

GRANT CONDITIONS IN THE AREA OF SUSTAINABLE TRANSPORT SUPPORT IN EU COUNTRIES: LINKS WITH ECONOMIC DEVELOPMENT

Marie Poláchová¹ , Martin Žapka¹ , Barbora Stojanová¹

¹ Mendel University in Brno, Faculty of Business and Economics, Zemědělská 1, 613 00 Brno, Czech Republic

Abstract

The transport sector is one of the most significant polluters of the environment. The requirement to achieve climate neutrality is putting pressure on sustainable investments in this sector as well. Subsidy conditions do not only follow the economic evaluation of the given investment, but also include other aspects, including social and environmental ones. Within the EU, there is an effort to harmonize the criteria and methods used to evaluate projects (co-)funded from EU resources. While mandatory criteria and methods set by the EU are binding for national methodologies, the recommended ones depend on the extent to which countries choose to adopt them. In order to identify differences in the level of reporting obligations, the article compares the subsidy requirements of individual EU countries in supporting sustainable investments in transport. Furthermore, by applying OLS and correlation analysis, we confirm the relationship between the level of reporting obligations defined in national subsidy titles and the economic development of a country measured by real GDP per capita.

Keywords: Sustainability Assessment, Transportation Sustainability, Subsidy Policy, Real GDP

<https://doi.org/10.11118/978-80-7701-082-5-0251>

JEL Code: R42, Q58

Introduction

The transport sector is one of the most significant producers of greenhouse gases (Andersson *et al.*, 2025; European Parliament and Council, 2020). Consequently, the transition of economies toward climate neutrality, as envisioned in the European Green Deal, necessitates a substantial increase in sustainable investments. One important mechanism to support such investments in transport is the provision of subsidies, including at the transnational level. This article focuses specifically on the promotion of sustainable investments within the European Union (European Commission, 2018). The design of support mechanisms, including the establishment of appropriate criteria and methodologies for assessing the sustainability of investments, is pivotal in achieving the stated sustainability objectives.

Integrating sustainability principles into transport planning contributes, according to Gutman and Malashenko (2025), to the creation of balanced and environmentally friendly infrastructure solutions that ensure the long-term prosperity of countries.

Within the transport sector, countries exhibit varying levels of sustainability (e.g. Czech *et al.*, 2022 highlight the relationship between transport sustainability and the level of a country's development) and simultaneously apply different approaches to fulfilling it.

Sustainable Mobility and Its Promotion

There is no universally accepted definition of sustainable transport. In various strategic documents, sustainability in transport is generally defined through specific objectives. According to the United Nations, for example, the goal of transforming transport into a sustainable system is “by 2030 provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons” (Project Everyone, n.d.).

At the EU level, the issue of transport sustainability is addressed through the Strategy for Sustainable and Smart Mobility – Steering European Transport into the Future (European Commission, 2020), which sets objectives, scenarios, and identifies priority areas, among other measures. This strategy also addresses financial support from the EU through various funds, including the Connecting Europe Facility (CEF), the Cohesion Fund, the European Regional Development Fund, and InvestEU (European Commission, 2020).

In cases where an investment is financed (or co-financed) through EU funds, it is necessary to evaluate the required criteria and, where applicable, use established methodologies. From the EU perspective, these are outlined in the following documents: European Commission Regulation No. 480/2014 (European Commission, 2014), Implementing Regulation No. 2015/207 (European Commission, 2015), Guide to Cost-Benefit Analysis of Investment Projects (European Commission, 2015), and European Parliament and Council Regulation (EU) 2021/1058 (European Parliament and Council, 2021).

Each EU member state, when supporting sustainable projects (investments) in transport, builds on the above regulations and defines its own specific criteria and evaluation methods for the relevant funding programs within its operational programs and methodologies (see methodology). At the same time, they must comply with the minimum reporting requirements imposed by the EU.

Sustainability assessment criteria and applied methods at the national level are aligned not only with national sustainability goals but also take into account the objectives of lower levels of public administration (regional/local), the achieved level of sustainability, and the specifics of national transport. National transport goals should ideally reflect the needs of local transport (Borgato *et al.*, 2021; Colombo and Dijk, 2023; Figueroa and Ribeiro, 2013; Hu *et al.*, 2025; Klinger *et al.*, 2013; Velasco Arevalo and Gerike, 2023).

The sustainability objectives of different levels of public administration may not always align (Black *et al.*, 2002; Haghshenas and Vaziri, 2012), and the tools used (including subsidies) may not support these objectives (Liu *et al.*, 2024). Even when agreement is reached in the design of multi-level policies, discrepancies can arise in financing. For example, Liu *et al.* conclude from the case of the Netherlands that EU funding is well aligned with local efforts and supports them. In contrast, national-level funding focuses on other objectives and does not necessarily support local-level initiatives (Liu *et al.*, 2024).

A discrepancy within sustainability policies may occur not only across different levels of public administration but also between selected ministries at the national level. Hu *et al.* (2025) state that it is necessary to introduce a coordinated regulatory mechanism among various ministries in order to prevent duplication and conflicts in regulatory measures. Furthermore, regular policy evaluations should be carried out to enable the government to adjust regulatory strategies based on actual outcomes, thereby improving the consistency and effectiveness of policy enforcement (Hu *et al.*, 2025).

