



# Evaluation in the Transport Sector and SDGs

Elisabetta Venezia<sup>1\*</sup>, Lidia Zakowska<sup>2)</sup>

<sup>1\*</sup>) University of Bari Aldo Moro, Department of Economics and Finance, Largo Abbazia Santa Scolastica, 70124 Bari, Italy; e-mail: elisabetta.venezia@uniba.it; ORCID: <https://orcid.org/0000-0002-7472-5069>

<sup>2)</sup> Cracow University of Technology, Faculty of Civil Engineering, Transport Systems, Warszawska 24, 31105 Krakow, Poland; e-mail: lidia.zakowska@pk.edu.pl; ORCID: <https://orcid.org/0000-0001-7806-3886>

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## Abstract

This paper aims to verify the impact of transport infrastructures and services on realisation the UN sustainable development goals. The purpose is to propose a methodological literature review of the evaluation tools, on one side, and an analysis of case studies referred to some European countries, in particular Italy and Poland with the geographic dimension of the urban scale. This research gives evidence to the most recent methodologies which help evaluators and policy-makers to measure the link between the transport endowment and public expense allocated on this sector and how they contribute to reach SDGs. Therefore the research questions are: - how do we measure and evaluate the impact of the transport sector on SDGs? What has been done in Europe to reach the SDGs? Do we have best practices in Europe at urban level with regard to local transport? The results highlight that the methodologies currently in use are extremely refined and allow us to capture the measurement of impacts and results in terms of SDGs. The scientific methodological review therefore helps us to select the right metrics for each local administration involved. Further, the results obtained indicate that the European Union countries have been improving their transport impact in the last years, even though there are still significant territorial imbalances. The case studies highlight these results. This is particularly true for those inefficient countries, whose results suggest they should improve the transport sustainability mainly by reducing the greenhouse gas emissions, and increasing the sharing mobility in favor of collective modes.

**Keywords:** *Transport infrastructures, SDGs, Evaluation methodologies, Public expense allocation*

## 1. Introduction

Although the literature on impact assessment is very broad, all the efforts finalized to estimate impacts through the use of ad hoc indicators suffer from the strong heterogeneity of territorial characteristics, which are hardly captured by the observed variables and considered for the economic analyses. In such a context, it is difficult to formulate unique indicators and apply one methodology for all the purposes. However, it has become of vital importance not only to measure but also to identify the most suitable indicators, even in the form of proxies, to outline the scope of intervention and suggest policies to the implementers of the 2030 Agenda at territorial level within the context of local programming that benefits from specific financial funds and implements cohesion policies. Most evaluations are requested, mandated, or regulated by central actors/institutions acting as funders, promoters, or coordinators of policies, programmes, and projects.

Evaluations, therefore, respond to central actors' needs, values, and methodological preferences. Nevertheless, development policies are increasingly put at their centre the role, knowledge and initiative of local actors and communities.

The European Union's internal cohesion policy devotes few resources to community-led development and on these aspects there are debates in both international and regional development contexts on whether or not policies should centre around individuals (people-based policies, seen as place-neutral) or places (place-based policies). As policies address issues of local knowledge, strategies and values, so must evaluations.

## 2. Methodologies

The scientific literature in the field of impact assessment relating to the achievement of the SDGs does not move methodologically away from the research carried out for the assessment of the impact of cohesion policy on regional growth carried out over the years by different researchers, including Pellegrini et al. [1]. This analysis specifically, thanks to the empirical evidence obtained regarding the inefficiencies or limitations that prevent the correct implementation of the policies (such as incorrect institutional governance, adopted programming, implementation procedures, etc.), allows us to trace the reasons and spatial contexts in which cohesion policy has proven to be ineffective and consequently allows for greater responsibility in the use of cohesion funds. For the purposes of evaluating the economic impact on European regional policies, however, traditional regression analyzes cannot be used as they are inadequate and not sufficient to conduct such analyses, due to the impossibility of controlling all the variables correlated with the policy, therefore, it was necessary to resort to new econometric techniques. In 2010, "counterfactual methods" were developed, i.e. estimation models, capable of measuring the impact of interventions by comparing what happened with what could have happened in the absence of such interventions: they consist in verifying the presence of a causal link between the factual situation, i.e. what happened after the policy was implemented and the counterfactual situation, i.e. what would have happened if that policy had not been implemented.

To carry out the study, the creation of a "control group" similar to the treated group is envisaged, i.e. those who have received the relative benefits from cohesion policies, in order to compare the results of the groups and derive the effect of the policies adopted.

