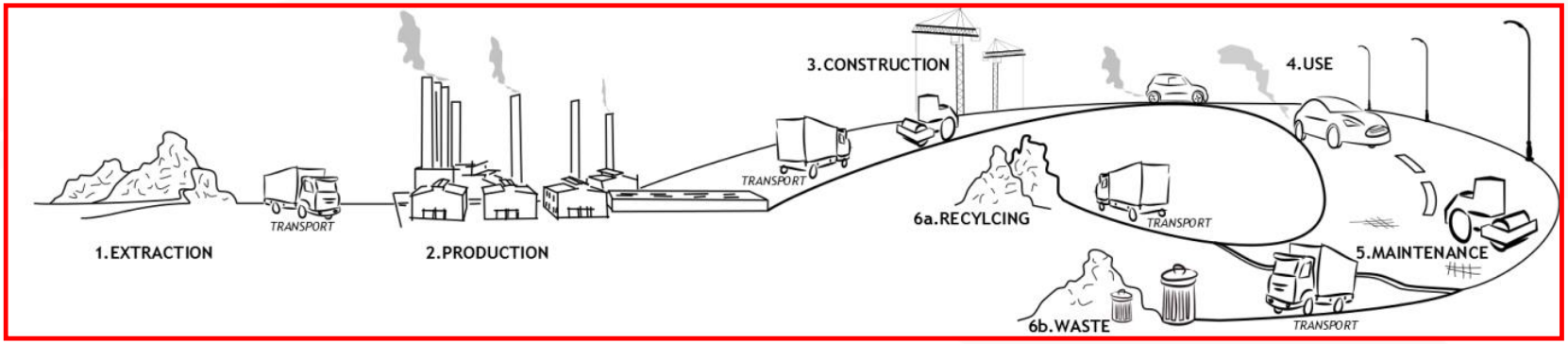
- Planning
- Design
- Construction
- Operation
- Maintenance
- EOL

Domains/Sust. pillars

- Technical
- Environmental
- Social
- Economical

LCE4ROADS: Boundary Conditions

The LCE4ROADS methodology assesses the sustainability of a road project over its life time. All life cycle stages are considered (design and planning, construction, operation, maintenance and end of life).