Infrastructure subsidies are not only an important fiscal policy tool with an impact on economic performance and economic growth and development, but they are also one of the tools that can be used to support the transition of economies to climate neutrality (European Commission, 2020, 2018; Takman and Gonzalez-Aregall, 2024).

Through subsidies, the state also supports investments (including financially demanding sustainable investments) that might not be realized without such financial support (for example, due to the high degree of uncertainty regarding the payback period).

Bruun and Vanderschuren (2017) emphasize the role of the state in promoting national interests in the area of sustainability at the regional level and in financially supporting interregional projects. Liu *et al.* (201...) and Song *et al.* (2022), on the other hand, state that above a certain level, excessive subsidies can lead to a dampening of innovation activity.

Policymakers can move transport towards greater sustainability by setting criteria, standards, and creating a favourable investment climate. Setting up effective financing frameworks is a key step to align different sources of transport financing and to support a significant increase in financing for sustainable transport (United Nations Secretary-General's High-Level Advisory Group on Sustainable Transport, 2016).

It is necessary not only to appropriately set the amount of subsidies (from the perspective of achieving certain goals in the area of sustainability and social well-being) (Badeanlou *et al.*, 2022; Becchetti *et al.*, 2022; Boix-Cots *et al.*, 2025; Kays, n.d.; Hu *et al.*, 2025), but also to set appropriate subsidy conditions (including evaluation criteria and their weights) under which subsidies are provided (Henke *et al.*, 2020).

Transport Sustainability Assessment Criteria

There is no consensus in the scientific literature, regulations, methodological requirements, etc., on the evaluation frameworks, methods and criteria for assessing the sustainability of transport, or rather the evaluation of investments in the field of transport. The transport sector is diverse. Therefore, according to Anastasiadou and Gavanas (2025), it is not possible to formulate a single possible list of evaluation criteria. Within the scientific literature, there is a large number of evaluation frameworks used (Badeanlou *et al.*, 2022; Becchetti *et al.*, 2022; Boix-Cots *et al.*, 2025; Kays, n.d.), criteria and methods for assessing the sustainability of transport investments (Anastasiadou and Gavanas, 2025; Bruun and Vanderschuren, 2017; Velasco Arevalo and Gerike, 2023).

Frameworks, methods and criteria for assessing transport sustainability can be classified according to different classifications. Measurement criteria can be classified according to which aspect of transport sustainability they assess. Economic criteria and environmental criteria are commonly included, and to a lesser extent social criteria. In the area of company reporting, a view of corporate governance (G) is also

included (European Parliament, 2022). Some authors also use indicators of system efficiency and equity to assess transport sustainability (transport investments) (Velasco Arevalo and Gerike, 2023). Anastasiadou and Gavanas (2025) recommend including criteria from the areas of strategic planning, design and construction, and functional and operational.

Another possible classification of criteria is whether they are used ex-ante or ex-post. Ex-ante approaches focus, for example, on the evaluation of possible alternatives, while ex-post approaches help, for example, to monitor and compare existing projects (Velasco Arevalo and Gerike, 2023).

The methods and evaluation criteria may also differ depending on who uses them and who is affected by the benefits/costs of the project (Velasco Arevalo and Gerike, 2023) or whether they focus on the city/regional level (Buenk *et al.*, 2019; Haghshenas and Vaziri, 2012; Karjalainen and Juhola, 2021; Klinger *et al.*, 2013) or serve to assess the success of government policies in the field of sustainable transport at the national level (Castillo and Pitfield, 2010; Cavalcanti *et al.*, 2017).

The criteria used and proposed in the assessment of transport sustainability are usually quantifiable. A number of authors point to the absence or insufficiency of criteria for assessing qualitative aspects of sustainability (Ahonen *et al.*, 2024; Karjalainen and Juhola, 2021). The criteria used and proposed in the assessment of transport sustainability are usually quantifiable. A number of authors point to the absence or insufficiency of criteria for assessing qualitative aspects of sustainability (de Oña *et al.*, 2016; Freitas, 2013; Jeon and Amekudzi-Kennedy, 2005; Klinger *et al.*, 2013).

Some authors also point out the inconsistent methodology in obtaining the values of the given criteria. This then leads to problematic comparability of results for many indicators, including indicators of a qualitative nature. This inconsistency may also be due to the specifics of the given region, the possibility of obtaining data, etc. (Karjalainen and Juhola, 2021).

Richardson (2005) examines the links between individual sustainability assessment criteria and factors influencing the value of indicators. Using diagrams of hierarchies, he illustrates the influence and interconnectedness of factors on the main indicators of transport sustainability (according to him, safety, traffic congestion, fuel consumption, vehicle emissions and transport availability) and suggests the optimal method and level of intervention.

The most common methods used for evaluating (sustainable) transport investments include cost-benefit analysis (CBA) and multi-criteria analysis (MCA) methods (Anastasiadou and Gavanas, 2025). Multi-criteria decision-making (MCA) methods are, according to Velasco Arevalo and Gerike (2023), the more frequently used method (in the scientific literature) due to their ability to include a number of qualitative, technical, etc., aspects of the investment. The advantage of MCA methods is that they consider both quantitative and qualitative indicators. Unlike CBA, MCA methods do not require the conversion of these criteria into monetary units, so it is possible to include indicators in the analysis that are impossible or problematic to convert into monetary units (Anastasiadou and Gavanas, 2025; Bruun and Vanderschuren, 2017; Burchart and Przytuła, 2024).