Furthermore, for the purposes of the study, the outcome variables that represent the fulcrum of the study analysis are considered since the value of the intervention will be greater the greater the estimated effect on the variables.

The econometric techniques used to conduct these analyses, as they are sometimes aimed at reconstructing the counterfactual scenario, are the following: Regression Discontinuity Design (RDD), Randomization, Instrumental variables, Matching, Differences in differences

The first researchers to have used the counterfactual method for evaluating the impact of cohesion policy were Becker et al. [2] in 2010 who, following their studies, noted the positive impact of the structural funds on the growth of European regions, in terms of economic growth, level of employment, infrastructural endowment and innovative capacity; in fact, the use of these funds had a significant effect on GDP per capita. However, following their analyses it was only possible to have a positive or negative binary response on the influence of cohesion policies, therefore it was necessary to consider the context and continue the study with the analysis of the external factors that conditioned the impact of the policy and study the different extent of the effects produced in the different member countries. These analyzes were conducted respectively by: Becker in 2013 [2], Percoco in 2017 [3], Bachtrögler et al. 2019 [4], Ferrara et al. in 2016 [5], Cerqua and Pellegrini in 2018 [6].

In accordance with Pellegrini et al. [1] it seems that some Member States have very different attitudes towards the EU and its policies, with varying degrees of acceptance of their objectives, also related to the SDGs of Agenda 2030 constraints and opportunities. Therefore, it seems that there is no single European cohesion policy, but rather different policy variations in different areas according to the character of their institutions and the objectives they pursue. This means that the impact of the policy is distributed heterogeneously, so that it is necessary to consider simultaneously the policy and the institutional characteristics, the macroeconomic conditions and above all the definition of the development objectives, in order to understand its effectiveness. Therefore, these evaluation tools are extremely useful for measuring, at a territorial level, the sustainability objectives indicated by the United Nations in the context of sustainable mobility at an urban level. These coincide with the cohesion objectives and therefore with the allocation of resources useful for their pursuit.



Fig. 1. AHP of SDG

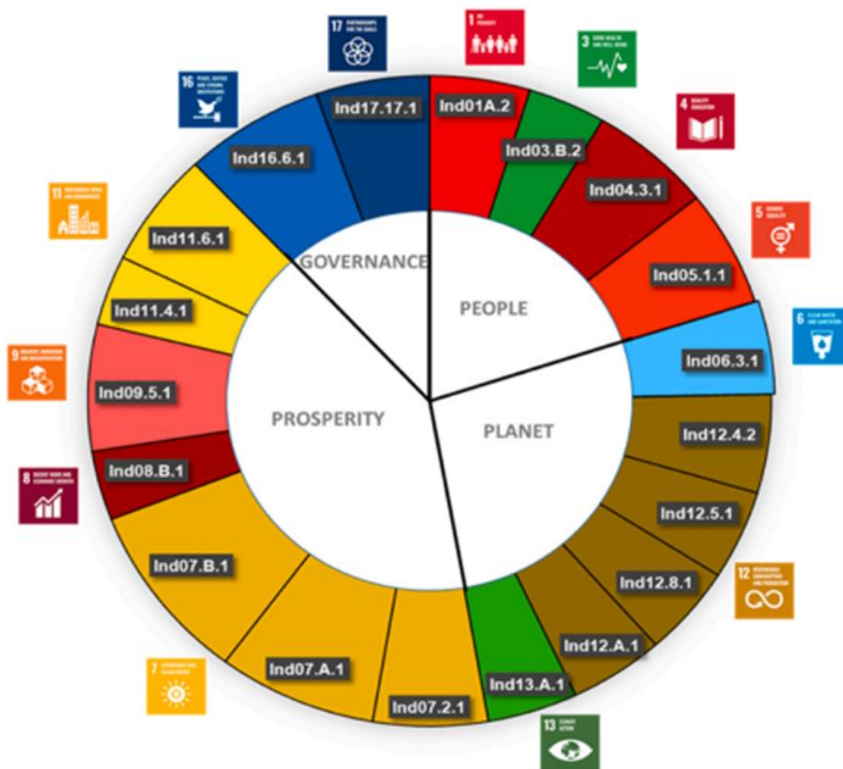


Fig. 2. Possible final results of AHP

Therefore we can say that certainly at a European level a considerable effort has been made to achieve both the pure objectives of the 2030 Agenda and those of cohesion policy [7], but that there is no real example, at least the best, to consider and aim for.

