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Neutral Infrastructure Governance

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Abstract **-** One of the activities that can most influence climate neutrality is the activity of executing projects in general and infrastructure projects in particular. Environmental concepts have long been included in all project work, but neutrality is something more and to approach it it is necessary to define a governance framework that includes this concept in detail throughout the life cycle of the project. A method is proposed to define the neutral governance framework, which is based on defining the project based on indicators of neutrality, zero emissions, circularity of materials, etc. And to show its validity, it is applied to the contracting of the construction of the A-67 motorway project, Capacity expansion, in Spain. Very good improvements have been made in infrastructure governance and contributing to climate neutrality.

Keywords**:** Governance; Neutrality, Circularity; Resource efficiency; Emissions; Carbon footprint; Risks.

1 Introduction

To meet the commitment of the 2030 Agenda [1] and the goal of achieving climate neutrality by 2050 [2], the governance of infrastructures must be updated and have a methodology that allows its management based on this compliance.

There are multiple developments on these aspects, but none of them contemplates a methodology of governance action that allows us to achieve climate neutrality, the reduction of emissions on the planet through climate actions, and the protection of the environment, in terms of the protection of the existence of materials, retaining the maximum possible value. for as long as possible, thus minimizing the use of natural resources, [3].

Therefore, it is necessary to define a methodology for measuring the neutrality of infrastructures so that their governance can be managed efficiently, quickly and transparently throughout their life cycle.

Thus, a proposal for the governance of neutral infrastructures is defined, based on indicators, which partly includes the ideas proposed in the different developments carried out to date, and complements them with the digitalisation of the infrastructure based on neutrality indicators.

And this methodology is applied and tested to the road infrastructure project, A-67 Capacity Expansion Highway, in Cantabria, Spain, obtaining clear results and ease of use.

2 Neutral Governance Developments

The concept of infrastructure neutrality has been partially developed, through different projects and standards.

- Green Public Procurement (2015). Procuring goods [4]. Acquisition of goods, services and works with a reduced environmental impact throughout their life cycle.
- RAGTIME, EC (2016) [5]. Based on risks, it proposes a general framework for infrastructure governance.
- ISO 20400: 2017, [6]. Sustainable Procurement, Guidance. It provides guidance to organizations, regardless of their activity or size, on integrating sustainability into procurement, as outlined in ISO 26000. It is aimed at stakeholders involved in or affected by procurement decisions and processes.
- Level(s). A common EU framework of core sustainability indicators for offices and residential (2017) [7].
- FORESEE, EC (2018) [8], which proposes the management of resilience to climate change, based on risks.
- Guide des achtas durables (2021) [9], the Federal Institute for Sustainable Development (IFDD) has developed a guide to sustainable procurement that describes technical sustainability criteria to be included in the specifications for the

purchase of supplies and services, and the Belgian Centre for Transport Research (CRR) has developed a series of sustainability indicators [10], of an environmental, social and economic nature with the aim of being included in tenders with an easy, simple and objective methodology.

- Platform CB'23 (2019) [11], a Dutch initiative of the construction sector, published a framework for assessing circularity in buildings and civil engineering in the Netherlands.
- CERCOM (2022) [12], inventory of good practices of current procurement systems and methods (Overview of research programme operations (cedr.eu)).
- LIAISON (2023) [13], making transport infrastructure climate-neutral, sustainable and circular

But, despite the effort made by all these developments, there is no practical methodology for measuring and expressing the neutrality of infrastructures.

3 Neutral Infrastructure Governance.

3.1 Concepts

Based on all these developments, a methodology is proposed to express the neutral governance of infrastructures, based on the concepts defined in the LIAISON, 2023 project1, [14].

- Materials Consumption Reduction. Reduce the use of materials by increasing their durability quantified in uses or years of useful life (risk resilience) and in their recyclability 9Rs [15], of which only 5Rs are used, which are directly applicable to construction materials, in addition to having special attention to waste and water use.
- LCC Reduction. Reduce the life cycle of infrastructure, planning and project, construction and operation and maintenance [7].
- Energy Optimization. Optimize energy through proper planning and integration of renewable energy solutions. Integrate the use of combustion energy with renewable energies.
- Reduction of CO2 emissions. Reduction of emissions based on the operating time of construction machinery and material production.