Individual indicators (groups of criteria) are weighted to calculate the final value using MCA. On the one hand, these weights allow for the consideration of different perspectives of stakeholders (Anastasiadou and Gavanas, 2025), on the other hand, they can be subjective or lead to the problem of double counting (Bruun and Vanderschuren, 2017).

Bruun and Vanderschuren (2017) state that despite the limitations of CBA, there is no consensus that cost-benefit analysis (CBA) should be replaced by MCA methods, because CBA increasingly includes intangible impacts that can be expressed in monetary units. By converting all costs and benefits into monetary units, the time value of money can also be considered through discounting.

For the purposes of this article, the use of MCA to assess the economic sustainability of EU countries in the article by Czech *et al.* (2022) is interesting. Based on the use of multi-criteria analysis, the authors conclude that higher values of the synthetic indicator of sustainable transport (composed of criteria from the economic, environmental and social areas) belong to the most developed countries, and conversely, the minimum aggregate values are achieved by less economically developed EU countries. The authors also note exceptions to this statement, namely in the case of the worse ranking of Denmark and Luxembourg and, conversely, the better ranking of the Czech Republic and Hungary.

Sensitivity analysis, as Velasco Arevalo and Gerike (2023) state in their literature review, is rarely performed. However, the authors recommend it to assess the robustness of the evaluation results, in terms of the choice of inclusion or exclusion of indicators, weighting schemes and aggregation methods. Sensitivity analysis is compatible with both CBA and, by changing weights, with MCA (Bruun and Vanderschuren, 2017).

Methodology

The aim of this article is to identify differences between the level of bindingness of subsidy requirements in selected EU countries and to assess whether there is a relationship between the economic development of the given countries and the level of bindingness of requirements for evaluating the social and economic benefits of subsidy-supported projects in the field of sustainable transport.

This article primarily works with three types of sources: scientific sources, current international EU guidelines and guidelines, and country-level methodologies.

Based on the analysis and comparison of EU requirements and requirements of current national subsidy titles of selected EU countries (years 2024–2025), we will determine the scope (degree of bindingness) of requirements for the assessment of economic and social impacts of projects supported by subsidies.

To obtain the values (degree of bindingness of the indicator) of independent variables, the following documents were used:

- EU: European Commission Regulation No. 480/2014 (European Commission, 2014) and European Commission Implementing Regulation No. 2015/207 (European Commission, 2015b) and Regulation (EU) No. 1303/2013 of the European Parliament and of the Council (European Parliament, 2013), CBA Methodological Guide (European Commission, 2015a) and Regulation (EU) 2021/1058 of the European Parliament and of the Council (European Parliament and Council, 2021).
- Czech Republic: methodological documents within the framework of the Operational Transport Programme 2021–2027, Kritéria výběru projektů OPD (Ministerstvo dopravy, 2023a); CBA Manual (Ministerstvo dopravy, 2023b); Rezortní metodika pro hodnocení ekonomické efektivity (Státní fond dopravní infrastruktury, 2024).
- Slovakia: Príručka CBA – OPII – Operačný program Integrovaná infraštruktúra (Ministerstvo dopravy Slovenskej republiky, 2024); Prehľad ukazovateľov Operačného programu Integrovaná infraštruktúra 2014–2020 vrátane popisu metodiky stanovenia hodnôt ukazovateľov (Ministerstvo dopravy Slovenskej republiky, 2014).
- Finland: email communication with the Finnish Transport and Communications Agency (Jouni Karhunen, personal communication).
- Portugal: documentation PO SEUR – Operational Programme for Sustainability and Efficient Use of Resources, including manual Critérios de seleção e prospetiva metodologia aprovada pelo comité de acompanhamento (PO SEUR, 2015).
- Ireland: Project Appraisal Guidelines Unit 6.1 – Guidance on Conducting CBA (Transport Infrastructure Ireland, 2023a); Project Appraisal Guidelines Unit 6.2 – Preparation of Scheme Costs (Transport Infrastructure Ireland, 2023b); Infrastructure Guidelines (Department of Public Expenditure, NDP Delivery and Reform, 2023).
- Denmark: Vejledning i samfundsøkonomiske konsekvensvurderinger (Finansministeriet, 2023).
- Germany: The 2030 Federal Transport Infrastructure Plan (Federal Ministry of Transport and Digital Infrastructure, 2016a); R & D Infrastructure Funding 2023 Call Guideline (Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie, 2023); Methodology Manual for the Federal Transport Infrastructure Plan 2030 (Federal Ministry of Transport and Digital Infrastructure, 2016b).
- Austria: Austria's 2030 Mobility Master Plan (Federal Ministry Republic of Austria, 2021); Call Guideline R & D Infrastructure Funding 2023 (Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie, 2023).
- Slovenia: Resolution on the National Programme for the Development of Transport in the Republic of Slovenia until 2030 (Republic of Slovenia, Ministry of Infrastructure, 2017); Uredba o enotni metodologiji za pripravo in obravnavo investicijske dokumentacije na področju javnih financ (Vlada Republike Slovenije, 2016); Uradni list RS – 005/2017 (Vlada Republike Slovenije, 2017).
- France: Guide to Socioeconomic Evaluation of Public Investments in France (Direction générale du Trésor, 2017).
- Netherlands: CBA materials (MKBA, n.d.); Werkwijzer MKBA bij MIRT (Modijefsky *et al.*, 2024).
- Belgium: Plan national pour la reprise et la résilience Belgique (Cabinet du Secrétaire d'État à la Relance et aux Investissements Stratégiques, en charge de la Politique Scientifique, 2021).
- Luxembourg: Guide de l'utilisateur FEDER 2021–2027 (Gestion assurée par le Ministère de l'Économie, Direction de la politique régionale, 2023); Accord de partenariat FEDER/FSE 2021–2027 (Grand-Duché de Luxembourg, 2021).

