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Presentation of Crina Oltean-Dumbrava Noise Barriers, Sustainability Criteria, Sustainability Key Performance Indicators and Sustainability Assessment

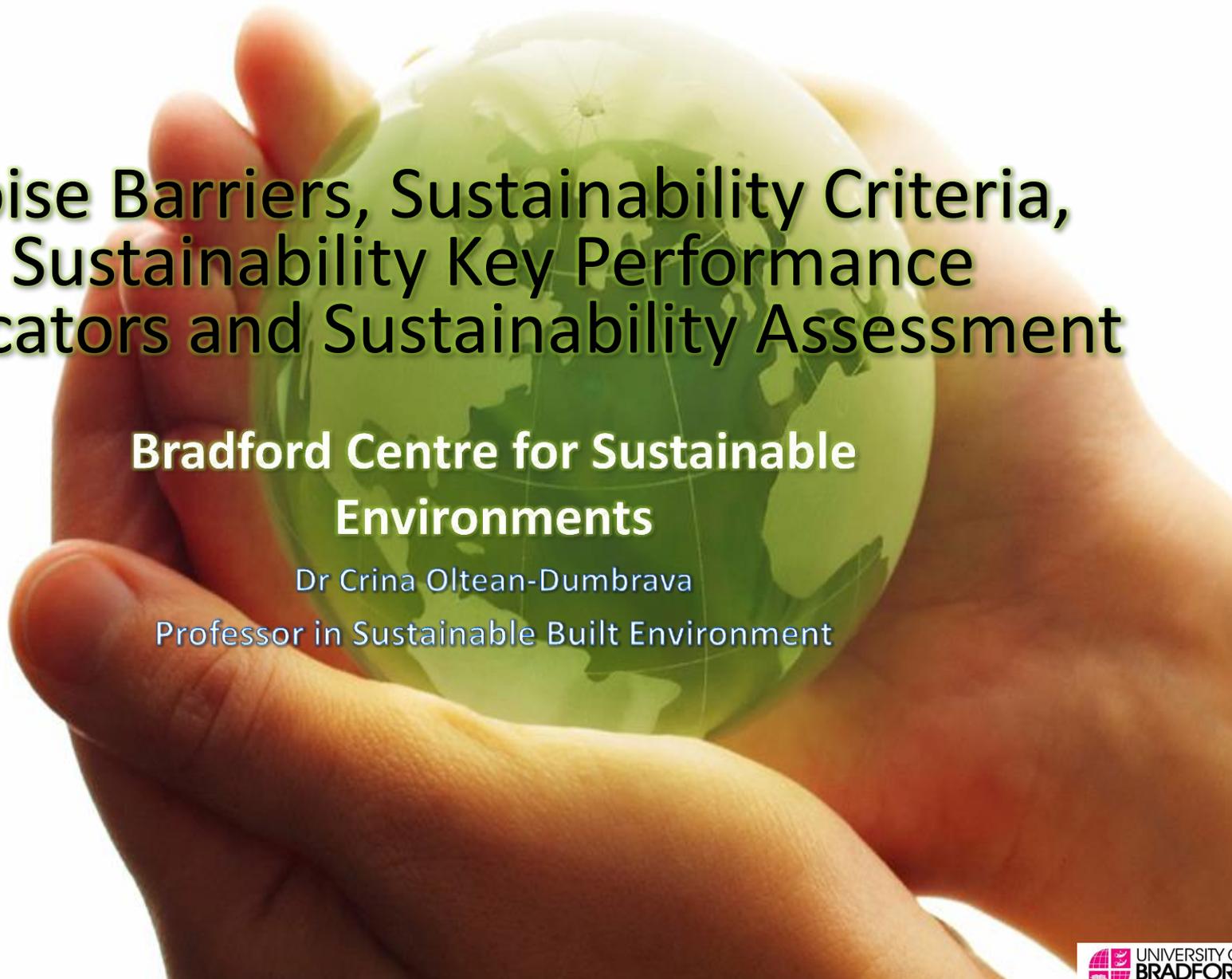
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Noise Barriers, Sustainability Criteria, Sustainability Key Performance Indicators and Sustainability Assessment

**Bradford Centre for Sustainable
Environments**

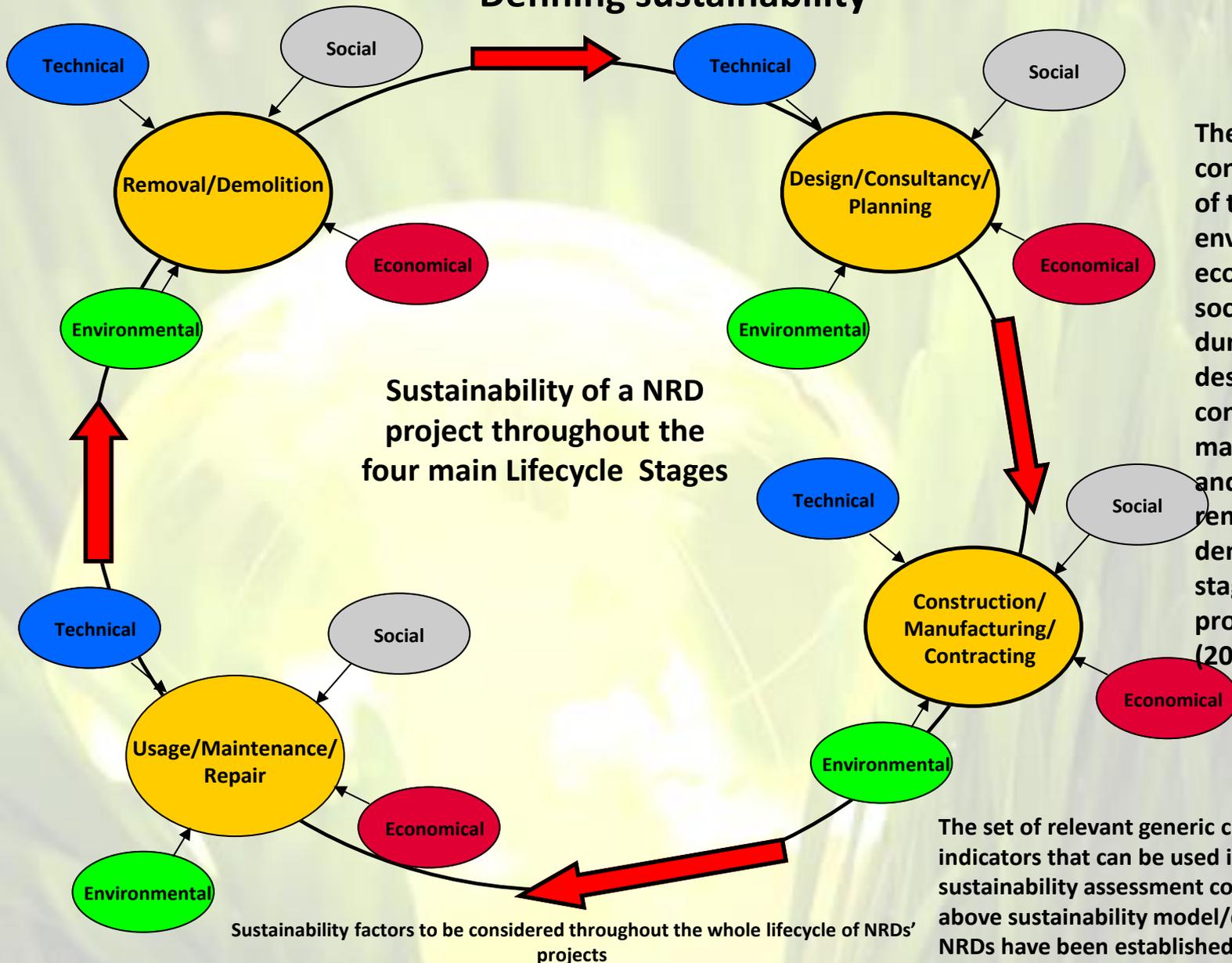
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Content