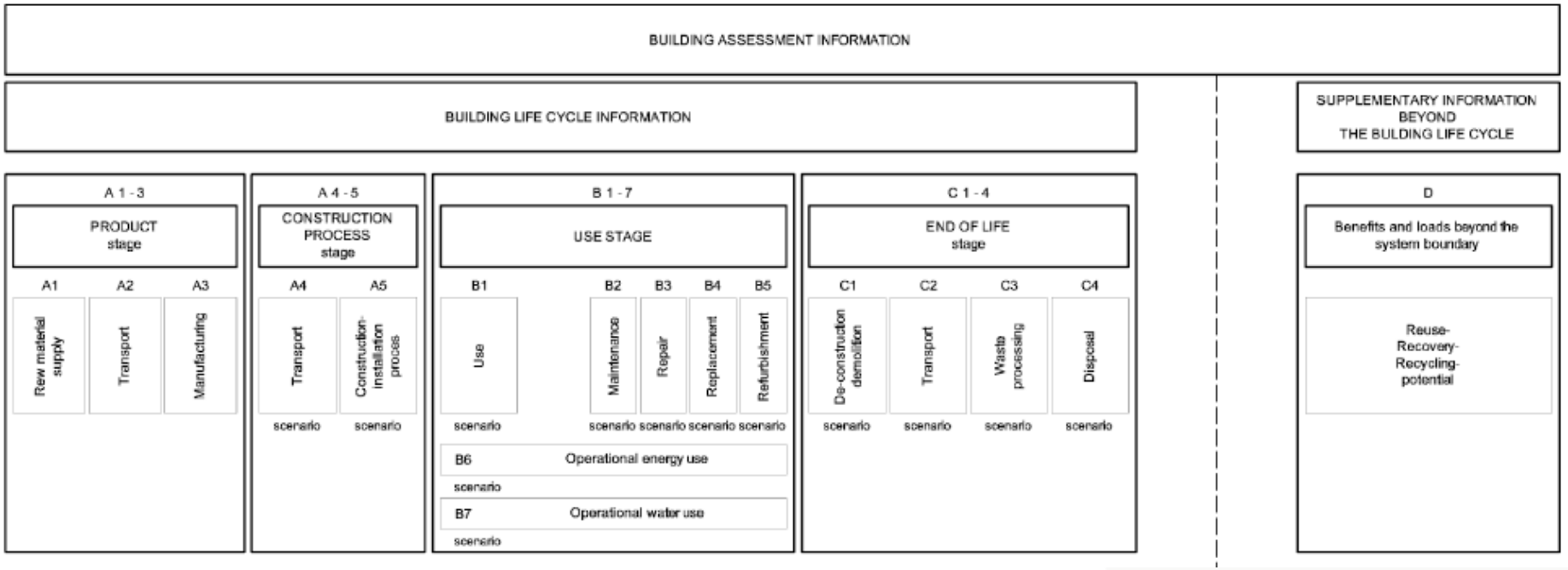


Stage 1: extraction of raw materials (→ A1)
Stage 2: production of road products (→A2 & A3)
Stage 3: construction of the road (→ A4 & A5)
Stage 4: use of the road (→ B1 + B6&7). Discuss about operational energy and water (B6 and B7)
Stage 5: maintenance of the road (→ B2 till B5)
Stage 6: end-of-life of the road (waste or recycling → C1-C4 or D)

