PROCEEDR

OPTIMISING RESOURCE USE
FOR ROADSIDE INFRASTRUCTURES

CEDR FINAL PROGRAMME CONFERENCE: DAY 1

Marco Conter (WP-Leader of PROCEEDR)
on behalf of the PROCEEDR consortium

CEDR FINAL PROGRAMME CONFERENCE

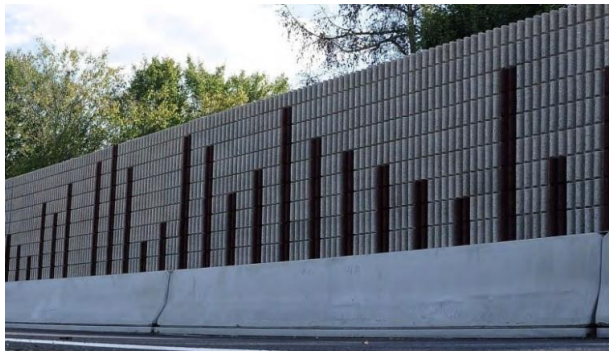
Utrecht, 12. & 13. March 2024

Core project team members:
Marco Conter, AIT
Giovanni Brero, ERF
Holger Wallbaum, Chalmers
Bijan Adl-Zarrabi, Chalmers
Nilufar Lebasi, ERF
Christophe Nicodeme, ERF
Alison Hewitt, TRL
Tadas Andriejauskas, TRL

Focus of the research project : Noise & Safety Barriers

Different types of roadside barriers (even integrated systems) have been considered with reference to materials used, and solutions adopted in Europe.

Safety barriers / Integrated safety & noise barriers / noise barriers





Main Goals of WP1: Innovative and sustainable roadside infrastructure solutions

- Summarise the multi **life cycle-based tools** currently available
- Collect **best practices on innovative and sustainable roadside infrastructure solutions**, including bio-based, composite and/or recycled materials used for noise & safety barriers
- Produce a **state-of-the-art survey** on roadside infrastructure equipment
- Selection of sustainable and innovative solutions and select a relevant sample of application cases
- Develop **recommendations** based on the evaluation of the application cases

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D1.2 State-of-the-art report on sustainability of roadside infrastructure equipment

CEDR TRANSNATIONAL RESEARCH PROGRAMME
Call 2020: Resource Efficiency and the Circular Economy

D1.2 State-of-the-art report on sustainability of roadside infrastructure equipment

M1.2: Selection of relevant roadside infrastructure solutions and methodology or ranking criteria for product selection

Work package / task: WP1 / task 1.2
Dissemination level of the document: public
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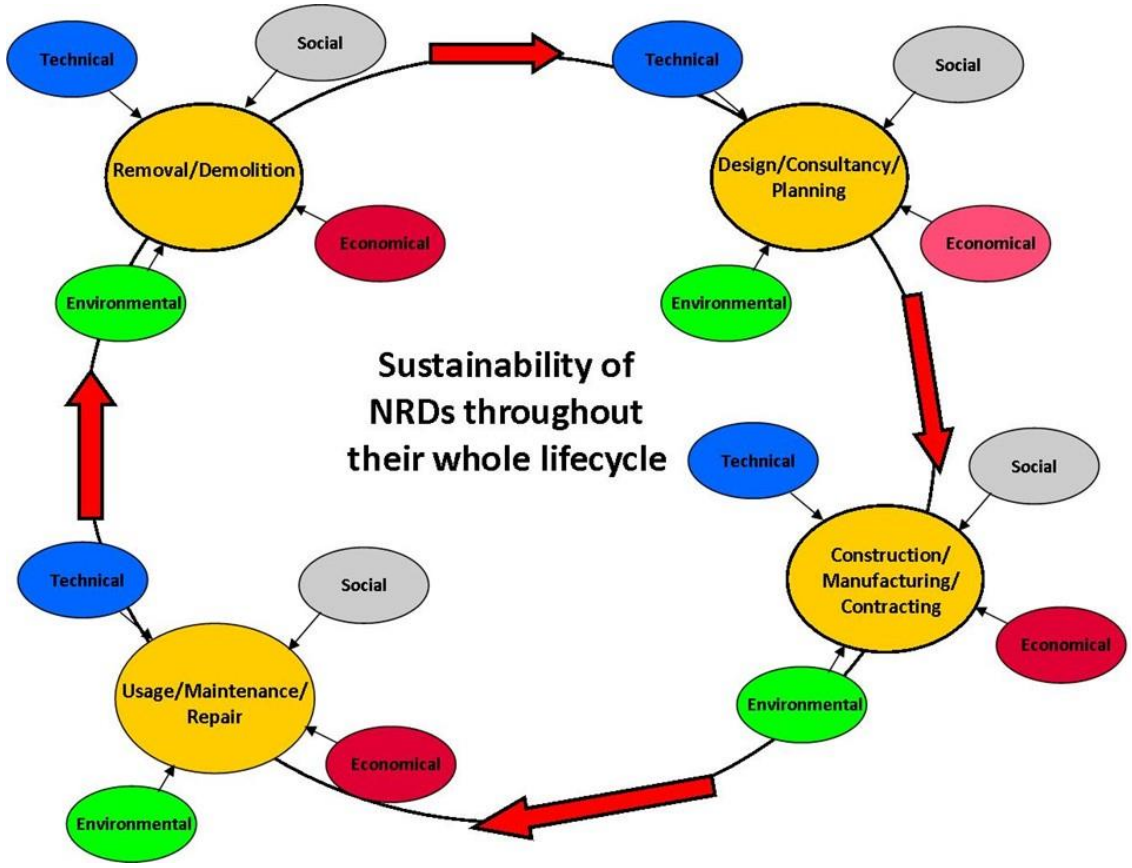
Author(s) of this deliverable:
Marco Conter (AIT Austrian Institute of Technology GmbH)
Giovanni Brero (European Union Road Federation ERF)
Isabela Erdelean (AIT Austrian Institute of Technology GmbH)
Nilufar Lebasi (European Union Road Federation ERF)

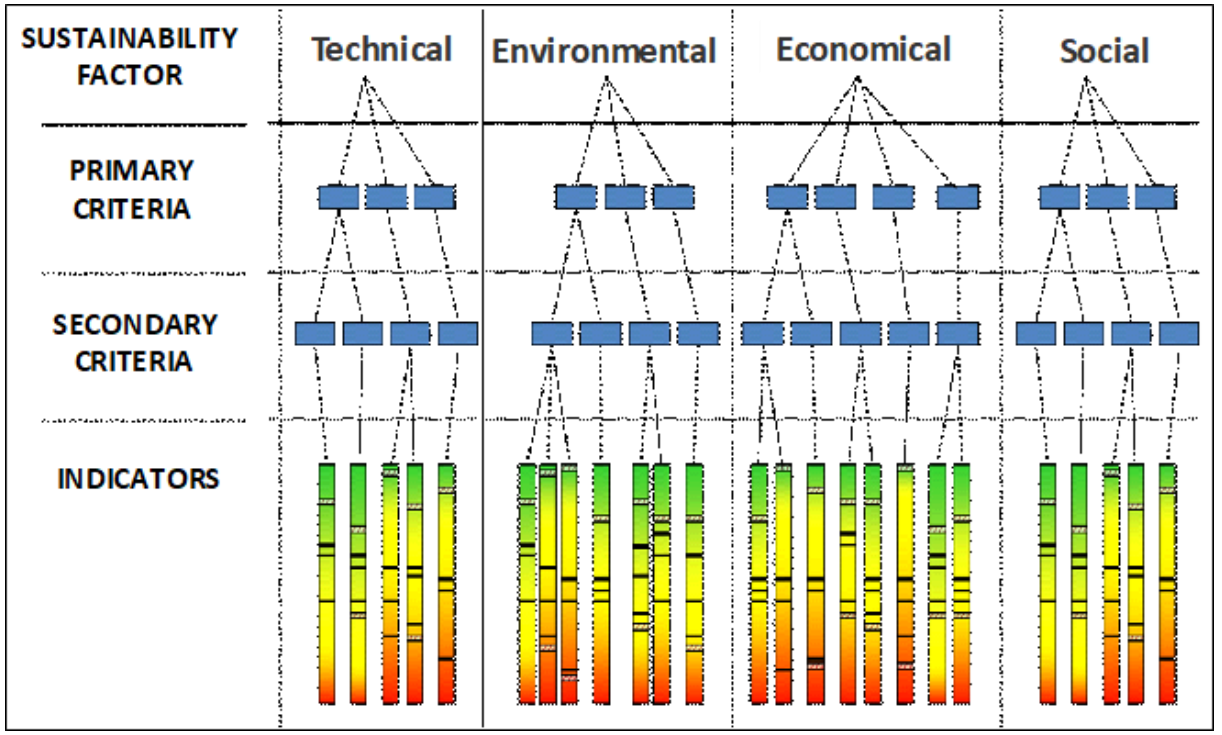
Reviewer of this deliverable:
Bijan Adl-Zarrabi (Chalmers University of Technology)

State-of-the-art report on sustainability of roadside infrastructure equipment

- **European regulations** and current sustainability approach in the field of noise and safety barriers
- Issues related to **CPR implementation** for noise and safety barriers
- Current implementation of environmental and **sustainability topics in construction projects**
- The Green Public Procurement (GPP)
- Research projects dealing with sustainability of noise barriers