- **Introduction**
- **Sustainability Definition for Noise Reducing Devices (NRDs) Projects**
- **Set of Generic Criteria and Indicators that can be used for the Assessment of the Sustainability of NRDs**
- **Benefits of Sustainability Assessment: the Standardisation Process**
- **Final Conclusions**

Defining sustainability



Sustainability of a NRD project throughout the four main Lifecycle Stages

The optimal consideration of technical, environmental, economic and social factors during the design, construction, maintenance and repair, and removal-demolition stages of NRDs projects (2010).

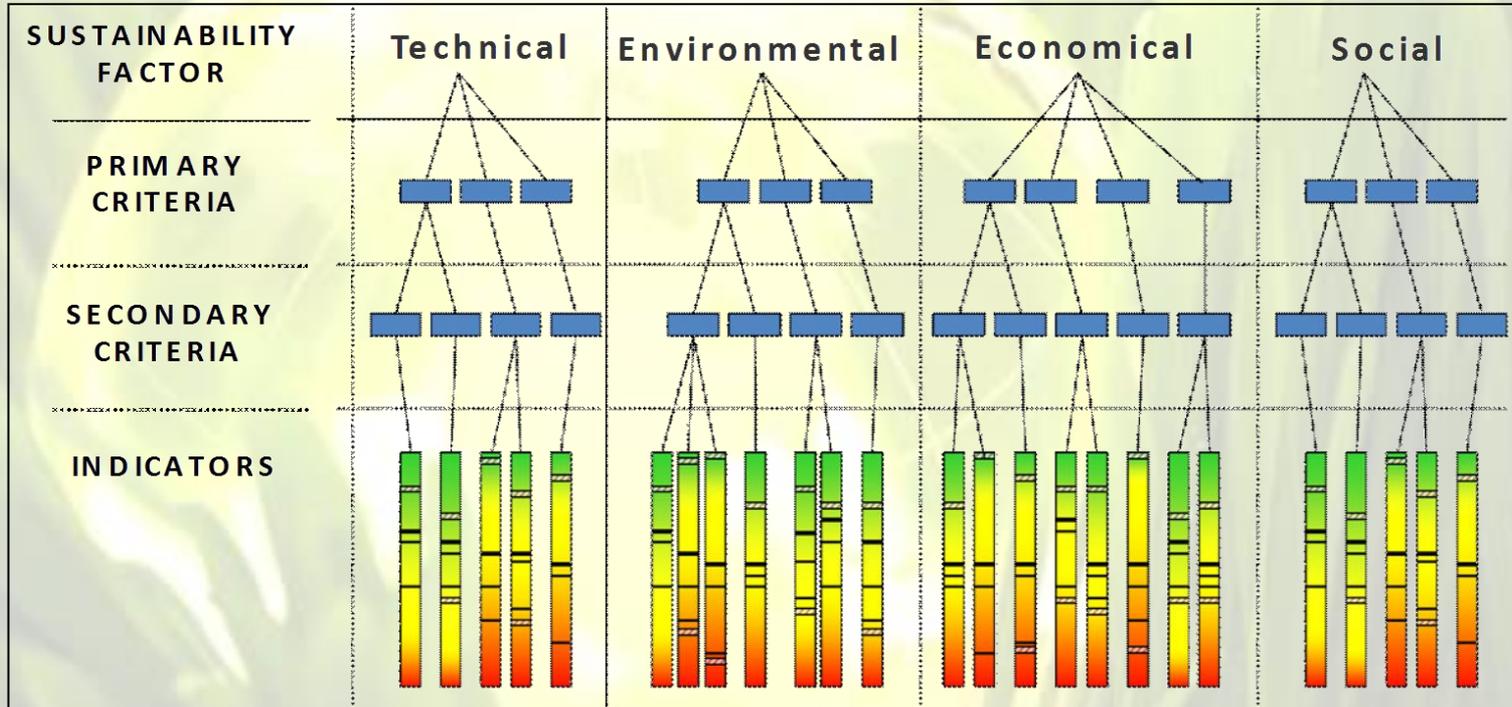
The set of relevant generic criteria and indicators that can be used in the sustainability assessment considering the above sustainability model/definition for NRDs have been established.