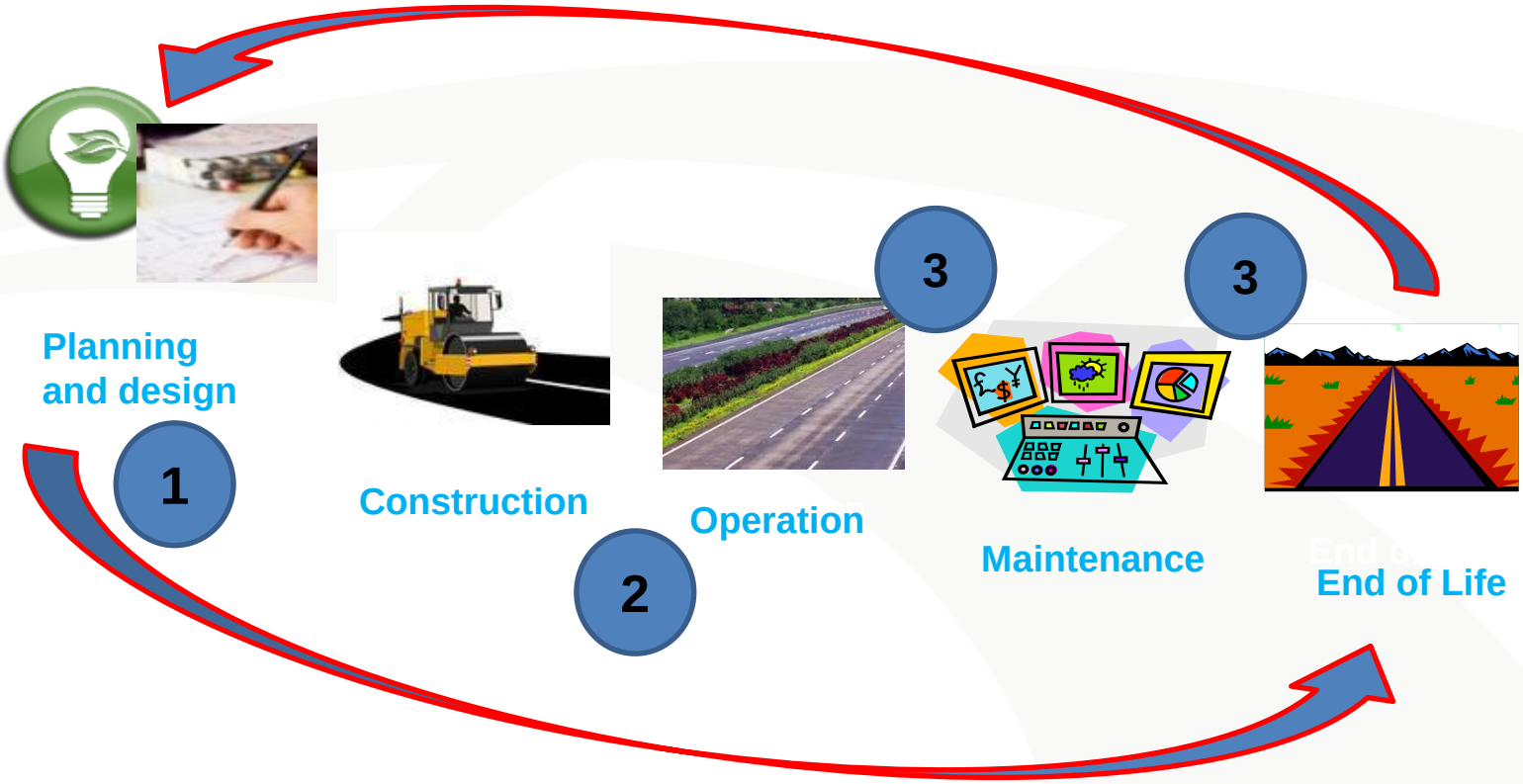
LCE4ROADS: Boundary Conditions

EN 15804+A1
Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

Product Stages



LCE4ROADS


Planning
and design
1
Construction
2
Operation
3
Maintenance
3
End of Life

LCE4ROADS: Certification Stages

There will be **three stages** when the certificate can be awarded.

- Firstly, a certificate can be awarded during the planning and design stages, based on information available at that phase.

- After construction, the certificate can be also awarded and, finally,

- During operation phase, the certificate can be also achieved

in order to check the real performances and level of service of the road infrastructure.

CERTIFICATION STAGES		
CS1	CS2	CS3
Planning and design	Construction	Operation

LCE4ROADS: Certification Scope

- ✓ Certification requirements (both qualitative and quantitative) will be defined.

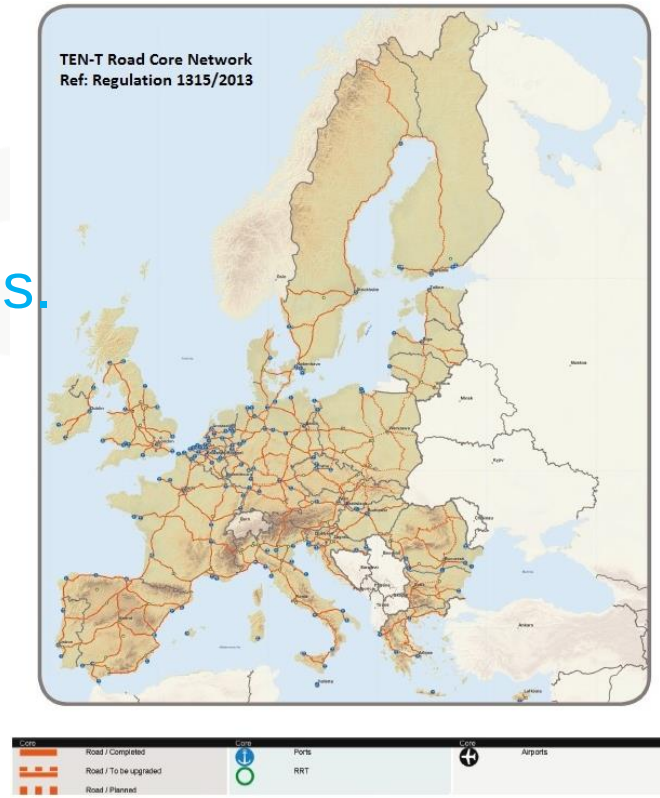
Light certificate covering a **minimum range** of requirements.

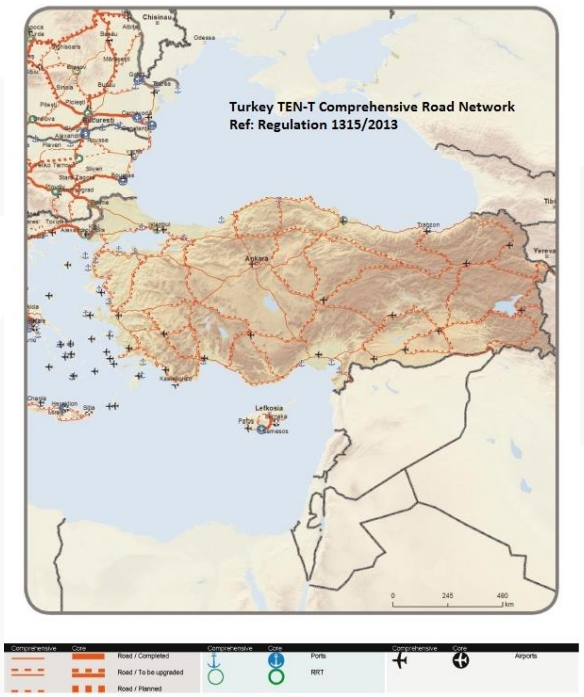
Complete certificate covering the **whole range** of requirements

- ✓ Regional peculiarities will be included (energy mix, regulations, etc.), to facilitate the deployment of LCE4ROADS in the different EU State Members

LCE4ROADS: Certification Scope

- ✓ Tailor made for TEN-T network and similar roads.