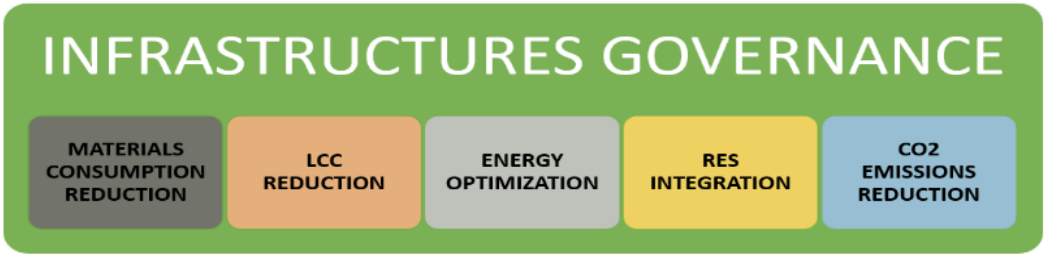

Fig. 1: Definition Concepts of Neutral Infrastructures [14].

3.2 Indicators

And the actions that governance must take to develop each of these concepts constitute the actions of neutral governance of infrastructures, represented by indicators.

[1] LIAISON, 2023, which proposes to review the governance of transport infrastructures and the strategies and concepts that promote zero emissions, as well as to define how to measure and monitor their environmental impact.

Table 1: Infrastructure Neutrality Indicators.

INDICATORS	Definition	Project Phase[2]		
$I_{Materials}$	Cost of materials / Direct Cost	L1	L2	L3
I_{Waste}	Cost of waste / Direct Cost	L1	L2	L3
I_{Water}	Cost of water / Direct Cost	L1	L2	L3
I_{Energy}	Cost of energy / Direct Cost	L1	L2	L3
I_{C02}	Cost of CO2 emissions / Direct Cost	L1	L2	L3

Indicators that are obtained from the costs of project neutrality concepts, with respect to the total direct cost of the project.

- Cost of construction materials classified based on the 5Rs, of circularity.
- Cost of construction waste.
- Cost of water used in the construction process.
- Cost of energy used by construction machinery.
- And the cost of CO2 emitted by construction machinery, plus the CO2 emitted in the production phase of the materials.

3.3 Methodology

The values of the indicators are obtained from:

- The composition of work units of Project, Labor, Machinery, Materials,
- of Project Budget Measurements.
- of the Direct Cost, Budget of material execution of the Project.
- And the combination of these with data provided by certain databases such as HueCO2 [16], providing CO2 from material production and CO2 from machinery production, and/or [17] which provides the energy produced by the machinery. Since the project lacks this information.

Table 2: Methodology for obtaining Indicators of Neutral Governance of Infrastructures.

Materiales. $I_{Materials}$
Materials are classified, with respect to 5Rs
The total quantity of each sorted material, is obtained.
The total cost of each type of material 5R / Direct Cost, is obtained
Waste. I_{Waste}
The total cost of project construction waste / Direct Cost, is obtained
Water. I_{Water}
The number of liters of water used in the project, is obtained

[2] LEVELS. L1: Planning and Project Phase; L2: Construction Phase, L3: Operation and Maintenance Phase.

The price per liter of water is defined, according to the phase of the life cycle of the infrastructure
The total cost of water / Direct Cost, is obtained
Energy. $I_{Energya}$
Machines are classified, according to the type of energy
You get the total amount of hours of use of each machine
The Kw of energy used by each machine is applied. **[17]**
Kw price is defined according to phase of the infrastructure life cycle
The total energy cost of the machinery / Direct Cost, is obtained
CO2. I_{CO2}
Regarding the production of Materials
Materials are classified, according to their nature
The Kg of CO2 used per material production is defined, **[16]**.
The total quantity of each of the materials, is obtained
The price of Kg of CO2 is defined, according to the phase of the life cycle of the infrastructure
The total cost of Kg CO2 per production of each material / Direct Cost, is obtained
Regarding the production of the Machinery
Machines are classified according to the type of energy.
The Kg of CO2 used per machine, is defined, **[16]**.
Total Kg of CO2 production from each machine, is obtained
The price of Kg of CO2 is defined, according to the phase of the life cycle of the infrastructure
The total cost of Kg CO2 per machinery production, is obtained
CO2 cost of materials plus CO2 cost of machinery, are added / Direct cost

The variation of these indicators throughout the life cycle will determine the governance of the infrastructure, in its definition, contracting and management functions.

Once the Infrastructure Neutrality Indicators have been obtained, governance can use them for their different functions, throughout their life cycle.