Sustainability factors to be considered throughout the whole lifecycle of NRDs' projects

This definition has been used for the Sustainability Assessment Framework

NRDs Sustainability Assessment Framework

The Quesst Sustainability Assessment Framework is defined for NRDs projects as *“a structure used to select and organise criteria, indicators and benchmarks for NRDs projects”* (UNIVERSITY of BRADFORD, BCSE, 2011)



Sustainability assessment framework for NRDs

Noise Barriers and NRDs

No.	Key	Noise Barrier
1	SM	Steel supporting structure + Metal panels
2	SC	Steel support structure + Concrete panels
3	ST	Steel supporting structure + Timber panels
4	SG	Steel supporting structure + Transparent modules
5	C	Self-supporting concrete or brick system
6	SP	Steel supporting structure with plastic panels
7	CT	Tunnel-concrete structure
8	STu	Tunnel-steel structure
9	GT	Tunnel with transparent panels
10	GB	Green barriers
11	GA	Gabion with stones
12	EB	Earth barrier (earth berm)
13	PVNB	PVNB (photovoltaic noise barrier)

Relevant Generic Sustainability Criteria for Assessing the Sustainability of NRDs

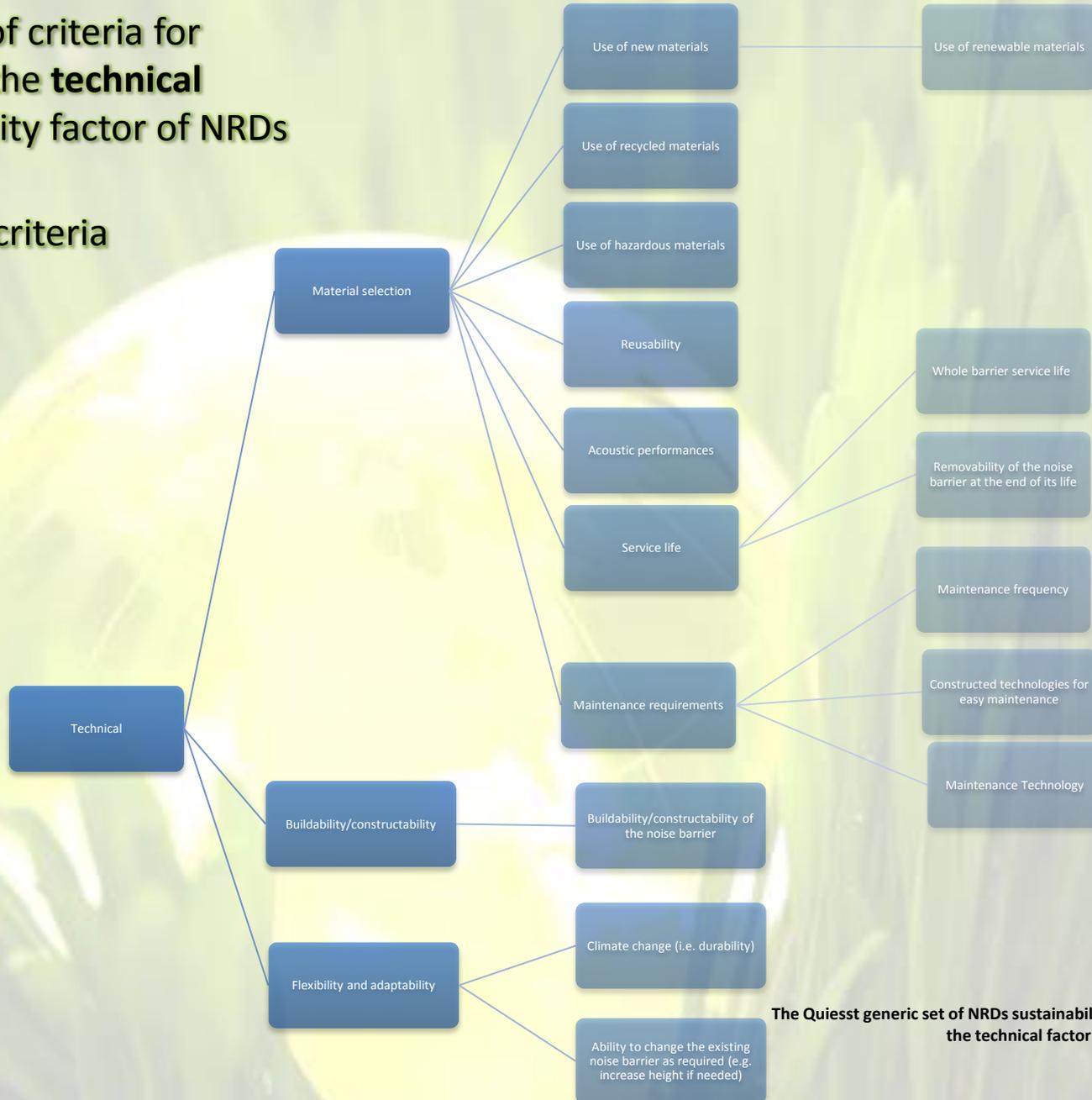
Primary criteria defined for assessing NRDs sustainability

Sustainability Factor	Primary Criteria
Technical	<ul style="list-style-type: none"> -Material selection -Buildability/constructability -Flexibility and adaptability
Environmental	<ul style="list-style-type: none"> -Energy -Land use -Air quality and climate change -Flora and fauna -Water -Waste
Economic	<ul style="list-style-type: none"> -Life cycle cost -Green value - Financial sources -Compensation cost -Affect on local residential/commercial property prices -Contractual and procurement type
Social	<ul style="list-style-type: none"> -Safety and security -Health and well-being -Severance/separation -Social acceptance -Architectural design and local context -Community engagement -Local employment and engagement with local business