- ✓EU harmonized safety audits and inspections: (Directive 2008/96/EC) to be considered.

Indicators accepted at International Level

- ✓ **Green Public Procurement Critera JRC (EC)**

- ✓ **ISO Standards for LCA (14040-44) & for LCC (15686) indicators**

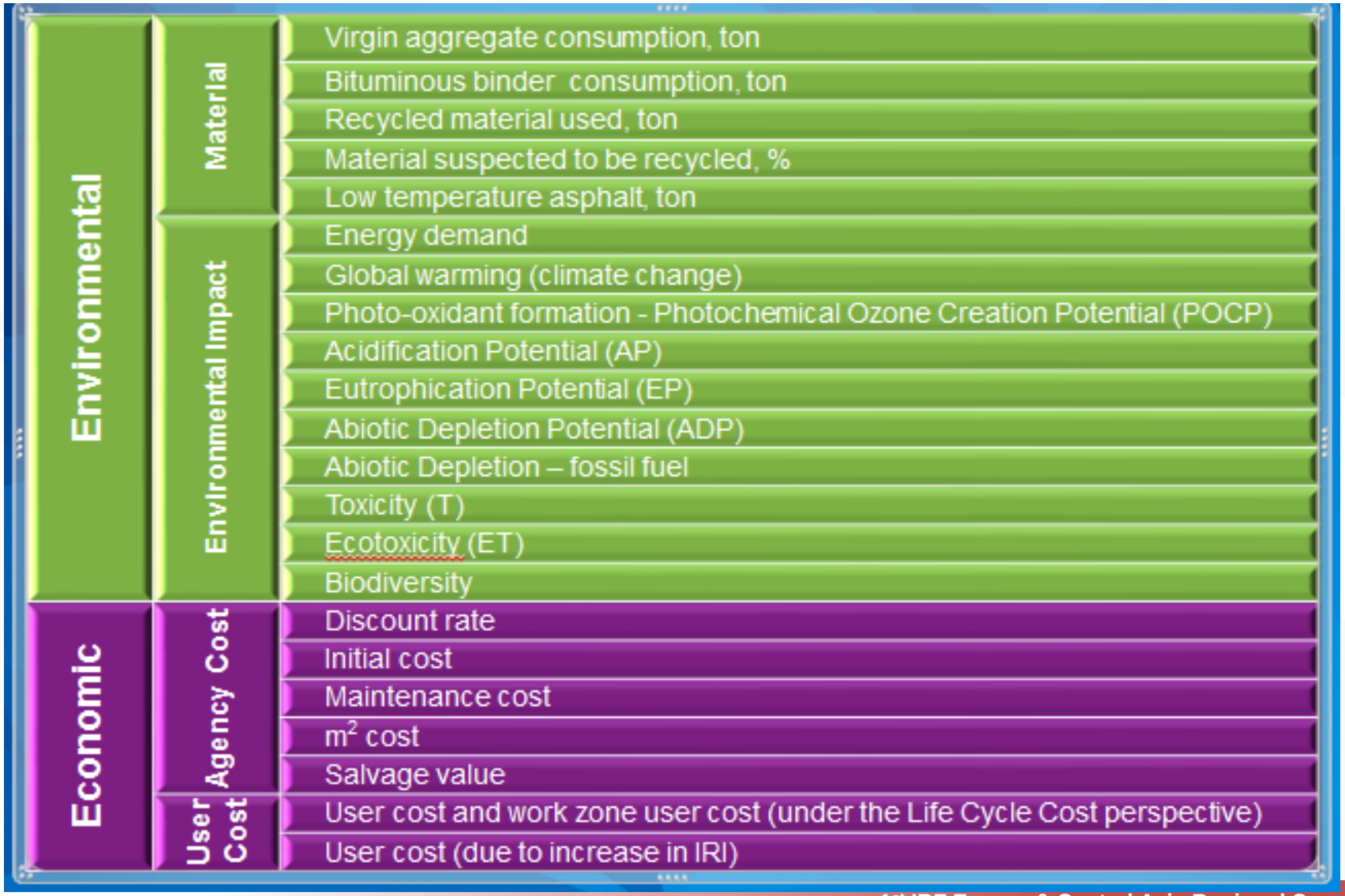
- *LCA:* GWP (kg eq. CO_2); POCP (kg eq. C_2H_4); AP (kg eq. SO_2); EI (kg eq.($PO4^{3-}$); EP (kg eq. 1.4-eq DCB); TP (kg eq. 1.4-eq DCB)
- *LCC:* natural resources costs; road construction costs; user costs; small maintenance costs; winter maintenance costs; deconstruction, landfilling, etc.