State-of-the-art report on sustainability of roadside infrastructure equipment

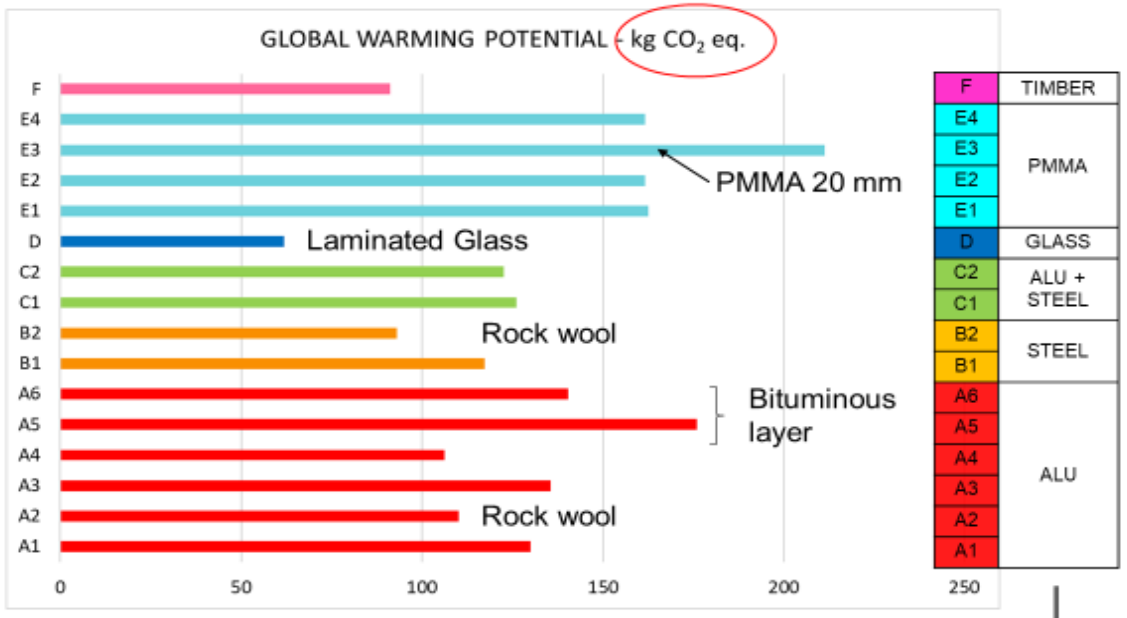




Source: C. Dumbrava et al. (QUIESST project)

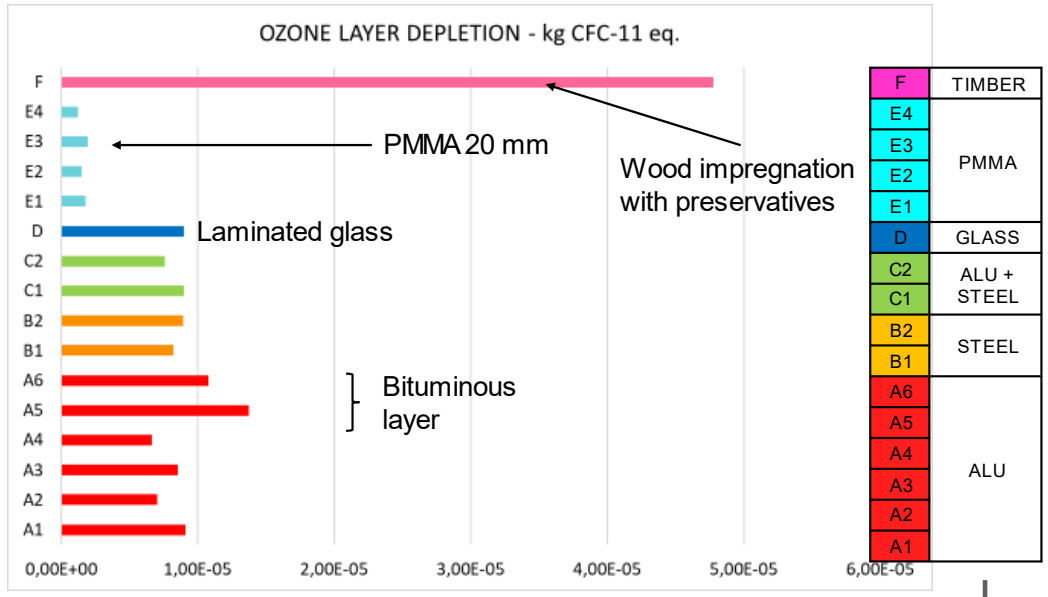
State-of-the-art report on sustainability of roadside infrastructure equipment

Results – Carbon footprint



M. Garai – University of Bologna ALMA MATER STUDIORUM - UNIVERSITÀ DI BOLOGNA 9

Results – Ozone layer depletion



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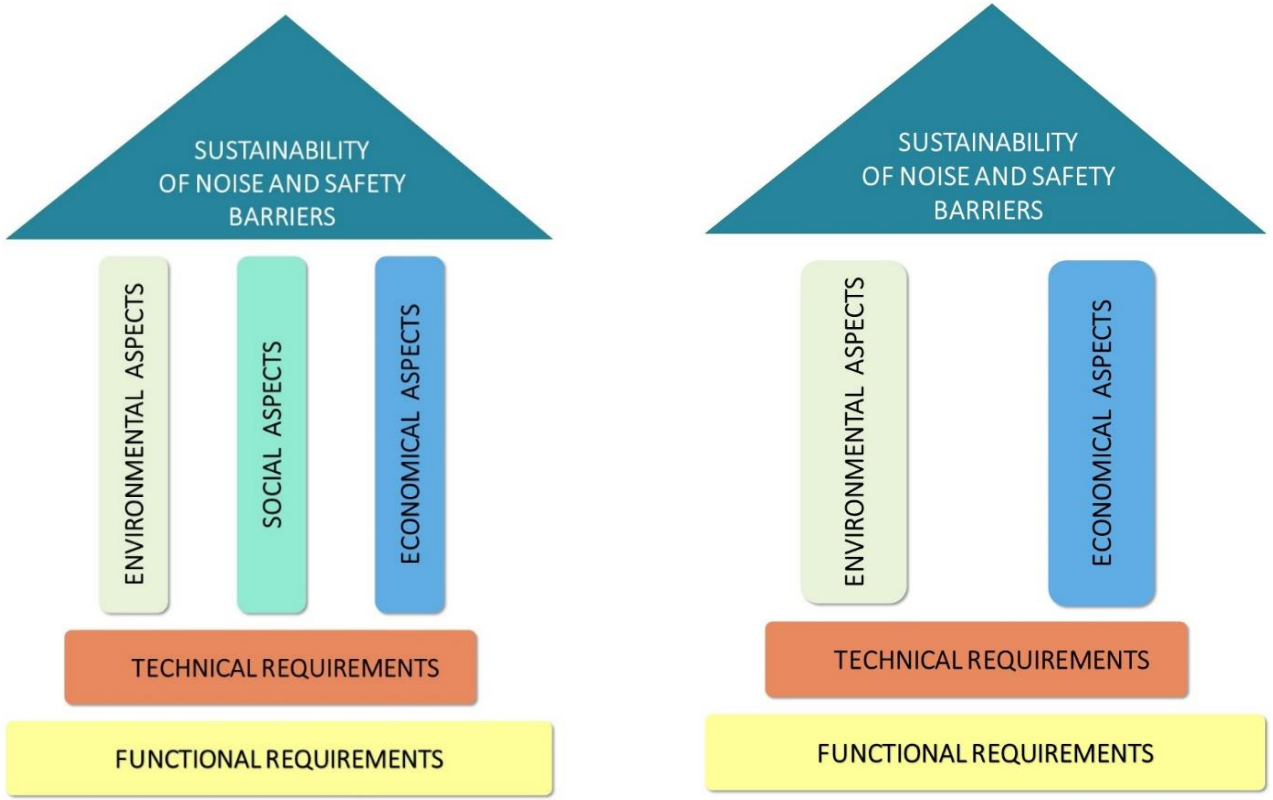
State-of-the-art report on sustainability of roadside infrastructure equipment: the PROCEEDR approach

- For noise and safety barrier project **technical and functional requirements** represents the basement.
- On the top of that **economic, social, and environmental requirements** need then to be considered for a sustainability evaluation
- For safety barriers the functional requirements are much stronger and social aspects have minor relevance



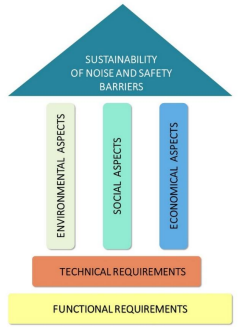
General classification of noise and safety barrier types currently used

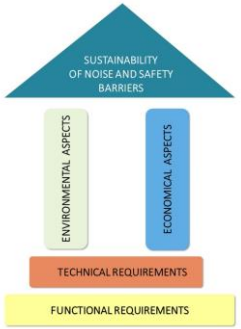
- For **noise barriers,** more materials can be used for non-structural components (e.g. acoustic panels).

→ more option for sustainable solutions

- For **safety barriers**, most components are of the structural type (e.g. steel and concrete).