Stakeholder engagement process for criteria validation

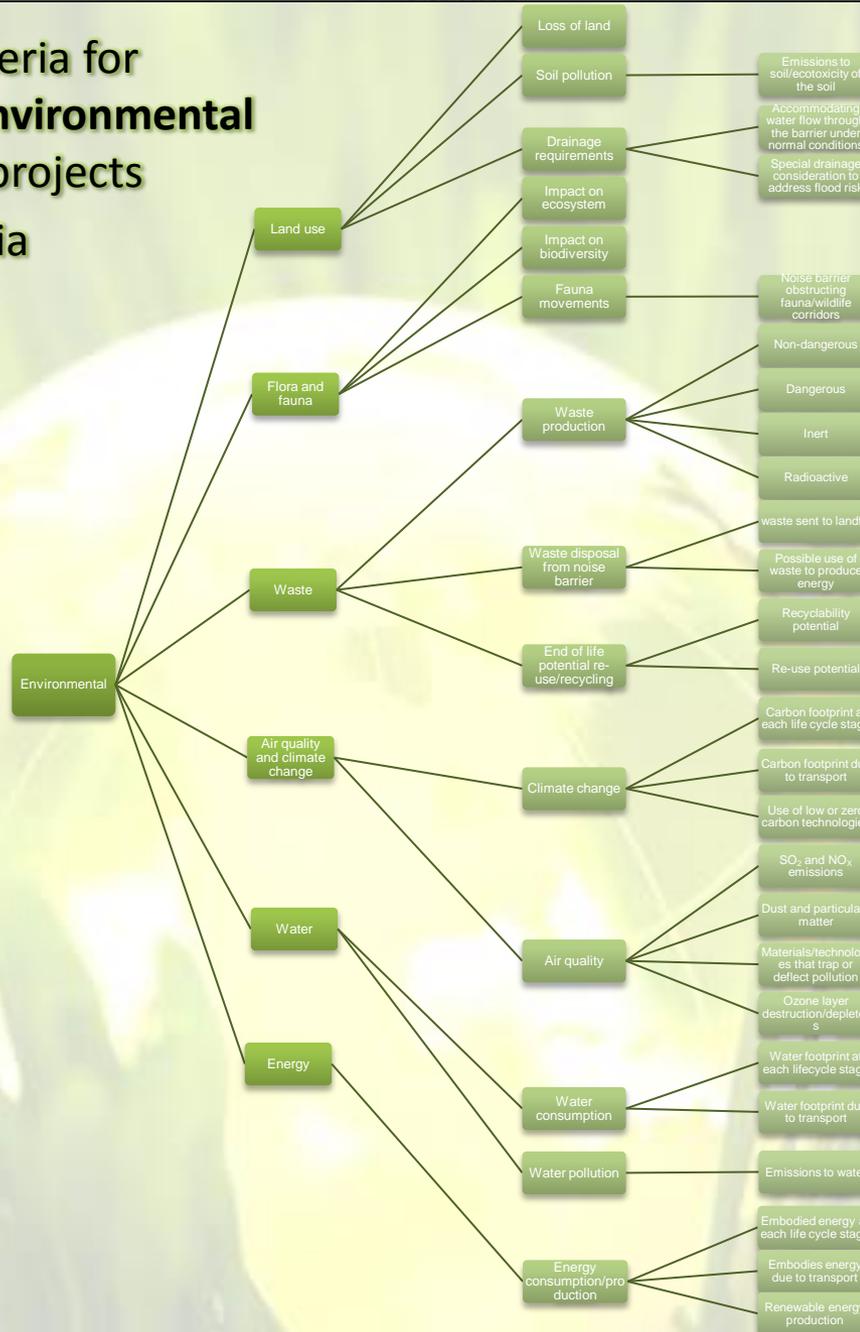
- Initial selection and recommendation by the expert WP6 working group
- Criteria presented to the stakeholders for validation mainly through a questionnaire survey
- 22 Primary criteria
- 141 Criteria in total
- More detailed/specific criteria can be defined under the primary criteria

- Initial set of criteria for assessing the **technical** sustainability factor of NRDs projects
- 3 Primary criteria



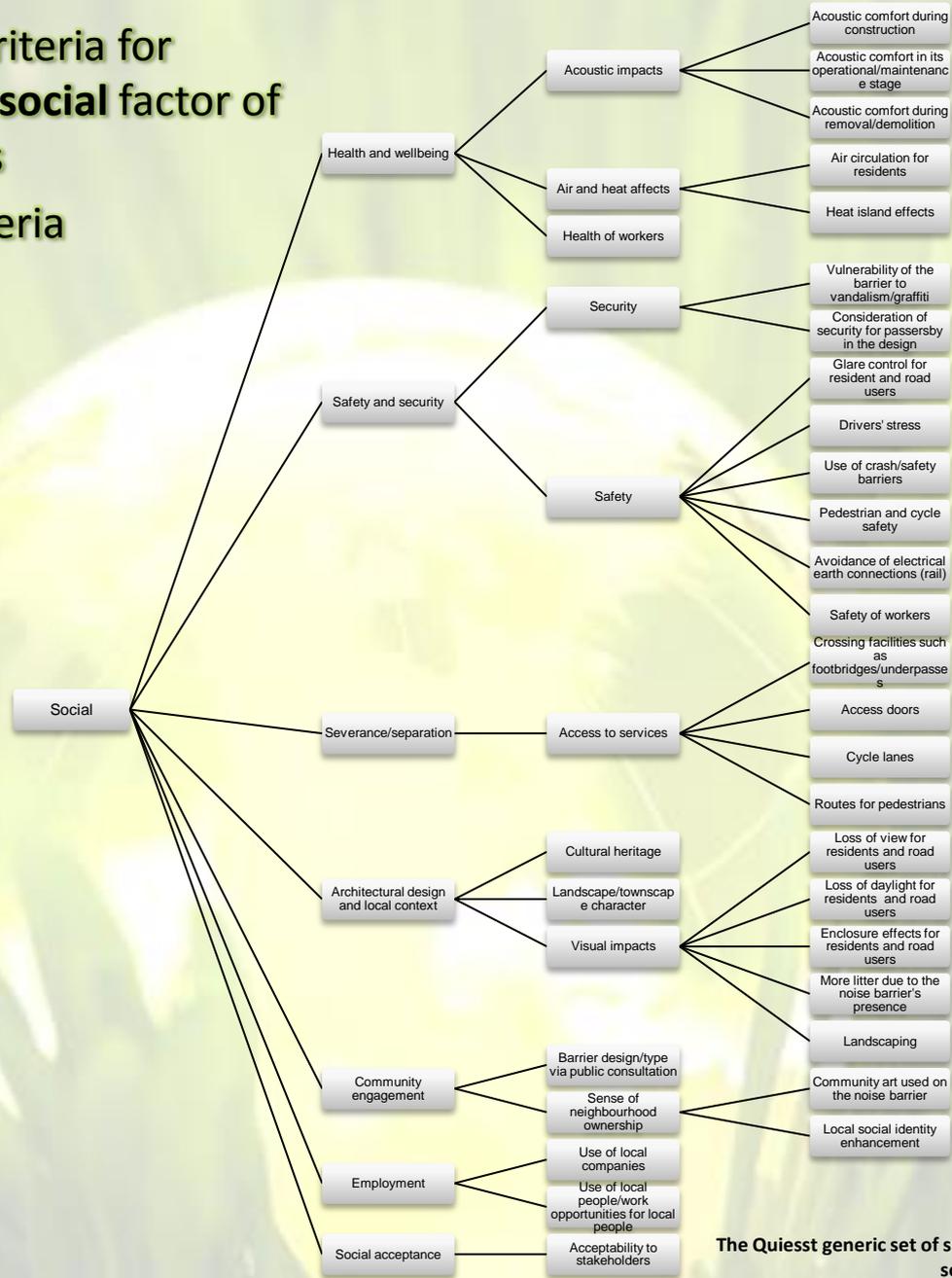
The Quesst generic set of NRDs sustainability criteria for assessing the technical factor