- ✓ **Aligned with CEN/TC 350 Sustainability in construction works and TC 227 Road materials:**

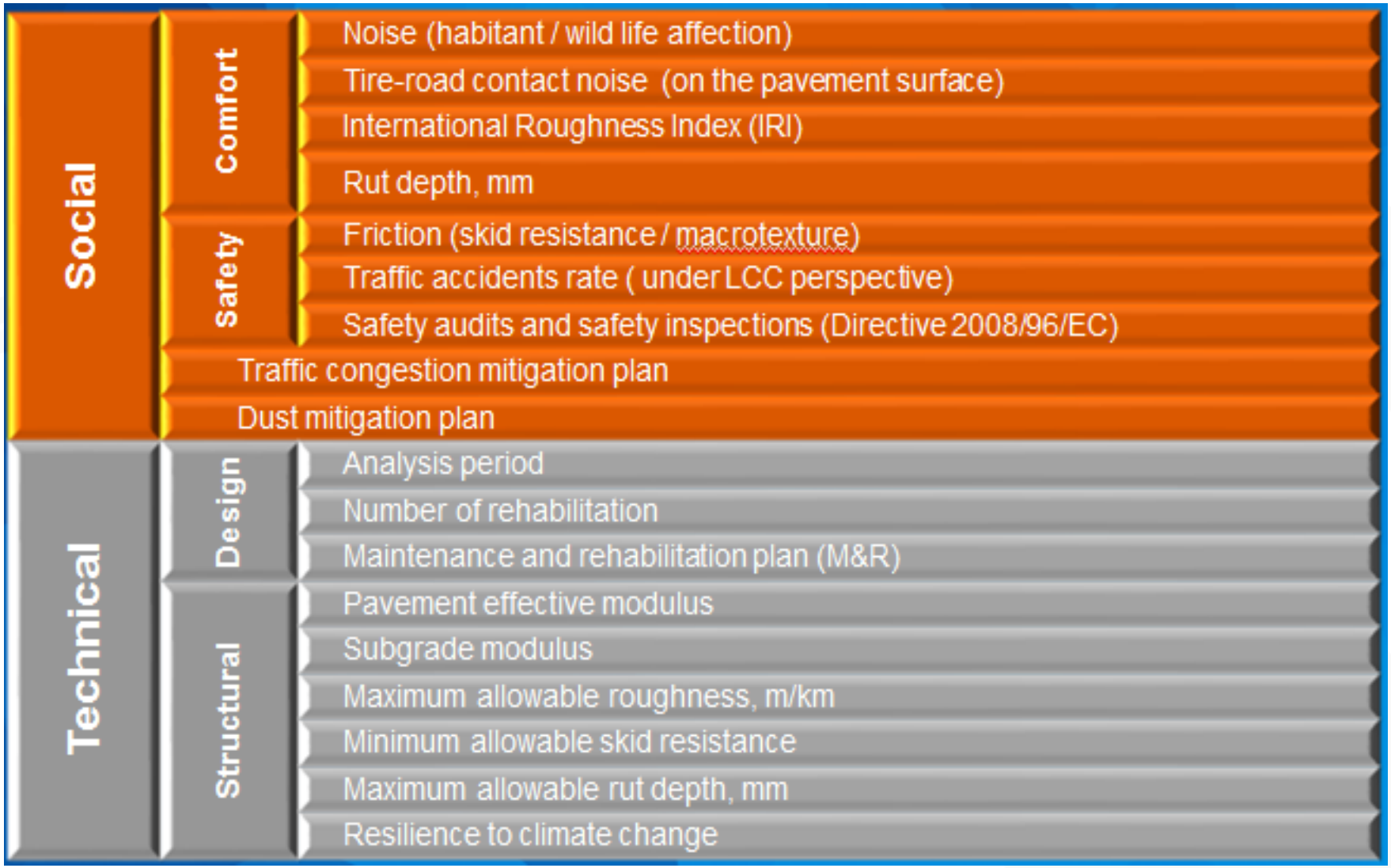
- EN 15804 for construction products (EPD)
- CEN/TC 350/WG6 for civil engineering works
- CEN Workshop Agreement (CWA) to be proposed in the next TC227 meeting.