As part of the analysis and comparison of the above documents, the following indicators and methods were identified:

- Economic Net Present Value (ENPV);
- Financial Net Present Value (FNPV);
- Economic Internal Rate of Return (ERR);
- Financial Internal Rate of Return (FRR);
- Benefit-Cost Ratio (B/C);
- CBA (Cost-Benefit Analysis);
- Multi-Criteria Analysis (MCA);
- Sensitivity Analysis;

- Risk Matrix;
- External Costs (noise, pollution);
- Evaluation of comfort and perceived quality of infrastructure;
- Climate emissions;
- Evaluation of regional development;
- Impacts on secondary markets;
- Consideration of socio-economic effects;
- Costs of traffic accidents.

The level of (minimum) required bindingness (EU) of the observed criterion or method was transformed into a 5-level quantitative scale, which can be found in the following table. This quantification makes it possible to capture the variability in the approaches of individual countries and to create measurable indicators of the binding nature of national requirements for the provision of subsidies.

I: Rating scale for the binding nature of criteria and methods

5	Mandatory with scenarios
4	mandatory
3	mandatory for large projects
2	mandatory for certain projects
1	recommended

Source: own proposal

- **Recommended:** The aspect is recommended by EU regulation or national methodology, which means that its use is not mandatory. Its use depends on the decision of the competent authority, the analyst, or the specifics of the project.
- **Mandatory for certain projects:** This aspect is mandatory only for specific types of projects that meet certain conditions, such as projects generating revenue from traffic (toll systems, railways, airports, ...).
- **Mandatory for large projects:** This aspect is mandatory only for projects that exceed a certain financial threshold or have a large impact (for example on transport capacity or the environment). These are mostly projects with costs over EUR 50 million.
- **Mandatory:** This aspect is always required, regardless of the size, type, or financing of the project.
- **Mandatory with extended scenarios or with detailed scenarios:** This aspect is mandatory and requires that detailed scenarios of changes (for example, changes in the economic environment, traffic growth, or climate effects) are considered. Mandatory with detailed scenarios, or the aspect must be included and must be supplemented with detailed scenarios that simulate different variants of future development.

Real GDP per capita for 2024 of selected countries was obtained from the Eurostat database. We work with the indicator in real prices of 2020. The sample covers countries with different economic levels. When compiling the sample, priority was given to EU member states that achieve higher values in the area of sustainability (so-called ESG score – Risk Watch Initiative ESG Index, 2023) compared to the countries of the former Czechoslovakia and can be an inspiration in the area of setting subsidy conditions for the Czech Republic. The sample is dominated by most of the “original” EU countries. The selected countries usually achieve higher-than-average values of real GDP per capita.

For the purposes of comparing the degree of bindingness of the criteria according to the economic maturity of the countries, the countries will be divided into two groups: countries with a real GDP per capita lower than the EU27 average (Czech Republic, Slovakia, Portugal, Slovenia) and countries with a higher real GDP per capita than the EU average.

The following complementary econometric approaches were used to identify the relationships between the binding levels of the monitored criteria and methods for evaluating transport and the real GDP per person of the given countries. The basic model was a linear regression measured using the method of least squares (OLS), which makes it possible to quantify the direct effects of individual aspects of the evaluation on the total GDP per person. In order to avoid this problem, the averages of strictness of individual countries were created (see Fig. 1) in the next chapter, which were used as a dependent variable against GDP per capita (independent variable). As a result, there was no need to go into more complex analyses, and it was possible to prove the fact that there is a relationship between countries with stricter levels of commitment to subsidies from the EU and GDP. For this case, the key is correlation analysis, which is expressed using the t-test.

II: Real GDP per capita for selected EU countries (2024/2020)

Country	Real GDP per capita (2024/2020)
Slovakia	19 130
Czechia	21 910
Portugal	22 230
Slovenia	25 480
France	38 110
Finland	43 040
Germany	43 110
Belgium	44 300
Austria	44 830
Sweden	48 210
Netherlands	50 880
Denmark	58 160
Ireland	88 600
Luxembourg	100 880

Source: Eurostat (2024)

$$t = \frac{r \times \sqrt{n-2}}{\sqrt{1-r^2}},$$

where r is the Pearson coefficient value and n is the number of observations. Subsequent t-test results were compared with the t-test critical value result, which was calculated using Gretl statistical software.

The analyses are implemented in the statistical software Gretl, which enables and describes a detailed diagnosis of the results.

The key indicators of the quality of analysis are the coefficient of determination, the modified coefficient of determination, the probability value of the statistical F-test, which shows the statistical significance of the model as a whole, and the t-test of the parameters, which express the statistical dependence of the individual parameters of the regression analysis.