→ option for sustainable solutions restricted to timber and other materials (e.g. for steel coatings)

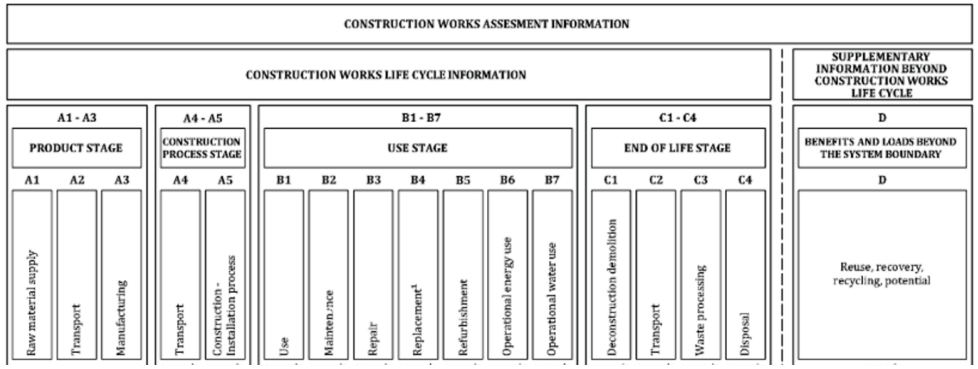




Noise barrier types (including road coverings and earth berms)		
	SC	Steel support structure + Concrete panels
	SW	Steel supporting structure + Wooden panels
	SM	Steel supporting structure + Metal panels
	ST	Steel supporting structure + Transparent modules
	SP	Steel supporting structure with plastic panels
	CB	Self-supporting concrete or brick system
	GB	Green barrier
	EB	Earth barrier (earth berm)
	RC	Road covering structure (including artificial tunnels)
Safety barrier types		
	SB	Steel safety barrier
	WB	Mixed wood steel safety barrier
	PB	Precast concrete safety barrier
	IC	In situ cast concrete safety barrier
	CC	Crash cushion
	IB	Integrated noise safety barrier

Description of the life cycle stages for the most common noise barriers in Europe

1. **raw material**
2. **production / manufacturing** process
3. **transportation** to construction site
4. **installation** / construction stage
5. **maintenance** stage
6. **end of life** stage



CONSTRUCTION WORKS ASSESMENT INFORMATION																	
CONSTRUCTION WORKS LIFE CYCLE INFORMATION																SUPPLEMENTARY INFORMATION BEYOND CONSTRUCTION WORKS LIFE CYCLE	
A1 - A3			A4 - A5		B1 - B7							C1 - C4				D	
PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY	
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	
Raw material supply	Transport	Manufacturing	Transport	Construction - Installation process	Use	Maintenance	Repair	Replacement[1]	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery, recycling, potential	

End of life

both steel and aluminium components may be recycled

mineral wool: the policy of main suppliers is that of recycling mineral wools to meet a target to take back a certain percentage of the scrap generated from their customers' job sites.

3.2.4 Life cycle stages for noise barriers made of steel supporting structure and transparent modules

Table 6: Life cycle stages for noise barriers made of steel supporting structure and transparent modules.

ST	Steel supporting structure + Transparent modules

Description: noise barrier made of structural elements (steel posts + base plate and anchor bolts) + acoustic elements made of transparent modules (transparent sheets made of solid polymethylmethacrylate, polycarbonate or laminated glass equipped with a metallic frame).

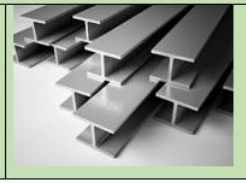
Raw materials used

For supporting structure:

Hot rolled steel profile of the open type

Different steel grades

Supplied in bars.



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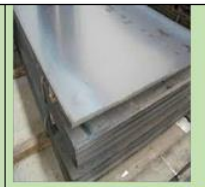
For supporting structure:

Steel plates

Different steel grades.



For PMMA /PC sheets:

MMA or polycarbonate granules used for further polymerization process.

For laminated glass sheets:

Float glass made of sand, soda ash and limestone.

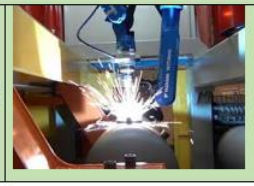
For transparent sheets of all types:

Steel profiles + EPDM gasket for the transparent sheet frame.

Manufacturing process

Cutting – Bending -

Welding of steel profiles to achieve the required shape and dimensions.



Description of the life cycle stages for the most common safety barriers in Europe

3.3 Description of the life cycle stages for safety barriers

The following tables describes the stages of the whole life cycle of the most relevant safety barrier types used in Europe. After a short description of the noise barrier types, the raw material used, and the manufacturing and production process are briefly shown. After that the transport to the installation site, the installation itself, the monitoring and the end-of-life phases are finally described including also relevant pictures of the most relevant processes.

3.3.1 Life cycle stages for noise barriers made of steel safety barriers

Table 12: Life cycle stages for noise barriers made of steel safety barriers.

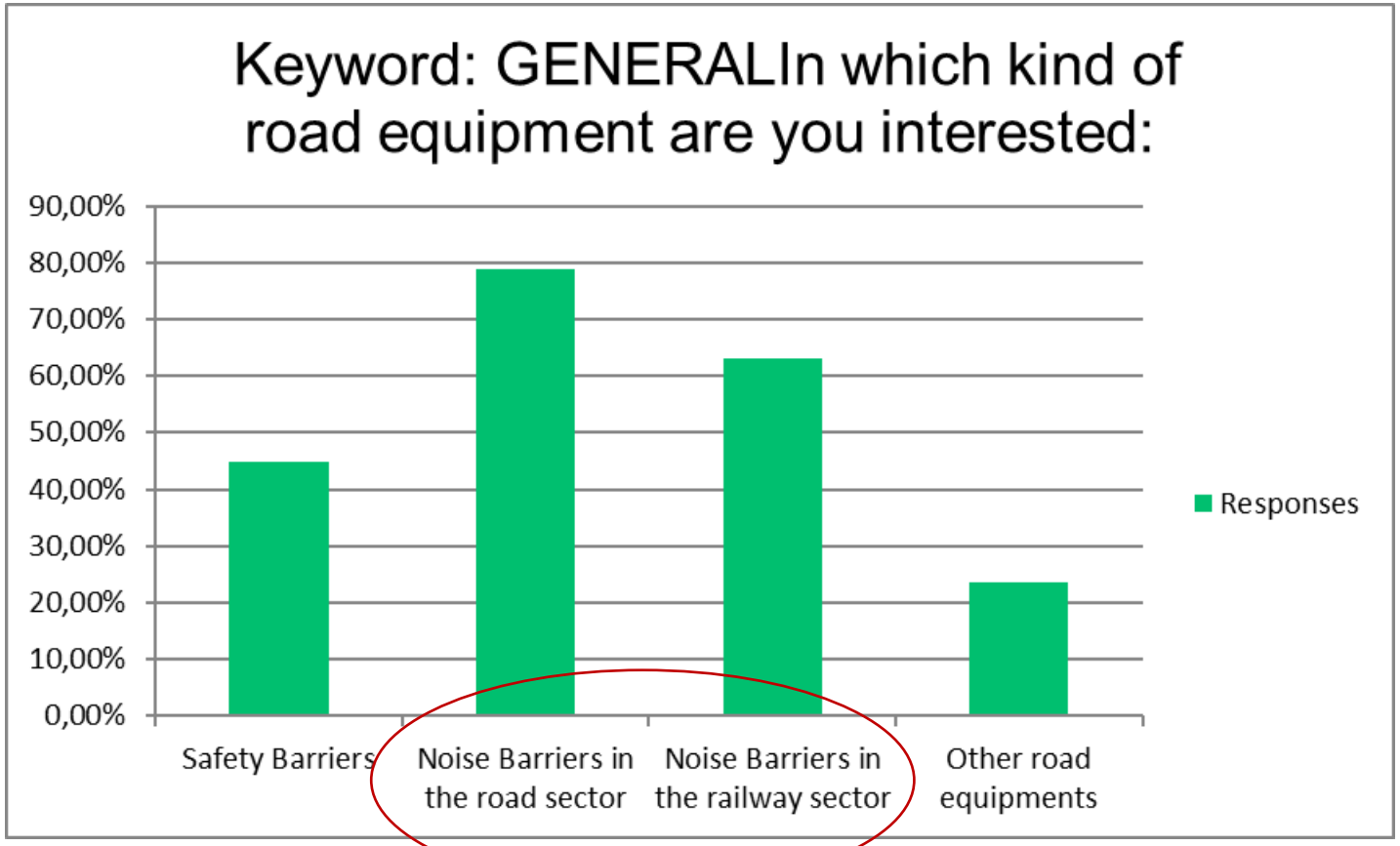
SB - Steel safety barriers	
	
Description: Safety barrier made of steel. Semi-rigid barriers, usually made from steel beams or rails. Most common type is the W-Beam steel barrier.	
Raw materials treatments	Different grades of hot rolled, perforated, hot-dip galvanised steel; steel posts; bolt, nuts, washers. The raw materials are used in coils. Killed or mild steel must be used for steel safety barriers otherwise they degrade over years and can become brittle. (Use of secondary material: % of scrap steel could be re-used for production).
Production phases	Horizontal parts are stamped and edged on a press. Vertical parts are shaped on profile machinery. Other construction parts are made on different hydraulic and ex-centre presses, welding robots or manual welding stations. Surface treatment is performed through galvanisation for surface protection – hot dip galvanising and strip galvanising.
	