- ✓ **Others under development:**
  Qualitative indicators, i.e. addition of innovative materials, processes or technologies, resilience to climate change, etc.

Indicators

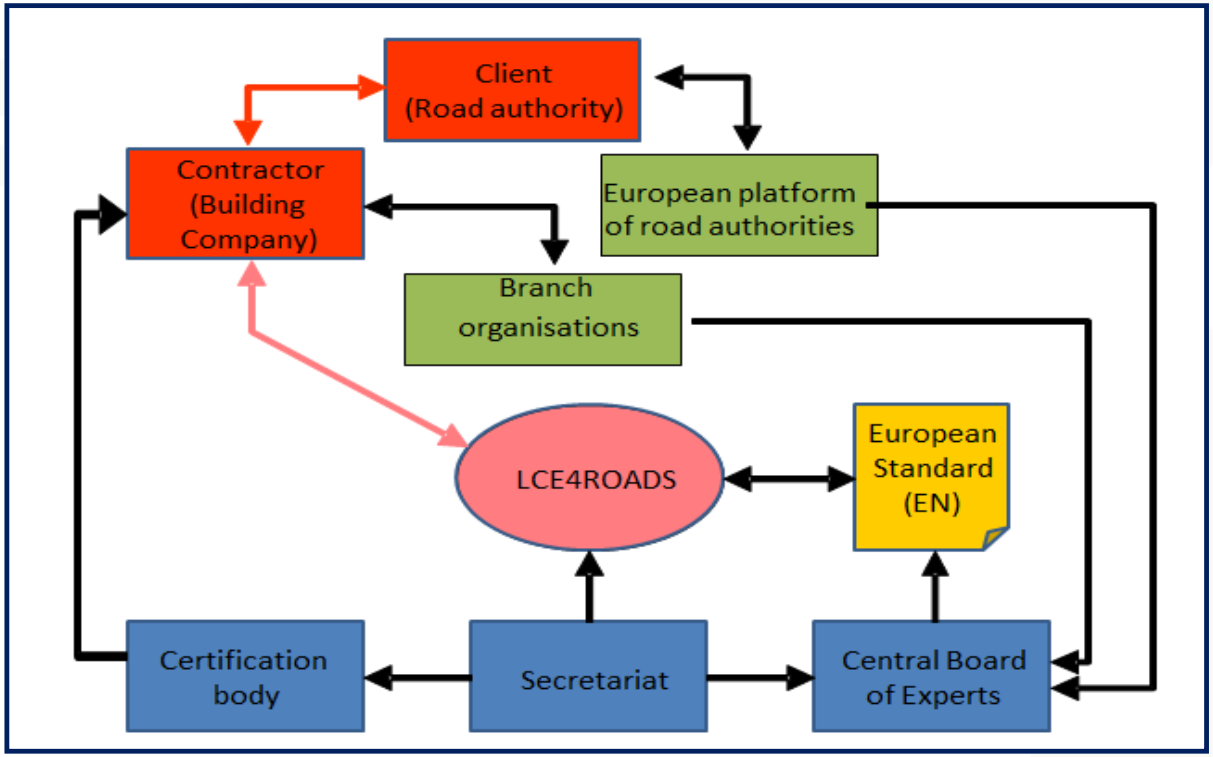

Environmental
Material
Virgin aggregate consumption, ton
Bituminous binder consumption, ton
Recycled material used, ton
Material suspected to be recycled, %
Low temperature asphalt, ton
Environmental Impact
Energy demand
Global warming (climate change)
Photo-oxidant formation - Photochemical Ozone Creation Potential (POCP)
Acidification Potential (AP)
Eutrophication Potential (EP)
Abiotic Depletion Potential (ADP)
Abiotic Depletion – fossil fuel
Toxicity (T)
Ecotoxicity (ET)
Biodiversity
Economic
Agency Cost
Discount rate
Initial cost
Maintenance cost
m^2 cost
Salvage value
User Cost
User cost and work zone user cost (under the Life Cycle Cost perspective)
User cost (due to increase in IRI)