If we started from the 232 indicators of the 2030 Agenda we could arrive at selecting the indicators that best evaluate and measure the contribution of a specific area/subject (for example the transport sector) to the SDGs (Sustainable Development Goals).

In this context, a possible methodology would consist in the identification and consultation of a group of experts through, for example, the Delphi technique which is applied to select the best indicators.

Furthermore, the need to establish a weighting method to arrive at the selection of some proposed indicators is addressed using the Analytic Hierarchy Process (AHP).

The study discards by consensus numerous indicators that do not fit or are superfluous for the purposes of the study and a useful ranking is made to identify urgent priorities for action and identify the gaps that must be filled to achieve the SDGs relating to all dimensions of sustainability.

From a methodological point of view it is also usual to combine the use of the Delphi technique with other methods such as the AHP (Analytic Hierarchy Process), since it plays an important role in prioritizing the topics initially developed by Delphi.

Once the 2030 Agenda indicators are selected and validated by the expert panel, the AHP is applied to evaluate the weights in the multi-criteria decision-making process.

In procedural terms, the AHP derives the priority vectors which allows obtaining a ranking among the proposed alternatives. It has been applied in different contexts but also in the field of sustainability.

The AHP, on a mathematical basis, allows you to compare two preferences of a variable with the same criteria and scoring rules. Here, this ranking method is applied to establish a preference order of SDGs indicators.

Given the multi-stakeholder nature of the 2030 Agenda, a comparative analysis is also carried out, separating the expert panel into two groups: academics and professionals. Likewise, taking into account the multidimensional nature of the 2030 Agenda, an analysis of the results in relation to the SDGs and sustainability dimensions is feasible.

Based on the methodology outlined above it is possible to achieve the result reported in Figure 1 which identifies the dimension analysis and the SDGs analysis through a selection of representative objectives. In the end, and in concrete terms, it is possible to identify the relevant SDGs and the related indicators as shown in Figure 2.

### 3. The Italian Case Study

In this session, the case study referring to Italy is presented, specifically the Puglia Region Administration, for which the Delphi methodology and the AHP were applied to identify the relevant SDGs. An effort was made to link the methodological results to regional programming referred to 2016 and 2021. This is useful in order to understand what the reference areas, indicators and allocated resources are. Subsequently we moved on to the more specific application relating to the system of urban mobility indicators.

Tab. 1. Selected indicators

DIMENSION	SDG	SELECTED INDICATORS	2021	2016
SOCIAL	1	1.A.2. "Resources allocated by the organisation to general education and promotion of healthy lifestyles"	4000 €	4000 €
	3	3.B.2. "Resources allocated by the organisation in the area of occupational health"	125,000 €	147,000 €
	4	4.3.1. "Resources of the organisation allocated to staff training and capacity building (excluding sustainability and climate change training)"	125,000 €	100,000 €
	5	5.1.1. "Resources allocated by the organisation to promote gender equality and prevent gender discrimination"	20,000 €	-
	ECONOMIC	7	7.2.1. "Resources allocated by the organisation to increase the use of renewable energies"	-
		7.A.1. "Resources allocated by the organisation to the development of technologies that improve energy efficiency and promote the use of renewable energies both inside and outside the organisation"	42,000 €	35,000 €
		7.B.1. "Resources allocated by the organisation to optimise the energy consumption associated with its activity"	5000 €	30,000 €
8		8.B.1. "Resources allocated by the organisation for decent employment, job placement and improvement of the working environment both inside and outside the organisation"	3000 €	10,000 €
9		9.5.1. "Resources allocated by the organisation to improve its R + D + i"	2,000,000 €	125,000 €
ENVIRONMENTAL	11	11.4.1. "Resources allocated by the organisation to the preservation, protection and conservation of natural and cultural heritage."	15,000 €	9000 €
		11.6.1. "Resources allocated by the organisation to the treatment of solid waste generated in its activity"	16,000 €	14,000 €
	6	6.3.1. "Resources allocated by the organisation for the treatment and/or reuse of wastewater both inside and outside the organisation"	-	-
	12	12.4.2. "Resources allocated by the organisation for the treatment of hazardous waste produced in its activity"	10,000 €	8000 €
		12.5.1. "Resources allocated by the organisation for the reuse and recycling of materials"	5000 €	4000 €
GOVERNANCE		12.8.1. "Resources allocated by the organisation for education and training on sustainable development"	-	-
		12.A.1. "Resources allocated by the organisation to promote and move towards more sustainable forms of production and consumption"	45,000 €	175,000 €
	13	13.A.1. "Resources allocated by the organisation to actions that mitigate the effects of climate change"	-	-
	16	16.6.1. "Resources allocated by the organisation to promote transparency and accountability to its stakeholders"	21,000 €	16,000 €
	17	17.17.1. "Resources allocated by the organisation to actions and partnerships aimed at achieving the SDGs"	-	-
Number of employees			309	406
Turnover			43.1 M€	73.6 M€

Table 1 is extremely useful for identifying the results of regional planning with reference not only to the individual dimensions of the 2030 Agenda, but also to the specific goal and detailed indicators. The table highlights the resources thus allocated.