As diagnostic tests, tests of correct specification were used, such as the Ramsey RESET test and nonlinearity tests for powers and logarithms, homoscedasticity tests of residuals where the Breusch–Pagan test was used, Q–Q graph of residuals and White's test, and tests of normality of residuals with graphical assessments of correctness.

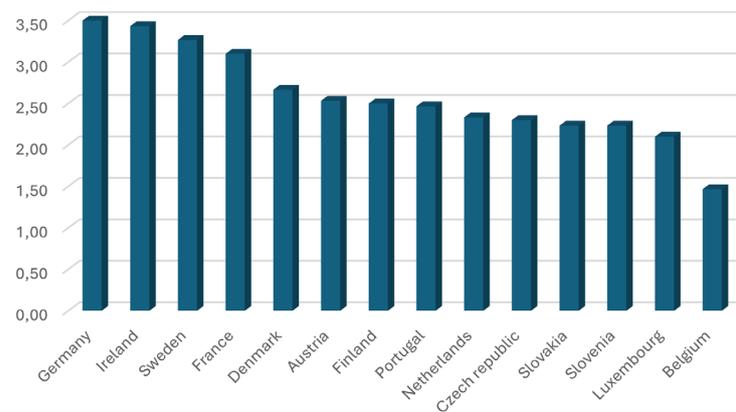
Results of the Comparison of National Subsidy Requirements

The cost-benefit analysis (CBA) is the basic method of investment evaluation according to the European Commission Implementing Regulation No. 2015/207 (European Commission, 2015). It is mandatory for large projects financed from European funds (in particular from the Cohesion Fund and the European Regional Development Fund). According to the above-mentioned regulation, within the CBA it is mandatory to include the value of time saved by the project and the environmental impacts among the intangible impacts of the project.

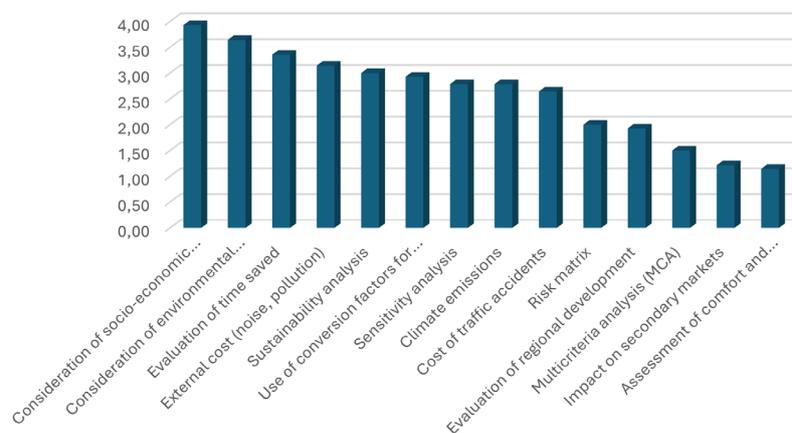
The regulation also defines basic requirements, such as the inclusion of economic net present value (ENPV), economic internal rate of return (ERR) or expression of the benefit-cost ratio (B/C). These indicators are modified dynamic indicators of investment efficiency evaluation, which include intangible impacts of the investment within the cash flow of project benefits and costs.

The financial net present value and the financial internal rate of return, considering the benefits and costs for the investor without taking into account the social impacts, are mandatory for certain projects by the EU. The calculation of the indicators considers the subsidy from the EU.

Environmental aspects such as climate emissions, noise, impacts on regional development, costs of traffic accidents or comfort assessment are only recommended from the EU perspective. Furthermore, it is within the competence of the individual states whether to require a sensitivity analysis, develop scenarios, develop a risk matrix, use multi-criteria analysis or sustainability analysis. Member States have the option of determining the level of bindingness of the given criteria and methods for these criteria and incorporating them into national methodologies.



1: Average level of binding subsidy requirements by country
Source: own processing



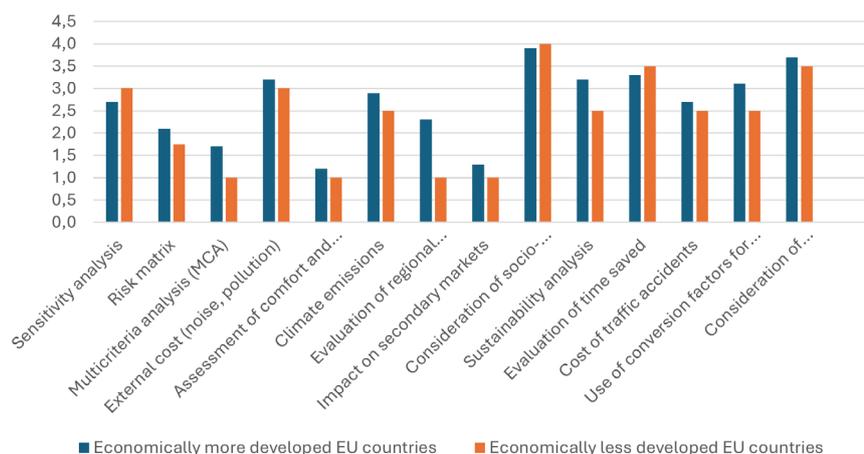
2: Average level of binding subsidy requirements by country
Source: own processing

Based on the assessment of the level of requirements for individual criteria and methods (see methodology), we have concluded that the strictest conditions for evaluating investments in the field of sustainable transport are in Germany, Ireland and Sweden. These countries are also among the countries where the real value of GDP per capita is higher than the average value of the Eurozone (36 950 euro) and the EU 27 (33 620 euro) (Eurostat, 2024). The least strict requirements for reporting criteria and using methods are in Belgium, Luxembourg, Slovenia and Slovakia. Slovenia and Slovakia are among the new EU countries, and they also show a lower GDP per capita than the EU average. However, Luxembourg is the country with the highest real GDP per capita within the EU.