- Initial set of criteria for assessing the **environmental** factor of NRDs projects
- 6 Primary criteria



The Quiess generic set of sustainability criteria for assessing the environmental factor

- Initial set of criteria for assessing the **social** factor of NRDs projects
- 7 Primary criteria



The Quiesst generic set of sustainability criteria for assessing the social factor

- Initial set of criteria for assessing the **economic/cost** factor of NRDs projects
- 6 Primary criteria



The Quesst generic set of criteria for assessing the economic/cost factor

Generic Set of Sustainability Key Performance Indicators for NRDs

- 30 general sustainability KPIs which could be selected to measure the key aspects of NRDs' sustainability
- Suggested sets of KPIs per life cycle stage and stakeholder group are presented in the table attached
- The set is not definitive
- Users can select and/or add other KPIs they consider relevant to their organisation or project

KPI n° per Sustainability Factor	NRDs' Sustainability Assessment Criteria	Sustainability Factor				Key Performance Indicator	Benchmark to Improve Sustainability Performance
		Social	Economic	Environmental	Technical		
Key: ✓ = Yes, applicable ✗ = No, not applicable							
S1 KPI	Acoustic comfort	✓				No. of complaints from residents	Reduce
S2 KPI	Work related sicknesses and Injuries	✓				No. of reported health incidents/work related injuries due to working conditions	Reduce
S3 KPI	Vulnerability of the barrier to vandalism	✓				No. of reported acts of vandalism to the NRD (includes graffiti)	Reduce
S4 KPI	Glare control for road users	✓				No. of reported road accidents due to the glare from the noise barrier to the emergency services	Reduce
S5 KPI	Crossing facilities such as footbridges/ underpasses	✓				No. of complaints from the impacted community due to the lack of adequate crossing facilities	Reduce
S6 KPI	Acceptance of the architectural design of the NRD	✓				No. of complaints due to the architectural design of the NRD	Reduce
S7 KPI	Loss of view for residents and road users	✓				No. of complaints from residents and road users due to loss of views	Reduce
S8 KPI	Barrier design/type via public consultation	✓				No. of projects that included (and implemented) a stakeholder engagement plan	Increase
S9 KPI	Use of local companies and labour	✓				No. of local companies employed/No. of local labour opportunities realised	Increase
S10 KPI	Social acceptability of the NRD	✓				No. of complaints from residents	Reduce
T1 KPI	Use of new materials				✓	% new(virgin)material content/m3 or m	Reduce
T2 KPI	Use of recycled materials				✓	% recycled material content/m3 or m	Increase
T3 KPI	Local materials				✓	% local material content/m3 or m	Increase
T4 KPI	Whole barrier service life				✓	Years	Increase or maintain
T5 KPI	Acoustic durability in-situ				✓	years (yrs) until acoustic performance drops below the accepted level	Increase or maintain
T6 KPI	Buildability/constructability of the noise barrier				✓	square meter/day to build the noise barrier system	Increase
T7 KPI	Durability				✓	No. of years the NRD system can be used in comparison to its design life	Increase
ENV1 KPI	Loss of land			✓		'Footprint' (m²) of the NRD/m or total length	Reduce
ENV2 KPI	Overall waste production			✓		kg/m²	Reduce
ENV3 KPI	Materials used for energy recovery at the end of its life			✓		% material recoverable for energy/m²	Increase
ENV4 KPI	Recyclability potential			✓		% recyclable /m²	Increase
ENV5 KPI	Re-use potential			✓		% re-usable/m²	Increase
ENV6 KPI	Carbon footprint (global warming potential)			✓		kg CO2equivalent/m²	Reduce
ENV7 KPI	Water footprint			✓		litre/m²	Reduce
ENV8 KPI	Embodied energy content (Use of primary energy resources/consumption)			✓		MJ/m²	Reduce
ENV9 KPI	Renewable energy production (Photovoltaic/small scale wind turbines)			✓		MJ/m²	Increase
EC1 KPI	Capital costs		✓			Euro/sqm	Reduce
EC2 KPI	Maintenance and repair costs		✓			Euro/sqm	Reduce
EC3 KPI	Removal/replacement costs		✓			Euro/sqm	Reduce
EC4 KPI	Income generation		✓			Euro/sqm	Increase

Construction Product Regulation (CPR)