Tab. 2. Sustainable urban mobility indicator system

Theme	Subtheme	List of key indicators
Quality and efficiency of the urban mobility system: accessibility to the city and its services	Traffic decongestion and control of private road mobility	Motorization rate Demand for private road mobility Modal share of private road transport Average traffic speed
	Efficiency of local public transport	Average speed of local public transport Proximity to local public transport Local public transport capacity Maximum waiting times at local public transport stops
	Cycle-pedestrian mobility and alternative methods for managing mobility	Length of cycle paths Extensions of pedestrian areas Extension of the areas subjected to traffic calming Spread of car sharing and car pooling practices
Negative effects of urban mobility on the environment and health	Resource consumption	Primary emergency consumption Land consumption
	Negative impacts on health and the environment	Greenhouse emissions Air pollution Noise pollution Transport system safety

#### 4. Polish Case Studies Results

Case studies in European Union countries, particularly in Poland, have shown significant improvements in transport impact over the years. It has been well documented in the recent European literature review [8] (“Empirical evidence from eu-28 countries on resilient transport infrastructure systems and sustainable economic growth” by Gherghina et al.), that deficiency of infrastructure generates bottlenecks for sustainable growth and poverty reduction.

European Union member states are required to fulfill the goal of 10% for the share of renewable energy in the transport sector by 2020 [9]. As well, EU set a 30% drop of emissions from both cars and vans in 2030 compared to the 2021 targets [10]. In this regard, investing in up-to-date infrastructure enables the use of more energy-efficient means and alternative technologies that positively affect the economy with minimizing negative externalities [11]. Therefore, authors noticed a strong association between physical and social infrastructure, and economic development [7].

##### 4.1 Methods related to SDGs used for evaluation in Poland

Several methods of evaluation of transport investments in relation to SDGs were used in Poland, including also combinations of the ones enlisted below:

- **Indicator-based evaluation:** This method involves identifying Key Performance Indicators (KPIs) that are directly related to the Sustainable Development Goals (SDGs) in the transport sector. These may include indicators such as the number of road traffic accidents, the percentage of public transport users, and the average journey times for commuters. By tracking these indicators over time, policymakers can assess progress towards achieving the SDGs.
- **Cost-benefit analysis:** This method involves analyzing the costs and benefits of different transport policies and projects in relation to their contribution to the SDGs. For example, policymakers may compare the cost of building a new public transport system with the economic, environmental, and social benefits it would bring, such as reducing congestion and air pollution.
- **Multi-criteria analysis:** This method involves evaluating transport projects and policies against a range of criteria, including their impact on the SDGs. Decision-makers may consider factors such as economic viability, environmental sustainability, social equity, and accessibility when assessing the effectiveness of different transport initiatives.
- **Stakeholder consultation:** This method involves consulting with a range of stakeholders, including government agencies, transport operators, and civil society organizations, to gather feedback on the impact of transport policies and projects on the SDGs. By incorporating the perspectives of different stakeholders, policymakers can gain a more comprehensive understanding of the challenges and opportunities in the transport sector.
- **Impact assessment:** This method involves conducting comprehensive assessments of the impact of transport policies and projects on the SDGs. This may involve modeling the potential outcomes of different transport interventions [12], such as the impact on greenhouse gas emissions, accessibility, and economic development. By quantifying the potential benefits and drawbacks of different options, policymakers can make more informed decisions about how to prioritize investments in the transport sector.