Indicators


Social
Comfort
Noise (habitant / wild life affection)
Tire-road contact noise (on the pavement surface)
International Roughness Index (IRI)
Rut depth, mm
Safety
Friction (skid resistance / macrotexture)
Traffic accidents rate (under LCC perspective)
Safety audits and safety inspections (Directive 2008/96/EC)
Traffic congestion mitigation plan
Dust mitigation plan
Technical
Design
Analysis period
Number of rehabilitation
Maintenance and rehabilitation plan (M&R)
Structural
Pavement effective modulus
Subgrade modulus
Maximum allowable roughness, m/km
Minimum allowable skid resistance
Maximum allowable rut depth, mm
Resilience to climate change

Initial Organization Structure

The coordination between all the stakeholders with interests in LCE4ROADS:



- various organisations involved in the procedure to assign the certificate.

Example of Draft LCE4ROADS Certificate

LCE4ROADS CERTIFICATE (COMPLETE)

OPERATIONAL PHASE

CERTIFICATE NUMBER: 1

Date: 28.07.2015

ROAD IDENTIFICATION

Road	Road Name : Gerede-Kızılcahamam Yolu	
	Road Class	State Road
	KKNo	750-06
	Kilometre	84+860-86+360
	Number of traffic lane	2x2
	Pavement width in one direction	11,3 m
	Year of opening to traffic	2011

Traffic and Climate	Annual average daily traffic	4428
	Percentage of heavy vehicle	59
	Annual average frost days	119
	Annual average rainy days	104
Pavement Layer Thickness, cm	SMA	4
	Binder	12
	CIPR Bituminous base	25
	Granular Base	20
	Subbase	20

SUSTAINIBILTY DOMAINS

ENVIRONMENTAL

Material	Virgin aggregate consumption	20736
	Material suspected to be recycled	50
	Low temperature asphalt, %	13951
	Energy demand	2,06E+00
Impact	Global warming (climate change)	1,32E+06
	Photochemical Ozone Creation (POCP)	3,96E+02
	Acidification Potential (AP)	9,73E+03
	Eutrophication Potential (EP)	1,65E+03
	Abiotic Depletion Potential (ADP)	1,79E+04
	Abiotic Depletion – fossil fuel	9,73E+03
	Toxicity (T)	-
	Ecotoxicity (ET)	-

SOCIAL

Safety	Skid resistance	SN_2
	Traffic accident rate	-
	Safety audits &safety inspections (Directive 2008/96EC)	No
	Noise (habitant affection)	-
	Noise (wild life affection)	-
	Tire-road contact noise, dBA	96
	IRI, m/km	1,05
	Ruth depth, mm	4
Traffic congestion mitigation plan		No
Dust mitigation plan		No

TECHNICAL

Analysis period / Life span, years	36
Number of rehabilitation	2
Maintenance and rehabilitation plan(M&R)	Yes
Pavement effective modulus, MPa	1005
Subgrade modulus, MPa	100
Maximum allowable IRI, m/km	3,5
Minimum allowable skid resistance	0,3
Maximum allowable rut depth, mm	30

ECONOMICAL

Discount Rate, %		10
Annual Uniform Costs, (x1000 €)	Initial Cost	68,6
	Maintenance cost	22,1
	Rehabilitation cost	65,1
	m² cost	0,04
	Salvage value	60,9
	User cost and Work zone cost	13076,9
	User cost (due to increase in IRI)	358,4