Table 3: Indicator-based Neutral Governance Functions

Governance Functions		Planning and Project Phase			Construction Phase		Operation and Maintenance Phase	
		L1			L2		L3	
		Definition	Procurement	Direction	Procurement	Direction	Procurement	Direction
$I_{Materials}$	$I_{MaterialsR1}$							
	$I_{MaterialsR2}$							
	$I_{MaterialsR3}$							
	$I_{MaterialsR4}$							
	$I_{MaterialsR5}$							
I_{Waste}								
I_{Water}								
I_{Energy}								
I_{C02}								

4 Neutrality Indicators for The Governance of The A-67 Highway Capacity Expansion.

From the application of this methodology to the Construction Project of the A-67 Highway Capacity Expansion, Cantabria, Spain, the following indicators are obtained:

Table 4: Specific neutrality data for the A-67 Highway Capacity Expansion, obtained directly from the project.

		BUDGET M€	Reduce M€	Reuse M€	Repair M€	Recover M€	Recycle M€	Kw M€	CO2 M€
MATERIALS	STEEL	**1,21**	**0,01**	**0,01**	**0,01**	**0,01**	**0,01**		**68,98**
	WATER	**0,02**							
	AGGREGATES	**1,32**	**0,01**	**0,01**		**0,01**			**0,39**
	BITUMEN	**0,00**	**0,01**						
	CEMENT	**0,02**							**0,92**
	CONCRETE	**0,83**				**0,01**	**0,01**		**0,15**
	PAINTS	**0,05**							
	PLANTS	**0,10**							
	PREFABRICATED	**0,08**							**0,01**
	PLASTICS	**0,44**							**0,13**

WASTE	**1,25**							
WATER	**0,02**							
ENERGY							**56,49**	
CO2								**83,86**

Set of Neutrality Indicators for the A-67 Highway Capacity Expansion.

Table 5: Neutrality Indicators, A-67 Highway Capacity Expansion.

$I_{Materials}$	$I_{MaterialsR1}$	0,03	0,09
	$I_{MaterialsR2}$	0,02	
	$I_{MaterialsR3}$	0,01	
	$I_{MaterialsR4}$	0,02	
	$I_{MaterialsR5}$	0,02	
I_{Waste}			0,01
I_{Water}			0,31
I_{Energy}			0,40
I_{CO2}			0,09

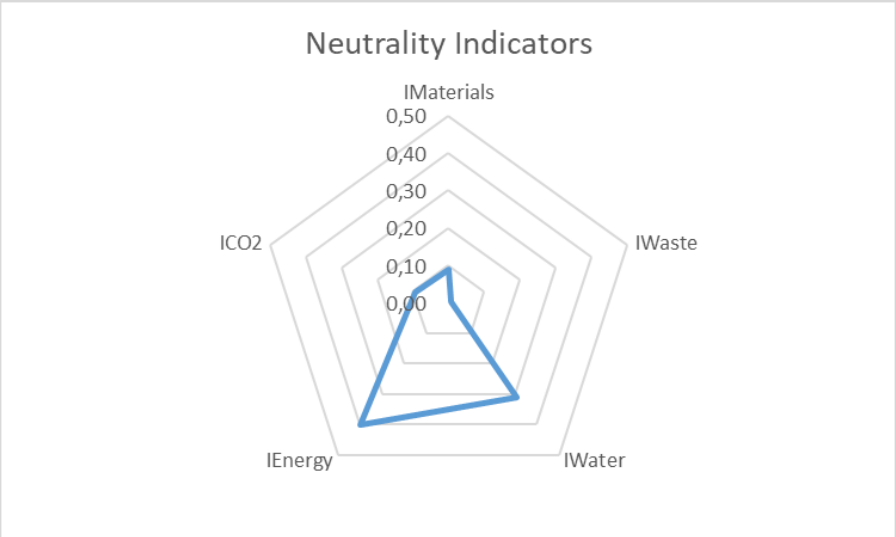

Figure 4. Neutrality Indicators of the A-67 Highway Capacity Expansion.

Thus, governance based on the control of the Neutrality Indicators can:

- L1: Define neutral infrastructure.
- L2, L3: Hire Consultants and Builders based on neutrality indicators, through the relevant tenders.

- L2, L3: Directing and managing the infrastructure, based on changes in neutrality indicators

5 Conclusions

As a final result, this methodology for defining the neutral governance of infrastructures, based on the indicators of infrastructure neutrality:

Proposes the neutral governance of infrastructures through indicators

Establishes its use for any governance function and for all phases of the infrastructure life cycle.

At the same time, it defines the neutral infrastructure based on indicators, which are easy to implement in current project management tools, BIM, and decision-making, multi-criteria analysis or artificial intelligence.

It completes the digitalization of infrastructures and their governance based on their neutrality.

And finally, it defines a simple governance framework, to achieve climate neutrality of infrastructures by 2050.

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