##### 4.2 Transport Investment in Poland Aligned with the SDGs

In Poland, investment in the transport sector plays a crucial role in the country's efforts to achieve the Sustainable Development

Goals (SDGs). Here are some ways in which transport investment in Poland is aligned with the SDGs:

- Goal 9: Industry, Innovation, and Infrastructure - By investing in the development of modern and efficient transportation infrastructure, such as roads, railways, and airports, Poland can improve its connectivity and accessibility. This will help boost economic growth, create jobs, and support innovation in the transport sector.
- Goal 11: Sustainable Cities and Communities - Transport investment in Poland can help promote sustainable urban development by improving public transport networks, enhancing cycling and walking infrastructure, and reducing traffic congestion. This will help create more livable and inclusive cities, with better access to services and resources for all residents.
- Goal 13: Climate Action - Poland's transport sector is a major contributor to greenhouse gas emissions, primarily from road transport. By investing in sustainable transportation modes, such as public transport, cycling, and electric vehicles, Poland can reduce its carbon footprint and contribute to global efforts to combat climate change.
- Goal 3: Good Health and Well-Being - Improving the safety and efficiency of transportation systems in Poland can have a positive impact on public health. By promoting active modes of transportation and reducing air pollution from cars, transport investment can help improve air quality and reduce the incidence of respiratory diseases and road traffic accidents.
- Goal 10 and 5: Reduced Inequality and Gender Equality - Access to affordable and efficient transportation is essential for social inclusion and reducing inequality. By investing in public transport and improving transport connectivity in underserved areas, Poland can help ensure that all citizens have equal access to opportunities, services, and amenities.

South Poland investments in transport infrastructure 2004-2024 were especially evaluated as case studies [13] on transportation infrastructure over the past two decades in Malopolska region, which has plans for further investments [14]. Some key investment projects in the region include:

- Upgrading and expansion of road networks: South Poland has been investing in upgrading and expanding its road networks to improve connectivity within the region and with neighboring countries. Projects include the construction of new highways, expressways, and bypasses to reduce traffic congestion and enhance accessibility.
- Modernization of railway infrastructure: Investments have been made in modernizing railway infrastructure, including upgrading railway lines, renovating train stations, and introducing high-speed rail connections. These improvements aim to enhance the efficiency and reliability of passenger and freight transportation in the region.
- Development of public transport systems: South Poland has been focusing on improving public transport systems, such as buses, trams, and metro systems, to provide residents with sustainable and accessible transportation options. Investments have been made in upgrading existing public transport networks and introducing new routes to serve growing urban areas.
- Expansion of airports: South Poland has been investing in the expansion and modernization of airports to accommodate the growing demand for air travel. Projects include upgrading terminal facilities, runway extensions, and the introduction of new flight routes to enhance regional and international connectivity.
- Sustainable transport initiatives: South Poland has also been investing in sustainable transport initiatives, such as promoting cycling infrastructure, electric vehicle charging stations, and green mobility solutions. These investments aim to reduce carbon emissions, improve air quality, and promote sustainable transportation alternatives in the region [15].

Furthermore, the introduction of innovative technologies, such as electric buses and e-scooters, has also contributed to the reduction of carbon emissions and improved air quality [16]. These technologies have been successful in improving the overall quality of life for residents in Poland, as they provide a cleaner and more efficient transportation system.

Overall, transport investment in Poland has the potential to contribute significantly to the country's progress towards the Sustainable Development Goals by promoting economic growth, environmental sustainability, social inclusion, and improved quality of life for all residents. By prioritizing sustainable and inclusive transport solutions, Poland can create a more resilient and prosperous society that benefits both current and future generations.

## 5. Conclusion

The evidence of these results allows us to highlight how the most advanced methodological aspects can find application in regional planning in order to guide policy makers in their choices. It is clear that scientific support is useful for the best allocation of resources in order to achieve sustainability objectives, in this case in transport and urban contexts. It is also true that the methodologies and choices, as was said initially, need to take strong account of the context area. Therefore there is no valid recipe for all countries and all areas, but we must be able to grasp all the suggestions that scientific research offers.

As EU set a 30% drop of emissions from both cars and vans in 2030 compared to the 2021 targets, in this regard, investing in up-to-date infrastructure enables the use of more energy-efficient means and alternative technologies that positively affect the economy with minimizing negative externalities. Therefore, authors noticed a strong association between physical and social infrastructure, and economic development.

One of the key findings from the case studies is the implementation of sustainable transport initiatives, such as the development of public transportation infrastructure and the promotion of cycling and walking as alternative modes of transportation. These initiatives have helped reduce the reliance on private cars, leading to a decrease in traffic congestion and air pollution in urban areas.

Additionally, the case studies have highlighted the importance of policy interventions, such as the implementation of low emission zones and congestion pricing schemes. These measures have been successful in reducing emissions in urban areas and incentivizing the use of sustainable modes of transportation.

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