Transportation to the construction site	Use of 16-32 metric tonnes truck. To optimise safety barrier installation and avoid obstructions on site, only the barrier material required on the day should be delivered at site.
Installation/ construction phase	Equipment: 7.5 to 10 tonnes truck, compressor, pneumatic rammer, and pneumatic hand tools. Hydraulic equipment for drilling or ramming in heavy ground conditions. Personnel: 3-5 workers + site supervisor. Traffic disruption: emergency lane. 
Maintenance	Service lifetime: 50 years. Maintenance: cleaning, renewal of barrier anti-corrosion coatings, exchange of corroded barrier joints, inspection rounds. Repairs usually relate to barrier crashes, barrier damage.

Survey results for Industry stakeholders

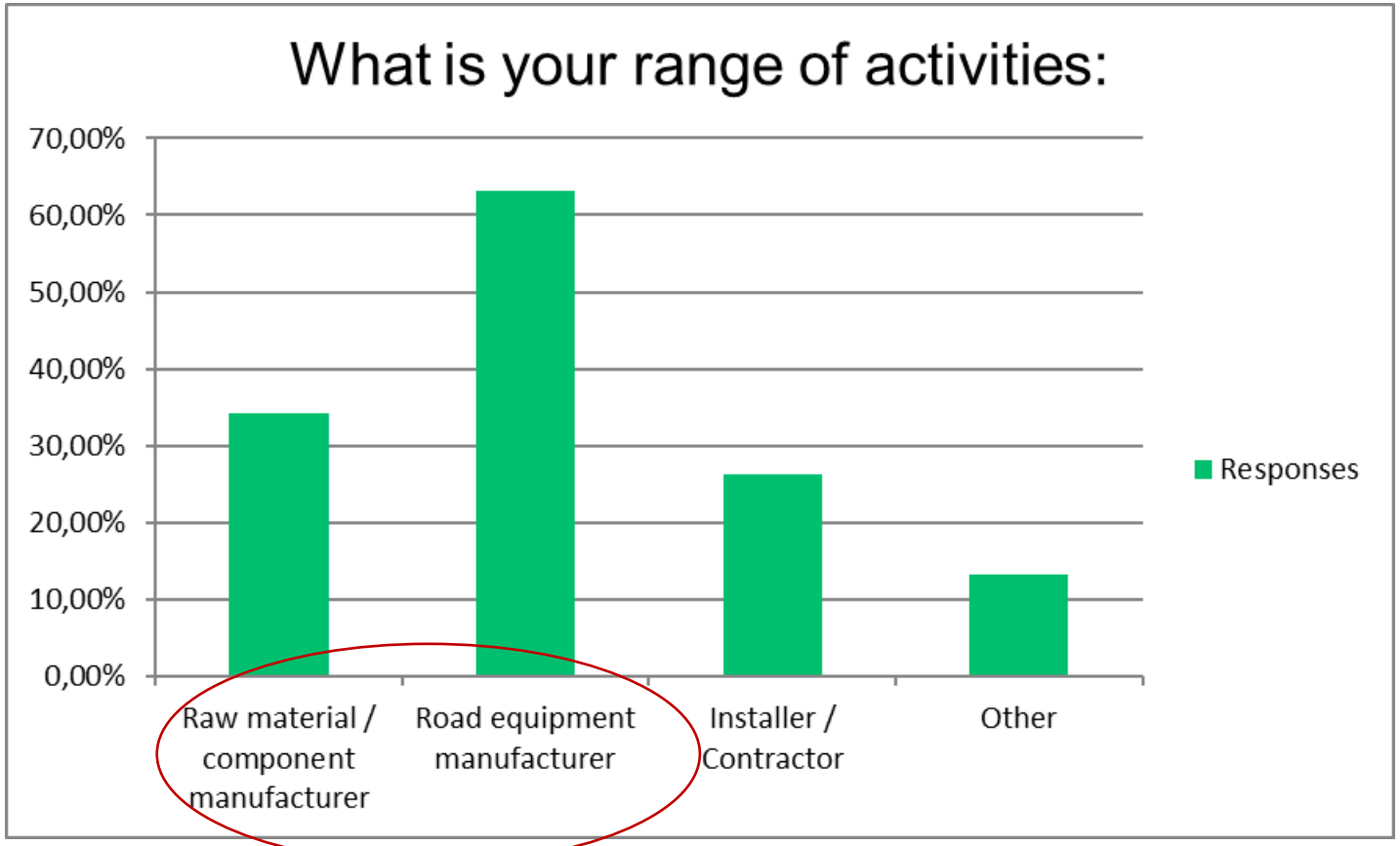
- Online survey using online tool SurveyMonkey
- Survey started in November 2021 with deadline in December (1st extension to January, 2nd extension to end of March to get more replies and cover initial gaps) → Final results collected (by end of April)
- 17 relevant questions
- 114 different companies approached
- 48 positive replies
- 13 different European countries: Sweden, Norway, Austria, UK, France, Poland, Italy, Luxembourg, Germany, The Netherlands, Spain, Croatia, Belgium