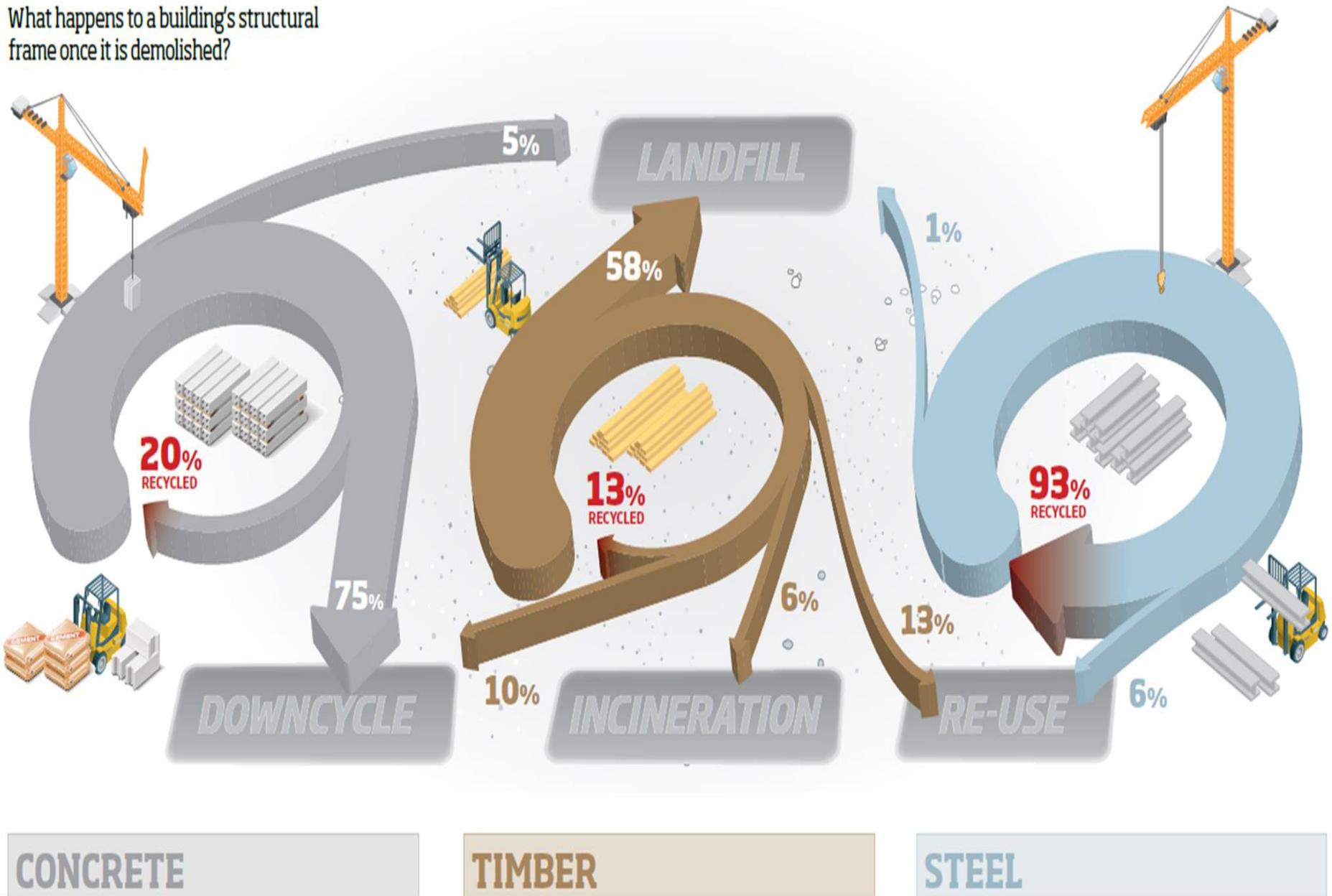
- The Road Equipment Industry is asked to face new challenges regarding product qualification and testing against legislation and standards. The new Construction Product Regulation (305/2011/EU -CPR) that has become mandatory on 1st July 2013 is promoting a new approach in products qualification based on the declaration of performance against seven essential requirements. With respect to the previous Construction Product Directive (89/106/EEC - CPD) some relevant new challenging requirements have been included.
- Sustainability has been specifically addressed with the new 7th basic requirement.
- From 1 July 2013, under the CPR, it has become mandatory for manufacturers to draw up a Declaration of Performance (DoP) and apply CE marking to any of their construction products which are covered by a harmonised European standard (hEN) or conforms to a European Technical Assessment (ETA) which has been issued for it, when such a product is placed on the market.

Table 8 New requirements of the Construction Product Regulation (CPR) 305/2011/EU

CPD	CPR
1- Mechanical resistance and stability	1- Mechanical resistance and stability
2- Safety in case of fire	2- Safety in case of fire
3- Hygiene, health and the environment	3- Hygiene, health and the environment <i>throughout the life cycle + safety of workers</i>
4- Safety in use	4- Safety and accessibility in use
5- Protection against noise	5- Protection against noise
6-Energy economy and heat retention	6-Energy economy and heat retention Energy efficiency of construction work during construction and dismantling
	7-Sustainable use of natural resources

END-OF-LIFE SCENARIOS

What happens to a building's structural frame once it is demolished?



CONCRETE

TIMBER

STEEL

End-of-life Scenarios

Standard(s) for Sustainability Assessment of NRDs to form the basis of including sustainability in all Road Equipment

- NRDs considered among “road equipments” are already covered by approved harmonized standard referring to EN 14388 (2008). The revised 2015 standard is not harmonised at the present moment.
- CEN/TC 226 relatively decided to include in its Working Plan sustainability and Liaise with CEN/TC 350, to determine how sustainability aspects can be included in road circulation products standardisations.
- CEN/TC 226 WG6 is the first TC 226 working group that has created a specific task group (TG4) dedicated to Sustainability. This group has recently started its work on a prEN standard that will look at the general aspects of sustainability assessment for NRDs.
- A similar approach can then be propagated to other sectors of Road Equipment’s Industry with an evident advantage for the Surface Transport development agenda.