For methods and criteria where the EU does not stipulate mandatory reporting, the highest level of binding is achieved by time saved and climate emissions. These indicators are also a mandatory part of the CBA. The lowest average level of binding among the monitored “recommended” criteria is achieved by the qualitative indicator of comfort and perceived quality of infrastructure and the indicator of impact on secondary markets. This confirms the findings of the scientific literature regarding the inadequacy of taking these indicators into account when assessing the sustainability of transport. Despite its advantages and its widespread use in scientific texts, the multi-criteria analysis method remains less binding than the CBA within the scope of subsidy titles (Velasco Arevalo and Gerike, 2023).

Regarding the degree of bindingness of criteria and methods from the perspective of the country's economic development, countries with higher real GDP per capita generally require stricter conditions for assessing the sustainability of transport. The exceptions are the indicators: sensitivity analysis, the requirement to include socio-economic impacts, and the assessment of time saved as a result of the investment.

In order to determine the relationship between the degree of bindingness of subsidy criteria and real GDP per inhabitant within the EU, to unify the criteria and prevent the problem with multicollinearity, the creation of the variable average strictness was imperative.



3: Comparison of the degree of bindingness of criteria according to the economic development of countries
Source: own processing

Subsequently, emphasis was placed on confirming the existence of a relationship where the average degree of commitment of selected countries regarding subsidies from EU funds was used as the dependent variable, and the independent variable was understood as GDP per inhabitant. The first step was the overall simplification of the equation, which could clearly demonstrate the dependence between these two variables. For control, it was sufficient to perform a correlation analysis; the resulting t-test showed a weak negative correlation between the variables (-0.016). When used in regression analysis using the OLS method, the statistical insignificance of the model as a whole was proven, where the F-test came out to 0.955.

After a deeper examination of the individual countries, it was necessary to point out the anomaly that was Luxembourg. As a country, it has one of the least stringent degrees of commitment and the highest GDP per capita. After removing this country, a correlation analysis was performed, the result of which showed a weak statistical significance between the real GDP per capita and the severity of the degrees of commitment, with a result of 0.312.

Discussion and Conclusion

The article analyses and compares the EU requirements for the provision of subsidies and the subsidy requirements of selected EU countries in the field of sustainable transport support. Within the framework of regulations and methodologies, quantitative criteria are preferred (they achieve higher levels of binding force), which is also confirmed by some literature searches of scientific sources dealing with the assessment of sustainability in transport (Ahonen *et al.*, 2024; Karjalainen and Juhola, 2021). Economic and environmental criteria are stated with a higher level of binding force in national methodologies than criteria from the social dimension. This finding is in line with Velasco Arevalo and Gerike (2023).

Although for most criteria and evaluation methods, economically more developed countries (with GDP per capita higher than the EU average) achieve higher levels of binding force, the correlation analysis showed only a weak positive correlation (0.312). An example of a country with the highest real GDP per capita in the EU and a low level of binding subsidy requirements is Luxembourg. The discrepancy between the country's economic development and the low level of sustainability in the field of transport is also mentioned in the study by Czech *et al.* (2022).

However, thanks to a smaller sample of countries with a focus on economically more developed EU countries, it is problematic to generalize the results of the statistical analysis at this time. The small number of observations increases the risk of random effects and means that the results are sensitive to extreme values and may unduly affect the regression model. The conclusions should therefore not be automatically extrapolated to the entire EU without further investigation and sample expansion. The mentioned limitations do not weaken the significance of the relationships found, but they provide a context for their correct understanding. At the same time, they point to room for further research that would eliminate these shortcomings (including expanding the sample of monitored countries to all EU countries).

Acknowledgements

This paper was supported by IGA25-PEF-TP-005, "Economic and social benefits of public transport investments subsidized from public funds".