Exemplary results

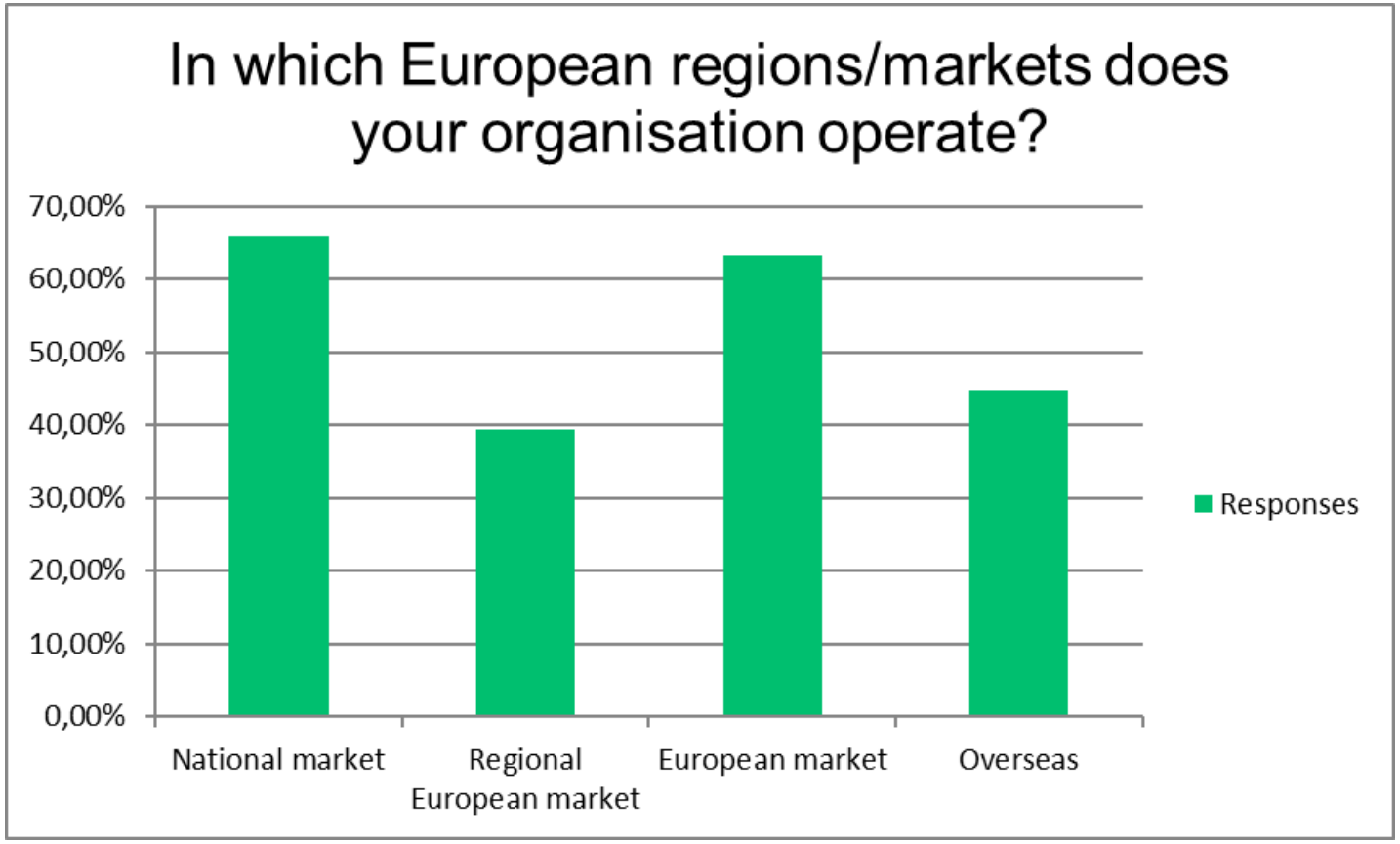
Sector Distribution



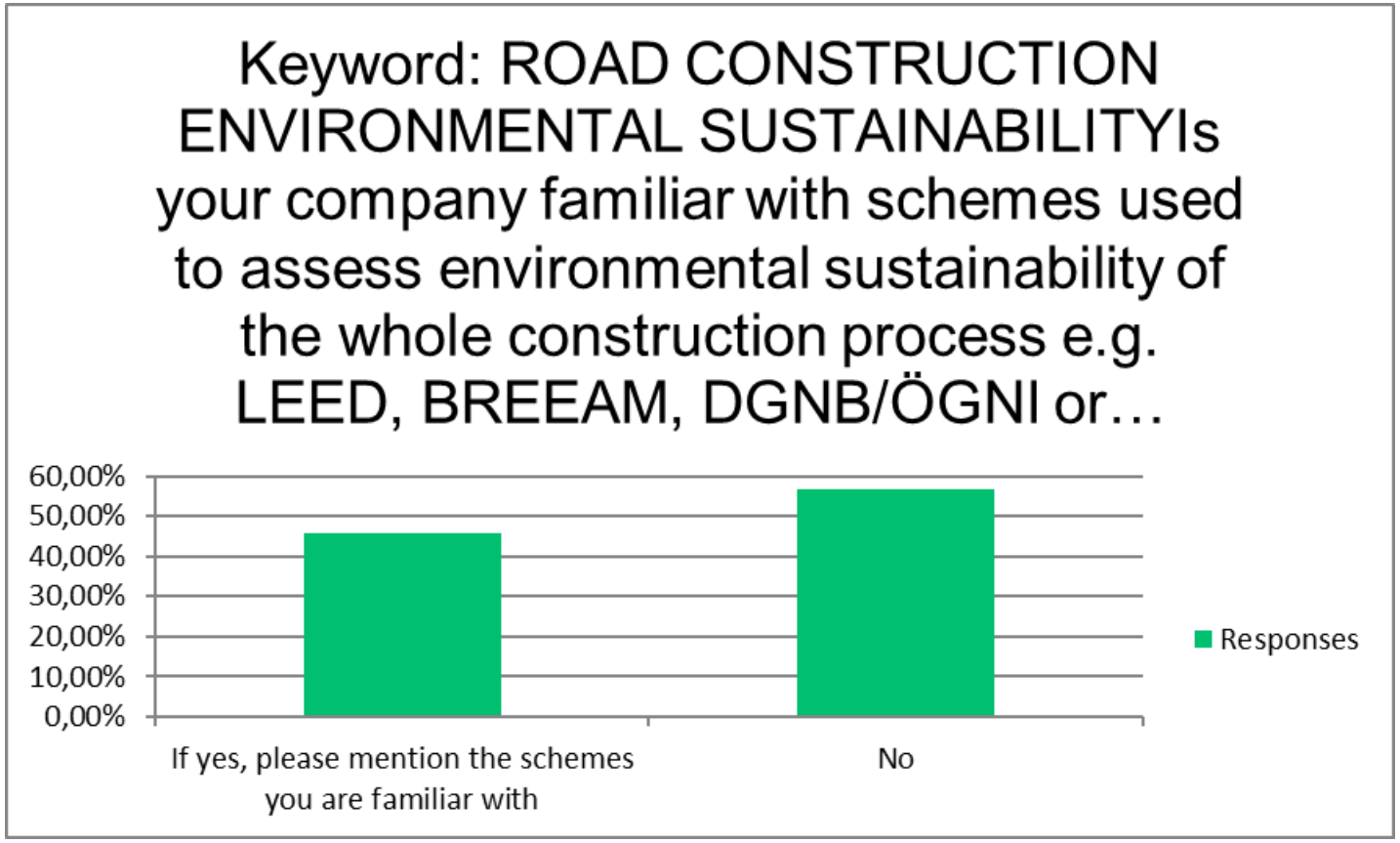
Range of Activities



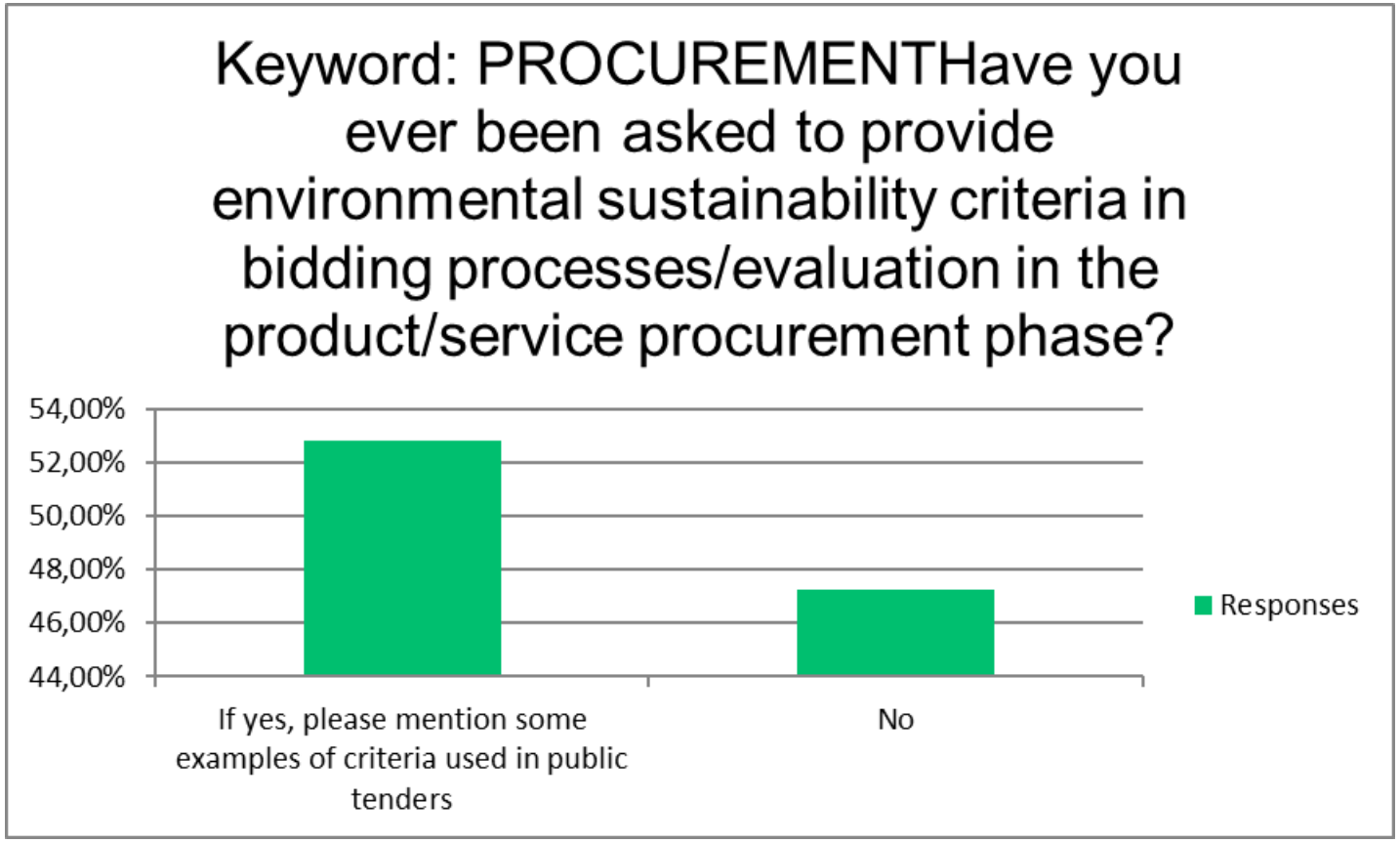
Market Area


In which European regions/markets does your organisation operate?
70,00%
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
National market
Regional European market
European market
Overseas
Responses

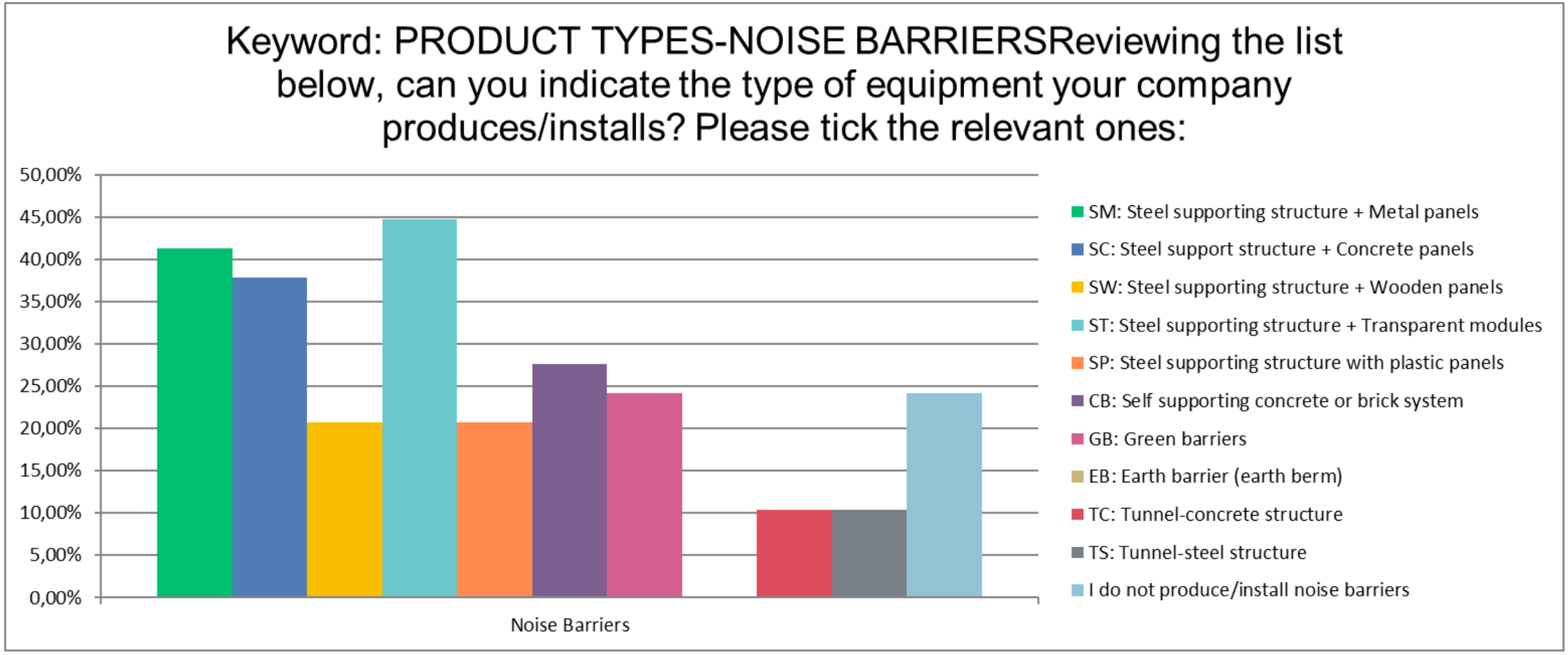
Familiarity with the Topic of Sustainability