CEN/TC 226/WG6-TG4 NRDs Agreed Generic Technical Criteria

n°	Generic Set of Technical Assessment Criteria for NRDs Projects	Life Cycle Stage	Criteria Hierarchy (P/S/T/Q)
1.	<u>Material selection</u>	Design and Production	P
1.1.	Use of new materials	Design and Production	S
1.1.1.	Use of renewable materials	Production	T
1.2.	Use of recycled materials	Production	S
1.3.	Use of hazardous materials	Production	S
1.4	Removability potential of the NRD at the end of its life	Design, Production, Removal	S
1.4.1	Reusability potential	Design, Production, Removal	T
1.4.2	Recyclability potential	Design, Production, Removal	T
1.5.	Acoustic performances	All stages	S
1.6.	Service life	All stages	S
1.7.	Maintenance requirements	All stages	S
2.	<u>Buildability/constructability</u>	Construction/Installation	P
3.	<u>Flexibility and adaptability</u> Ability to change existing noise barrier as required (e.g. increase height if needed)	Usage	P

3 Primary
7 secondary
and
3 tertiary
criteria

The agreed generic set of NRDs sustainability criteria for assessing the technical factor CEN/TC 226/WG6-TG4

CEN/TC 226/WG6-TG4 NRDs Agreed Generic Environmental Criteria

n°	Generic Set of Environmental Assessment Criteria for NRDs projects	Life Cycle Stage	Criteria Hierarchy (P/S/T/Q)
1.	<u>Land use</u>	Construction, Usage	P
1.1.	Land footprint	Construction, Usage	S
1.2.	Soil pollution	Construction, Usage	S
1.3.	Drainage capability	Construction, Usage, Removal	S
2.	<u>Flora and fauna</u>	Construction, Usage, Removal	P
2.1.	Impact on ecosystems	Construction, Usage, Removal	S
2.2.	Impact on biodiversity	Construction, Usage, Removal	S
2.3.	Impact on fauna	Construction, Usage, Removal	S
2.3.1.	Obstructing fauna	Construction, Usage, Removal	T
2.3.2.	Endangering fauna	Construction, Usage, Removal	T
3.	<u>Waste management</u>	All stages	P
3.1.	Waste generation	Production, Construction, Usage	S
3.1.1.	Non-hazardous	Production, Construction, Usage	T
3.1.2.	Hazardous	Production, Construction, Usage	T
3.2.	Waste disposal	Production, Construction, Usage	S
3.2.1.	Non-hazardous	Production, Construction, Usage	T
3.2.2.	Hazardous	Production, Construction, Usage	T
3.3.	Waste disposal	Removal	S
3.3.1.	Recyclability	Removal	T
3.3.2.	Reusability	Removal	T
3.3.3.	Waste sent to landfill	Removal	T
4.	<u>Climate change and air quality</u>	All stages	P
4.1.	Climate change	All stages	S
4.1.1.	Carbon footprint at each life cycle stage	All stages	T
4.1.2.	Carbon footprint due to transport	Construction, Usage, Removal	T
4.1.3.	GHG gases emissions	All stages	T
4.2.	Air quality	All stages	S
4.2.1.	Non GHG gases emissions	All stages	T
4.2.2.	Dust and particulate matter	Construction, Usage, Removal	T
4.2.3.	Materials that trap or deflect pollution	Design, Construction/Installation, Usage	T
4.2.4.	Ozone layer destruction / depleter	Construction, Usage, Removal	T
5.	<u>Water</u>	All stages	P
5.1.	Water consumption	All stages	S
5.2.	Water pollution	All stages	S

The agreed generic set of NRDs sustainability criteria for assessing the environmental factor CEN/TC 226/WG6-TG4

5 Primary, 14 secondary and 16 tertiary criteria

CEN/TC 226/WG6-TG4 NRDs Agreed Generic Social Criteria

n°	Generic Set of Social Assessment Criteria for NRDs projects	Life Cycle Stage	Criteria Hierarchy (P/S/T/Q)
1	<u>Health and well-being</u>	All stages	P
1.1.	General public	Construction, Usage, Removal	S
1.1.1	Air	Construction, Usage, Removal	T
1.1.2	Heat Island Impact	Usage	T
1.2	Workers	Construction, Usage, Removal	S
2	<u>Security and safety impacts</u>	All stages	P
2.1.	Security	Construction, Usage, Removal	S
2.1.1	Public	Construction, Usage, Removal	T
2.1.2	Product	Construction, Usage, Removal	T
2.2.	Safety impacts on workers and public	Construction, Usage, Removal	S
2.2.1.	Drivers' stress	Usage	T
2.2.2.	Safety of workers	Construction, Usage, Removal	T
2.2.3.	Safety of Public	Construction, Usage, Removal	T
2.2.4.	Pedestrian and cycle safety	Construction, Usage, Removal	T
3	<u>Social Acceptance</u>	All stages	P

3 Primary,
4 secondary
and
8 tertiary
criteria

The agreed generic set of NRDs sustainability criteria for assessing the social factor CEN/TC 226/WG6-TG4

CEN/TC 226/WG6-TG4 NRDs Agreed

Generic Economic Criteria

n°	Generic Set of Economic Assessment Criteria for NRDs projects	Life Cycle Stage	Criteria Hierarchy (P/S/T/Q)
1	Life cycle cost/Whole life cost	All stages	P
1.1.	Capital costs	Design, Construction	S
1.1.1.	Land cost	Usage	T
1.1.2.	Design costs	Design	T
1.1.3.	Construction costs	Construction	T
1.1.3.1	Costs for adaptation to structural/safety constraints	Usage	Q
1.1.3.2	Labour cost	Construction, Usage, Removal	Q
1.1.3.3	Material cost	Construction, Usage, Removal	Q
1.1.3.4	Plant cost	Construction, Usage, Removal	Q
1.1.3.5	Transport cost	Construction, Usage, Removal	Q
1.2	Costs related to the impact on traffic	Construction, Usage, Removal	S
1.3	Maintenance cost	Usage	S
1.4	Removal/demolition cost	Removal	S
1.5	Disposal cost	Removal	S
2.	Added value	Usage	P