References

- AHONEN, V., HUSSAIN, S., MERISALO, V., PEKKALA, V., LEVIÄKANGAS, P. 2024. Addressing sustainability in mobility: A study on Finnish smart mobility innovation projects. *European Transport Research Review*. 16, 7. <https://doi.org/10.1186/s12544-023-00630-0>
- ANASTASIADIS, K., GAVANAS, N. 2025. Evaluation and selection of public transportation projects in terms of urban sustainability through a multi-criteria decision-support methodology. *Future Transportation*. 5, 90. <https://doi.org/10.3390/futuretransp5030090>
- ANDERSSON, M., KÖHLER-ULBRICH, P., NERLICH, C. 2025. Green investment needs in the EU and their funding. *ECB Economic Bulletin*. [Accessed: 15 December 2025] https://www.ecb.europa.eu/press/economic-bulletin/articles/2025/html/ecb.ebart202501_03~90ade39a4a.da.html
- BADEANLOU, A., ARALDO, A., DIANA, M., GAUTHIER, V. 2022. Equity scores for public transit lines from open-data and accessibility measures. *arXiv:2210.00128v1*. <https://doi.org/10.48550/arXiv.2210.00128>
- BECCHETTI, L., CORDELLA, M., MORONE, P. 2022. Measuring investments progress in ecological transition: The Green Investment Financial Tool (GIFT) approach. *Journal of Cleaner Production*. 357, 131915. <https://doi.org/10.1016/j.jclepro.2022.131915>
- BLACK, J. A., PAEZ, A., SUTHANAYA, P. A. 2002. Sustainable urban transportation: Performance indicators and some analytical approaches. *Journal of Urban Planning and Development*. 128, 184–209. [https://doi.org/10.1061/\(ASCE\)0733-9488\(2002\)128:4\(184\)](https://doi.org/10.1061/(ASCE)0733-9488(2002)128:4(184))
- BOIX-COTS, D., DE LA FUENTE, A., PUJADAS, P. 2025. A decision-support framework for evaluating public investments: Integrating sustainability in urban planning and resource allocation. *International Journal of Urban Sustainable Development*. 17, 44–68. <https://doi.org/10.1080/19463138.2025.2474416>
- BORGATO, S., FERMI, F., CHIRICO, F., BOSETTI, S. 2021. Study on costs and benefits of the sustainable urban mobility transition. *Urban mobility*. [Accessed: 15 December 2025] <https://www.eiturbanmobility.eu/costs-and-benefits-of-the-sustainable-urban-mobility-transition-in-europe/>
- BRUUN, E., VANDERSCHUREN, M. 2017. Assessment methods from around the world potentially useful for public transport projects. *Journal of Public Transportation*. 20, 103–130. <https://doi.org/10.5038/2375-0901.20.2.6>
- BUENK, R., GROBBELAAR, S. S., MEYER, I. 2019. A framework for the sustainability assessment of (micro)transit systems. *Sustainability*. 11, 5929. <https://doi.org/10.3390/su11215929>
- BUNDESMINISTERIUM KLIMASCHUTZ, UMWELT, ENERGIE, MOBILITÄT, INNOVATION UND TECHNOLOGIE. 2023. *Call guideline R & D infrastructure funding 2023*. Version 1.0. [Accessed: 15 December 2025] https://www.ffg.at/sites/default/files/allgemeine_downloads/strukturprogramme/FuE-Infrastrukturf%C3%B6rderung/AS-LF_5AS_FuE_Infrastruktur_1AS-Runde_Englisch_bf.pdf
- BURCHART, D., PRZYTUŁA, I. 2024. Sustainability assessment methods for the transport sector considering the life cycle concept – A review. *Sustainability*. 16, 8148. <https://doi.org/10.3390/su16188148>
- CABINET DU SECRÉTAIRE D'ÉTAT À LA RELANCE ET AUX INVESTISSEMENTS STRATÉGIQUES. 2021. *Plan national pour la reprise et la résilience Belgique*. Bruxelles. [Accessed: 15 December 2025] <https://nextgenbelgium.be/images/documents/FR-Plan-national-pour-la-reprise-et-la-r%C3%A9silience.pdf>
- CASTILLO, H., PITFIELD, D. E. 2010. ELASTIC – A methodological framework for identifying and selecting sustainable transport indicators. *Transport Research Part D: Transport and Environment*. 15, 179–188. <https://doi.org/10.1016/j.trd.2009.09.002>
- CAVALCANTI, C. DE O., LIMONT, M., DZIEDZIC, M., FERNANDES, V. 2017. Sustainability of urban mobility projects in the Curitiba metropolitan region. *Land Use Policy*. 60, 395–402. <https://doi.org/10.1016/j.landusepol.2016.11.015>
- COLOMBO, C. M., DIJK, M. 2023. Understanding the policy integration challenges of sustainable urban mobility in the context of rapid decarbonisation. *European Journal of Risk Regulation*. 14, 583–606. <https://doi.org/10.1017/err.2023.62>
- CZECH, A., LEWCZUK, J., USTINOVICHUS, L., KONTRIMOVICHUS, R. 2022. Multi-criteria assessment of transport sustainability in chosen European Union countries: A dynamic approach. *Sustainability*. 14, 8770. <https://doi.org/10.3390/su14148770>
- DE OÑA, J., DE OÑA, R., EBOLI, L., MAZZULLA, G. 2016. Index numbers for monitoring transit service quality. *Transport Research Part A: Policy and Practice*. 84, 18–30. <https://doi.org/10.1016/j.tra.2015.05.018>
- DEPARTMENT OF PUBLIC EXPENDITURE, NDP DELIVERY AND REFORM. 2023. *Infrastructure guidelines*. gov.ie [Accessed: 15 December 2025] <https://gov.ie/en/department-of-public-expenditure-infrastructure-public-service-reform-and-digitalisation/collections/infrastructure-guidelines>
- DIRECTION GÉNÉRALE DU TRÉSOR. n.d. *Guide to socioeconomic evaluation of public investments in France*. [Accessed: 15 December 2025] <https://www.strategie-plan.gouv.fr/files/files/Publications/English%20Articles/ESE%20Guide%202017/fs-guide-to-socioeconomic-evaluation-of-public-investments-in-.pdf>
- EUROPEAN COMMISSION. 2015. *Guide to cost-benefit analysis of investment projects: Economic appraisal tool for cohesion policy 2014–2020*. Luxembourg: Publications Office. <https://doi.org/10.2769/97516>