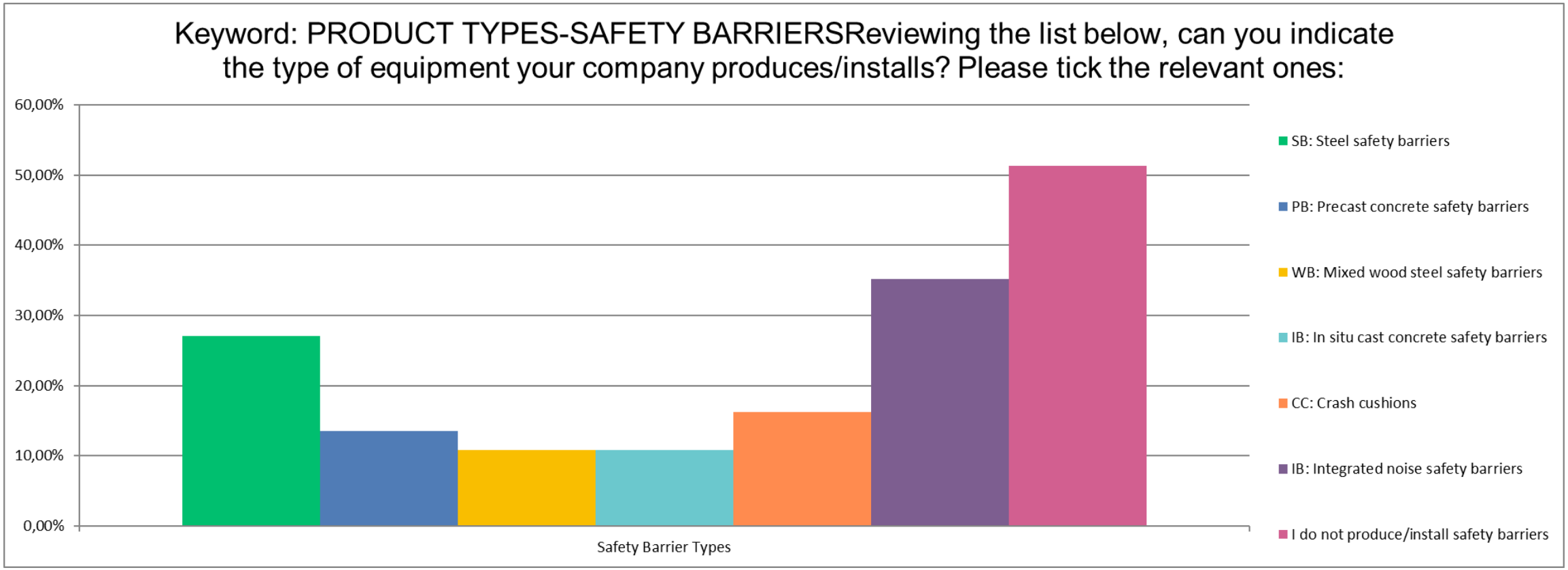
Sustainability already requested in Procurements?



Exemplary results



Exemplary results



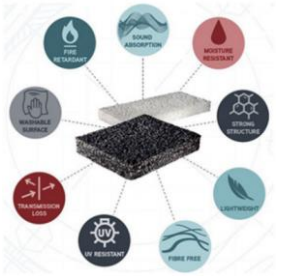
Main findings of the PROCEEDR survey for industry stakeholders

- About **50% of the industry stakeholders are not familiar with** schemes used to assess **environmental sustainability** of the whole construction process e.g., LEED, BREEAM, DGNB/ÖGNI or specifically for road infrastructure.
- About 50% of the companies have ever been **asked to provide environmental sustainability criteria in bidding processes**/evaluation in the product/service procurement phase.
- **70 to 90% of the companies tries to improve the sustainability** of the product concerning selection of the raw material, manufacturing process and maintenance.
- The results indicates that the **interest for improving the sustainability** of the products exists, however, there is a **lack in knowledge related to existing tools**, which can be improved by adding documentation concerning sustainability assessment in bidding process.
- Topic of sustainability in the noise and safety barrier sector is rather new, **the noise barrier sector seems to be more advanced in considering some of the sustainability criteria** and trying to improve their products

Possible Case Studies over the whole Life Cycle from the Industry Survey

Relevant roadside infrastructure sustainable (?) solutions

- Sound absorbing materials for acoustic cassette panels
- Galvanisation protection of steel surface
- Timber safety barriers
- PVC acoustic cassette panels
- Integrated noise and safety barriers
- Transparent noise barriers
- Noise barriers equipped with PV modules

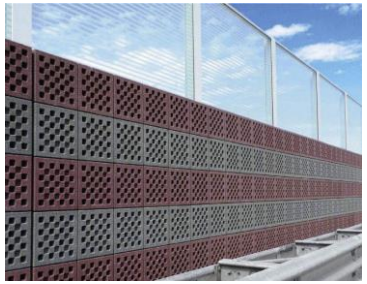






Relevant roadside infrastructure sustainable (?) solutions

- Foundation system integrated with the supporting structure of noise barriers
- Sound absorbing concrete tiles
- Bio-based noise barriers
- Innovative systems for noise protection



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D1.3 & D2.3 - Practical guideline with a recommendation for industrial stakeholders to assess the use of different materials in roadside infrastructure

Legal Framework

- GPP:Green Public Procurement (GPP) is defined in the Communication of the EC (COM -2008- 400) "Public procurement for a better environment" as "a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle
- The European Commission (EC) has been developing voluntary GPP criteria for several product groups
- Road design, construction and maintenance volountary GPP: https://circabc.europa.eu/ui/group/44278090-3fae-4515-bcc2-44fd57c1d0d1/library/57e2abc4-a42e-4666-8ce8-dfbc987b6f2d?p=1&n=10&sort=modified_DESC

Legal Framework

CPR 305 2011: Construction Product Regulation is currently under revision

According to the CPR, manufacturers, or their representatives, are requested to declare and guarantee the performance of road equipment's according to a **common set of technical standards** developed by technical commissions established within CEN[2].

The **product performance is declared** for the so-called **essential characteristics** of the road construction, which are listed in CPR as following ones:

(i) Mechanical resistance and stability

(ii) Safety in case of fire

(iii) Hygiene, health, and the environment

(iv) Safety and accessibility in use

(v) Protection against noise

(vi) Energy economy and heat retention

(vii) Sustainable use of natural resources.

Technical Standards

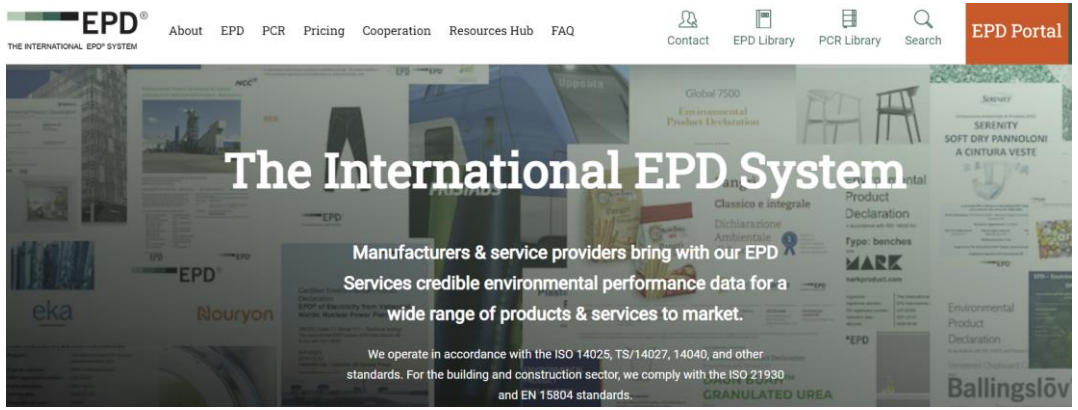
- Technical standards for noise and safety barriers are currently developed by CEN TC 226 Road Equipment, specifically

- WG1 is dealing with safety barriers
- WG6 is dealing with noise reducing devices (i.e. noise barriers)

- Within WG6 the prEN 17383 Road traffic noise reducing devices — Sustainability: Key Performance Indicators (KPIs) Declaration is ready for publication

Technical Standards

- CEN is asking for an harmonized procedure to assess sustainability of costruction products
- for Noise barriers: prEN 17383 is based on the standard **EN 15804 2012+A2:2019**, *Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products* developed by TC 350.
- for Safety barriers*:* **cPCR about Guardrails and bridge parapets** has been developed with the support the preparation of EPDs, see http://www.environdec.com/