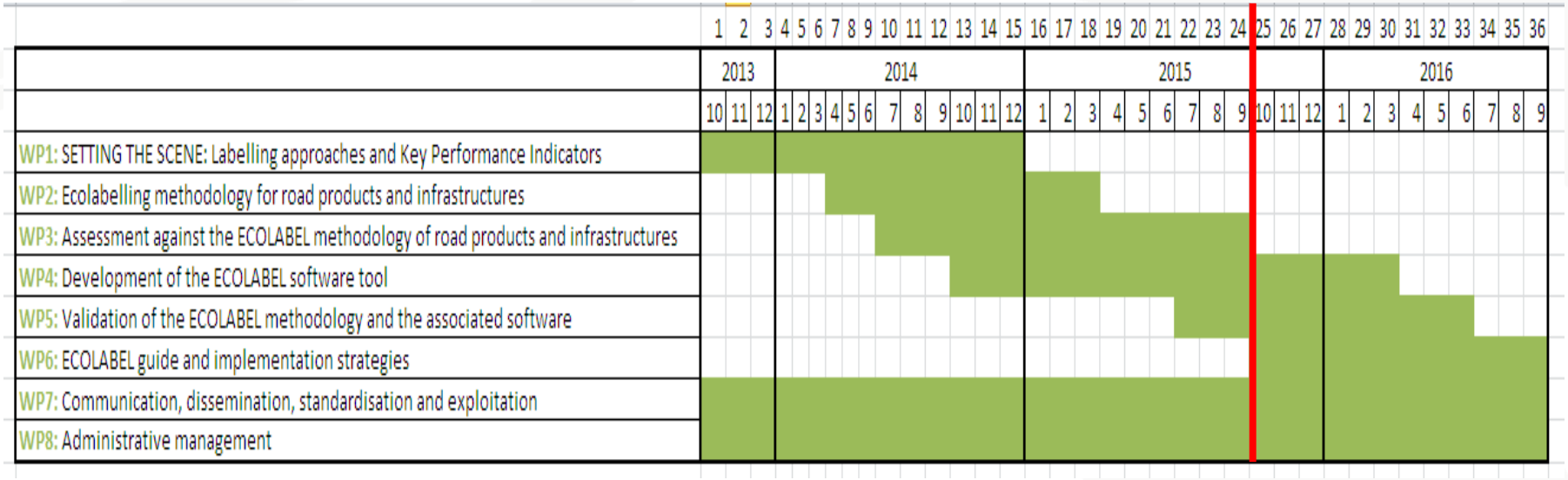
Our Team

acciona Infraestructuras

No	Participant	Country
1	ACCIONA	Spain
2	BASt	Germany
3	CIRCE	Spain
4	CHALMERS	Sweden
5	ERF	Belgium
6	FEHRL	Belgium
7	IECA	Spain
8	IFSTTAR	France
9	TNO	Netherlands
10	KGM	Turkey
11	AENOR	Spain
12	INVESTEKO	Poland
13	NAPE SA	Poland

Time Schedule

M24, Oct 2015



Main Outputs

- ✓ **LCE4ROADS certification system guide.**
- ✓ **Development of an innovative and friendly software tool.**
- ✓ **Implementation strategies to foster Green Public Procurement all around Europe.**
- ✓ **Pre-normative research activities towards standardization. Creating a CWA (CEN Workshop Agreement)**
- ✓ **Exploitation plan for the project results. Certification system, bodies and authorized entities.**

Main Outputs

In less than 24 months we intend to demonstrate that LCE4ROADS is around TRL 7 : integrated pilot system demostrated

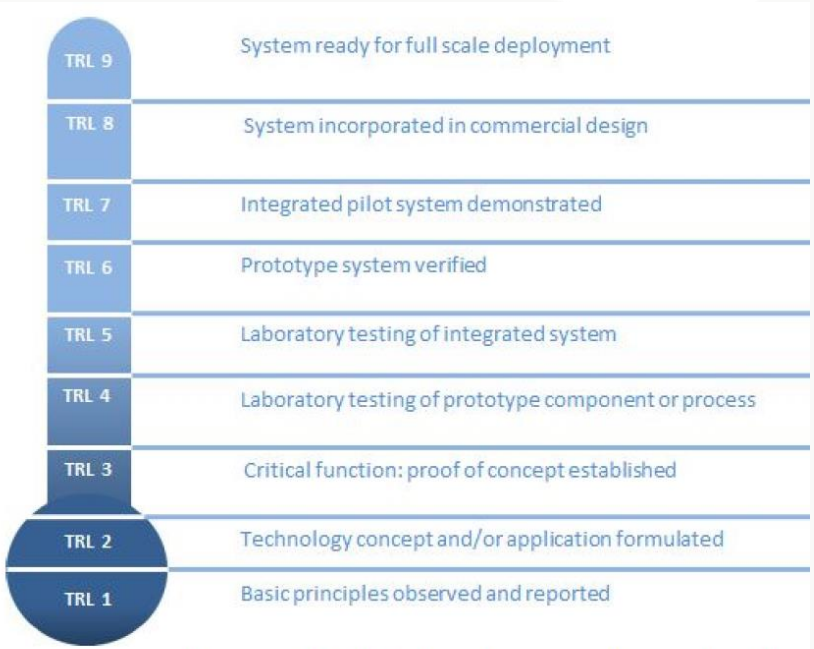


Figure: NASA technology readiness levels

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