2 Primary
5 secondary
3 tertiary
and
5 quaternary
criteria

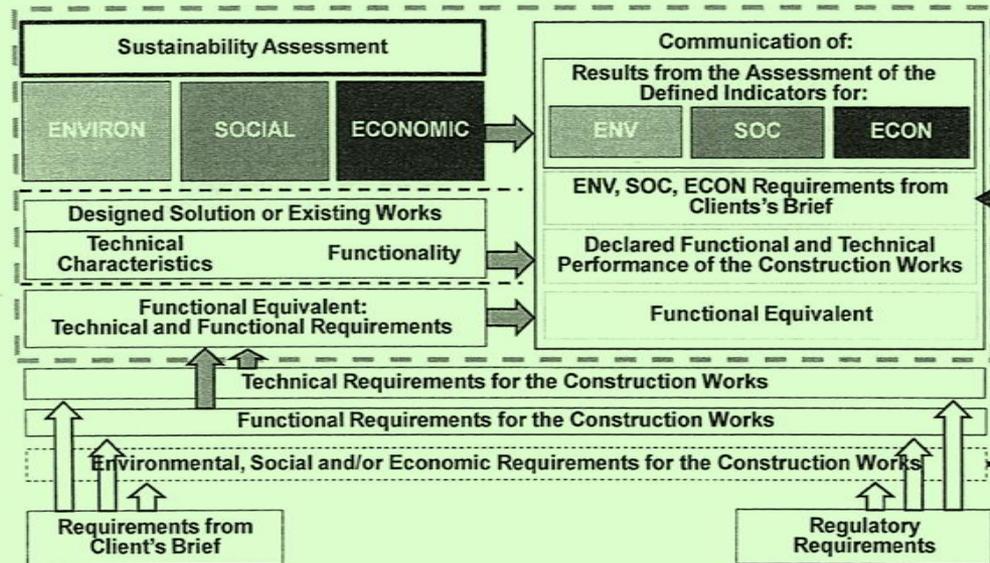
The agreed generic set of NRDs sustainability criteria for assessing the economic factor CEN/TC 226/WG6-TG4

CEN/TC 350 WD prEN 15643-5 Framework for sustainability assessment of civil engineering work – critical analysis

- The sustainability assessment of civil engineering work at framework level has only started and is based on the EN 15643-1 Sustainability Assessment of Buildings – General Framework and on EN15643-2, EN15643-3 and EN 15643-4 Frameworks for the Environmental, Social and Economic Performances of Buildings, respectively. There is no Framework standard addressing the Technical Performance.
- The sustainability assessment of civil engineering work at works level has not started, yet but will be developed in the future. No information about the assessment of the technical performances at this level is given.
- **The only sustainability assessment of civil engineering work at product level is EN 15804 Environmental Product Declaration. References are made to EPD of Build Products ISO 21930, EN 15942 and CEN/TR 14941. The technical information related to some aspects of social and economic performance are included under the provisions of EN 15804 to form part of EDP, instead of being considered individually and separate, hence the individual performances are not independent and the assessment results in confusion, double counting and possible litigation.**
- **THERE IS A MAJOR CONCERN ON HOW EN 15804 CAN BE USED FOR ROAD EQUIPMENT SUSTAINABILITY ASSESSMENT AND THE SUSTAINABILITY DEMONSTRATION AS REQUIRED BY CPR AND CE MARKING TO ENSURE A FAIR COMPARISON OF PRODUCTS DURING THEIR LIFE CYCLE.**

CEN/TC 350 WD prEN 15643-5 Framework for sustainability assessment of civil engineering work

prEN 15643-5



Assessment at the civil engineering works level means that the descriptive model of the works with the major technical and functional requirements has been defined in the client's brief or in the regulations.

NOTE: The outer box with the dotted line represents the area standardised by CEN/TC 350.

Concept of sustainability assessment of Construction Works

In concept, the integrated civil engineering works performance incorporates environmental, social and economic performance as well as the technical and functional performance, and these are intrinsically related to each other, as illustrated in Figure 2. Although the assessment of technical and functional performance does not form part of this series of standards, their interrelationship with environmental, social and economic performance is a prerequisite for an assessment of sustainability performance of civil engineering works and, therefore, is taken into

CEN/TC 350 WD prEN 15643-5 Framework for sustainability assessment of civil engineering work- cont.

prEN 15643-5

Framework level	EN 15643-1 Sustainability Assessment of Buildings - General Framework (TG)			Technical Characteristics	Functionality
	EN 15643-2 Framework for Environmental Performance of Buildings (TG)	EN 15643-3 Framework for Social Performance of Buildings (WGS)	EN 15643-4 Framework for Economic Performance of Buildings (WG4)		
	WI 022 (prEN 15643-5) Framework for Sustainability Assessment of Civil Engineering Works (WG6)			Service Life Planning – General Principles (ISO 15686-1)	
Works level	EN 15978 Assessment of Environmental Performance of Buildings (WG1)	EN 16309 Assessment of Social Performance of Buildings (WGS)	FprEN 16627 Assessment of Economic Performance of Buildings (WG4)	CEN Standards on Energy Performance of Buildings Directive (EPBD)	
	To be developed later: Methods for Sustainability Assessment of Civil Engineering Works (WG6)				
Product level	EN 15804 Environmental Product Declarations (WG3)	(see Note below)	(see Note below)	Service Life Prediction (ISO 15686-2), Feedback from Practice (ISO 15686-7), Reference Service Life (ISO 15686-8)	
	EPD of Build. Products (ISO 21930)	<i>Note:</i> At present, technical information related to some aspects of social and economic performance are included under the provisions of EN 15804 to form part of EPD			
	EN 15942 Comm. Form. B-to-B (WG5)				
	CEN/TR 15941				

NOTE: The coloured boxes represent the current work programme of CEN/TC 350.

Work programme of CEN/TC 350

This framework is a part of the framework standards for sustainability assessment of construction works. The purpose of this EN 15643-5 is to provide a framework with principles, requirements and guidelines for the assessment of the environmental, social and economic performance of a civil engineering works at the "framework level". In the drafting of this European Standard, ISO 21930 and ISO/DTS 21929-2 have been taken into consideration.

Conclusions

1. The **communication of sustainability related information** throughout the whole life of road equipment products, such as NRDs, is **increasingly demanded** both by private and public sector organizations as the sustainability agenda becomes prevalent and cannot be provided by the **CEN/TC 350 WD prEN 15643-5 Framework for sustainability assessment of civil engineering work**
2. The **evidence-based Quiesst sustainability assessment framework based on multi-criteria analysis developed in 2011** was selected by European Commission's Environment Directorate-General independent scientific advisors to assist the **development of effective, evidence-based sustainability policies**. 13 most common noise barriers have been assessed and benchmarks have been produced using data from the EU countries . Two case studies (Italy and Spain) using site specific and project data were also assessed.
3. This work has been developed further by CEN TC 226/WG6/TG4 to provide a harmonized and reliable method for assessing the sustainability of NRDs and can be used by other road equipment products' standards.
4. The development of a **sustainability standards for Road Equipment is firmly recommended** to drive explicitly sustainability in design, management, and procurement, activities related to these equipment.

THANK YOU!
Questions