EPD-Databases currently available

EPD declaration scheme according to EN 15804 (which version?), however **many differences can be encountered:**

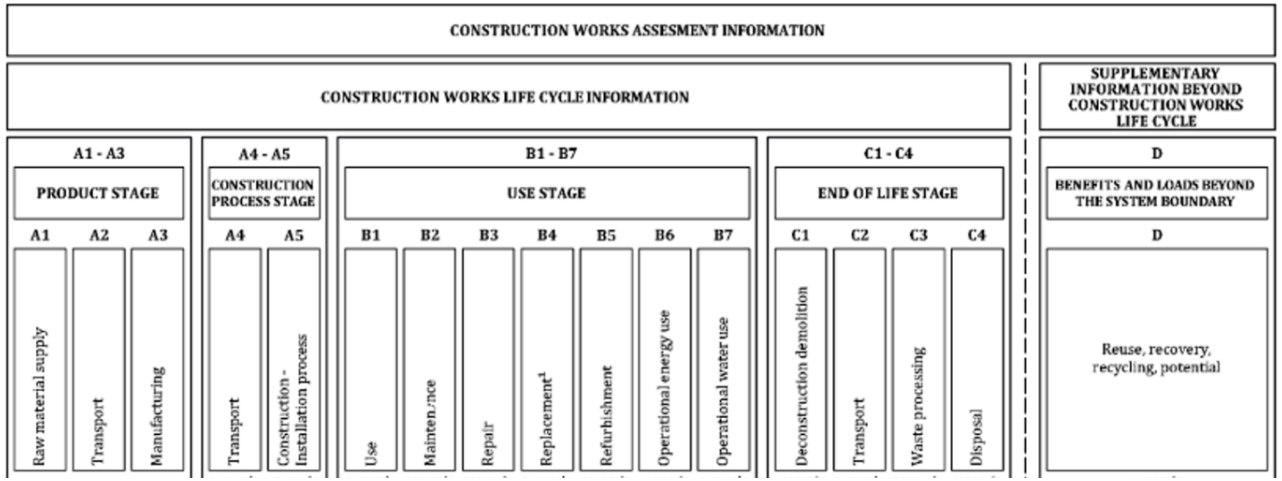
- Lack of uniformity of schemes
- High costs of some existing databases that coexist while alternative data bases available for free
- Need to achieve familiarity with quantitative data resulting from LCA calculations
- Only LCA modules A1, A2, A3 based on primary data to be considered in tendering process

- **GaBi** (Ganzheitliche Bilanzierung, USA/Germany) https://gabi.sphera.com/deutsch/datenbanken/gabi-datenbanken/baumaterialien/ Thinkstep (Germany) was acquired in 2019 by Sphera (USA), 1500$, big database but not only construction industry, (314 EPDs for Construction Materials)
- **SimaPro** (Netherlands) https://simapro.com/ 5500€, implements Ecoinvent database
- **Ecoinvent** (Switzerland) https://ecoinvent.org/the-ecoinvent-database/ 4400€ + yearly 1350€, big database but not only construction industry (916 datasets for Construction EN 15804)
- **Institut Bauen und Umwelt** (Germany) https://ibu-epd.com/veroeffentlichte-epds/ free, medium database (1621 EPDs for Construction Products)
- **OneClickLCA** (Finland/UK/US/France) https://www.oneclicklca.com/ free, medium database (130.000 "datapoints")
- **ÖKOBAUDAT** (Deutschland) https://www.oekobaudat.de/no_cache/datenbank/suche.html free, medium database (1085 / 629+86 EPDs for Construction Products) based also on GaBi and Ecoinvent
- **Bau-EPD GmbH** (Austria) https://www.bau-epd.at/en/epd/list free, very small database (20 EPDs)
- **EPD International AB** (Sweden) https://environdec.com/library free, medium database (726 EPDs for Construction Products Europe)
- **Epd-Norway** (Norway) https://www.epd-norge.no/epder/ free, medium database (1852 EPDs for Construction Products Scandinavia)
- **KIWA** (Germany) https://www.kiwa.com/de/de/veroffentlichte-epds/ free, medium database (only products certified by KIWA)
- **ECO Platform** (Brussels) https://www.eco-platform.org/list-of-all-eco-epd.html free, medium database, based also on GaBi and Ecoinvent
- **GreenBook** (UK) https://www.greenbooklive.com/search/scheme.jsp?id=260 free, medium database (104 EPD holders!)
- **Digital Environmental Hub for Global Construction Products** (International) https://lcadatabase.com/ free, big database (4820 records)

Expectations have been collected by the industrial sector

How to implement environmental sustainability in GPP ?

- Confine declarations to modules A
- Eventually extended to modules C
- Clarify the use of module D
- Define appropriate scenarios for modules B

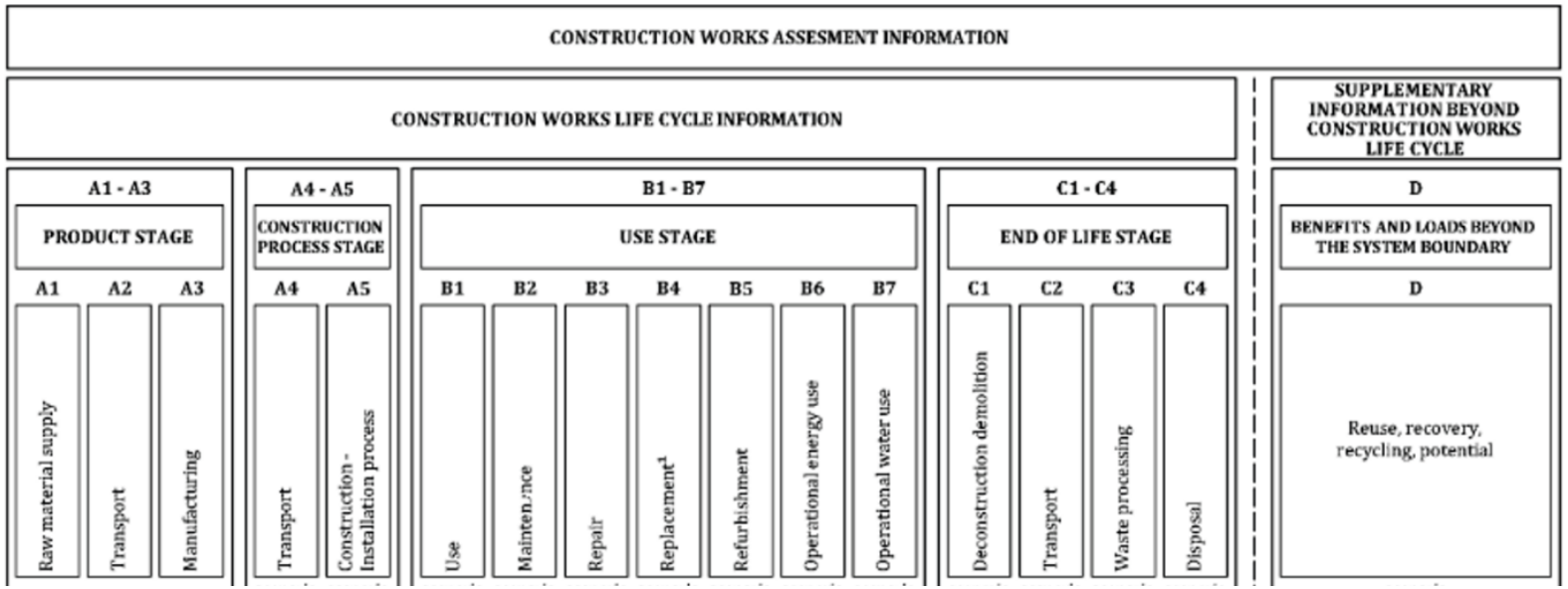


- Identify a global indicator i.e.: The Environmental Cost Indicator (ECI) is a single-score indicator expressed in Euro

Need to be remarked that **CPR is not governing the installation phase, the maintenance and the procedure for dismantling, recycling, or reusing the construction products when the end of life is reached**. Those phases fall out of the perimeter of the harmonization (common law) and remain entirely under the control of National Authorities.

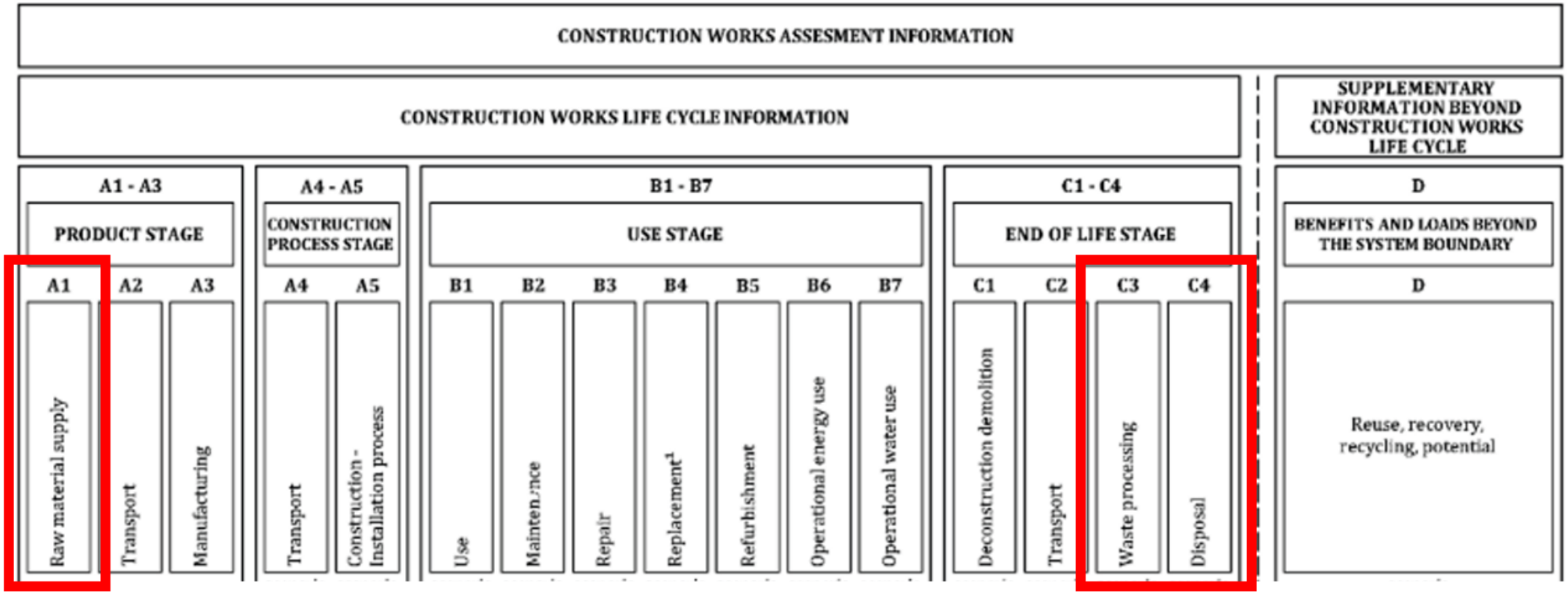
Recommendations for

- ***Raw material producers***
- ***Road equipment manufacturers***
- ***Installers***



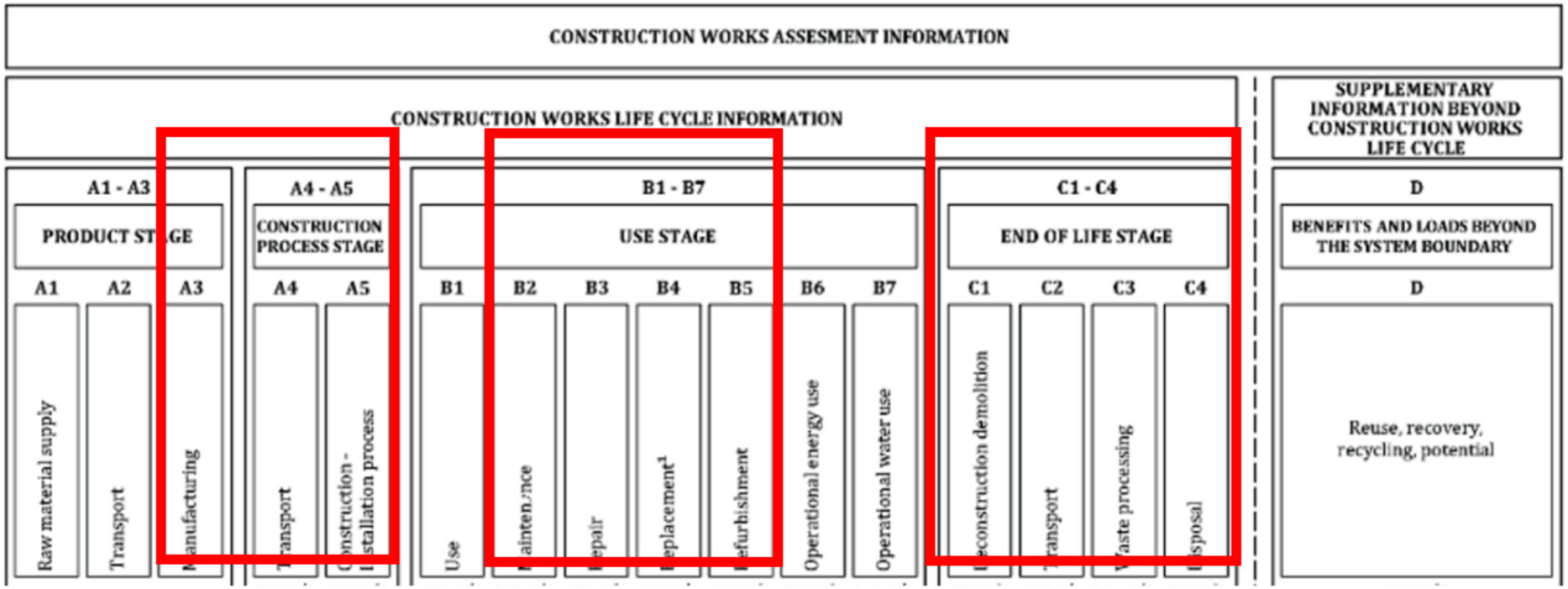
- Phase B is mainly managed by NRAs
- Phase C is managed by NRAs supported by producers of raw materials, installers, and manufacturers

Recommendations for raw material producers



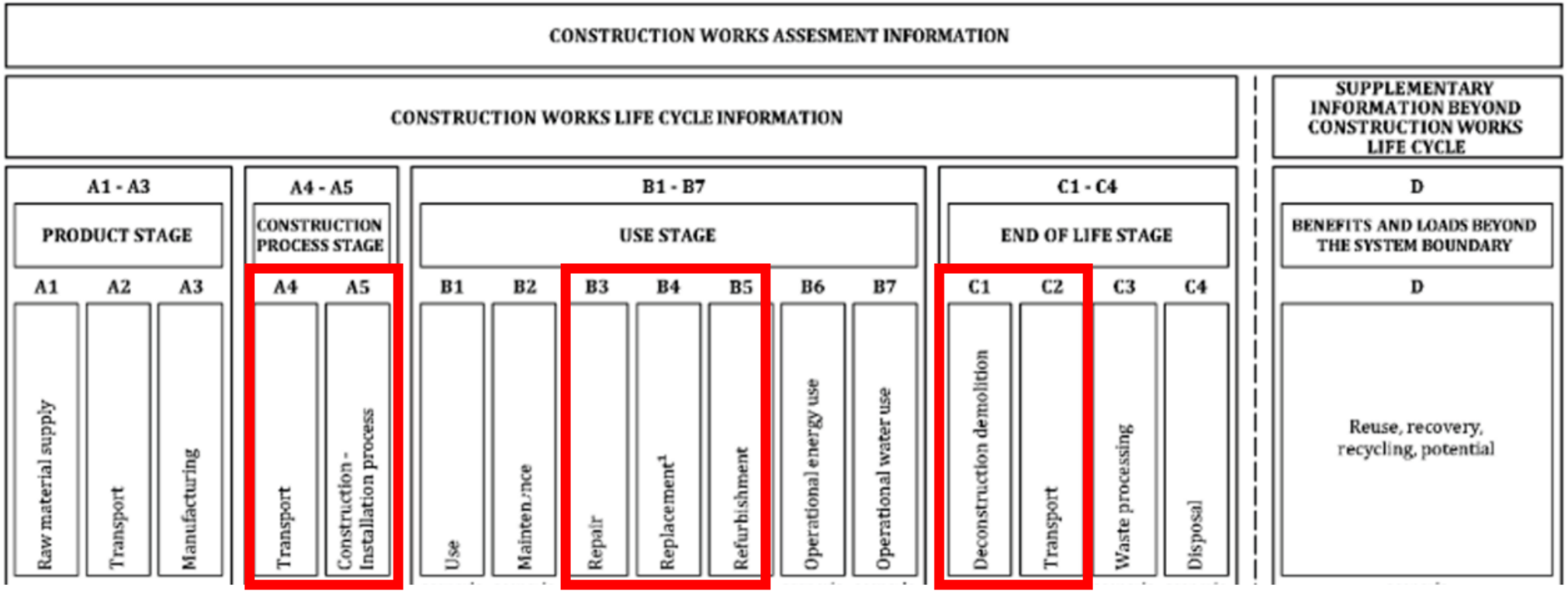
Producers of raw materials should ideally bring new solutions on the table. There is a wide variety of new and innovative materials available to the noise barrier sector (phase A1-A3). In the safety barrier sector is more constrained at the moment and limited to concrete and steel

Recommendations for road equipment manufacturers



- **Manufacturers** should bring questions to the producers (phase A1-A3) and M should be flexible to implement new materials (e.g., to go beyond CE marking) phase A1-A3).
- Should address new questions from the Installers (phase A3-A5).

Recommendations for installers



Installers should ideally **communicate** and **interact with Manufacturers** and bring questions and solutions to them (phase A3-A5).

Final Recommandations

The following suggestions are made to improve sustainability of noise & safety barriers:

- **Choosing materials that have lower environmental impacts**, such as recycled, renewable or biodegradable materials, or materials that have lower embodied energy or carbon footprint.
- **Optimizing the design and function of road equipment**, such as using modular, adaptable or multifunctional components, or incorporating smart features or renewable energy sources.
- **Improving the construction and maintenance processes** of road equipment, such as using efficient methods, technologies and equipment, or minimizing waste, emissions and resource consumption.
- **Minimizing Transport** distances by making greater use of local materials.
- Adopting new technologies for **foundations works**.

PROCEEDR

OPTIMISING RESOURCE USE
FOR ROADSIDE INFRASTRUCTURES

Thank you very much for your attention on behalf of the PROCEEDR consortium