- EUROPEAN COMMISSION. 2014. *Commission Delegated Regulation (EU) No 480/2014 of 3 March 2014 supplementing Regulation (EU) No 1303/2013*. https://eur-lex.europa.eu/eli/reg_del/2014/480/oj/eng
- EUROPEAN COMMISSION. 2015b. *Commission Implementing Regulation (EU) 2015/207 of 20 January 2015 laying down detailed rules implementing Regulation (EU) No 1303/2013 and Regulation (EU) No 1299/2013*. <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32015R0207>
- EUROPEAN COMMISSION. 2018. Communication from the Commission to the European Parliament, the European Central Bank, the European Economic and Social Committee and the Committee of the Regions: Action Plan – Financing sustainable growth. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0097>
- EUROPEAN COMMISSION. 2020. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Sustainable and Smart Mobility Strategy – Putting European transport on track for the future*. COM/2020/789 final <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789>
- EUROPEAN PARLIAMENT AND COUNCIL. 2020. *Regulation (EU) 2020/852 of 18 June 2020 on the establishment of a framework to facilitate sustainable investment*. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32020R0852>
- EUROPEAN PARLIAMENT AND COUNCIL. 2021. *Regulation (EU) 2021/1058 of 24 June 2021 on the European Regional Development Fund and on the Cohesion Fund*. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R1058>
- EUROPEAN PARLIAMENT. 2013. *Regulation (EU) No 1303/2013 of 17 December 2013 laying down common provisions on the European Structural and Investment Funds*. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013R1303>
- EUROPEAN PARLIAMENT. 2022. Directive (EU) 2022/2464 of 14 December 2022 as regards corporate sustainability reporting. *Official Journal of the European Union*, L.
- EUROSTAT. 2024. Real GDP per capita. *Eurostat*. [Accessed: 15 December 2025] <https://ec.europa.eu/eurostat/databrowser/product/page/TIPSNA40>
- FEDERAL MINISTRY OF TRANSPORT AND DIGITAL INFRASTRUCTURE. 2016. Methodology manual for the Federal Transport Infrastructure Plan 2030. *Federal Ministry of transport* [Accessed: 15 December 2025] <https://www.bmv.de/SharedDocs/EN/Articles/G/federal-transport-infrastructure-plan-2030.html>
- FEDERAL MINISTRY OF TRANSPORT AND DIGITAL INFRASTRUCTURE. 2016. The 2030 Federal Transport Infrastructure Plan. *Federal Ministry of transport* [Accessed: 15 December 2025] <https://www.bmv.de/SharedDocs/EN/publications/2030-federal-transport-infrastructure-plan.html>
- FEDERAL MINISTRY REPUBLIC OF AUSTRIA. 2021. Austria's 2030 Mobility Master Plan. *Federal Ministry Republis of Austria*. [Accessed: 15 December 2025] <https://www.bmimi.gv.at/en/topics/mobility/mobilitymasterplan2030.html>
- FIGUEROA, M. J., RIBEIRO, S. K. 2013. Energy for road passenger transport and sustainable development: Assessing policies and goals interactions. *Current Opinion in Environmental Sustainability*. 5, 152–162. <https://doi.org/10.1016/j.cosust.2013.04.004>
- FINANSMINISTERIET. 2023. *Vejledning i samfundsøkonomiske konsekvensvurderinger 2023*. København. [Accessed: 15 December 2025] https://fm.dk/media/m5bp2ead/vejledning-i-samfundsoekonomiske-konsekvensvurderinger-juni-2023_web-a.pdf
- FREITAS, A. L. P. 2013. Assessing the quality of intercity road transportation of passengers: An exploratory study in Brazil. *Transport Research Part A: Policy and Practice*. 49, 379–392. <https://doi.org/10.1016/j.tra.2013.01.042>
- GESTION ASSURÉE PAR LE MINISTÈRE DE L'ÉCONOMIE, DIRECTION DE LA POLITIQUE RÉGIONALE. 2023. *Guide de l'Utilisateur FEDER 2021–2027*. [Accessed: 15 December 2025] <https://fonds-europeens.public.lu/dam-assets/publications/feder/g/guide-de-lutilisateur-feder-selon-charte-graphique-version-finale-du-17032023-by-bs.pdf>
- GRAND-DUCHÉ DE LUXEMBOURG. 2021. *Accord de partenariat FEDER/FSE 2021–2027*. [Accessed: 15 December 2025] <https://fonds-europeens.public.lu/dam-assets/publications/feder/g/guide-de-lutilisateur-feder-selon-charte-graphique-version-finale-du-17032023-by-bs.pdf>
- GUTMAN, S., MALASHENKO, M. 2025. The impact of transport infrastructure on sustainable economic development of Russian regions. *Sustainability*. 17, 3776. <https://doi.org/10.3390/su17093776>
- HAGHSHENAS, H., VAZIRI, M. 2012. Urban sustainable transportation indicators for global comparison. *Ecological Indicators*. 15, 115–121. <https://doi.org/10.1016/j.ecolind.2011.09.010>
- HENKE, I., CARTENI, A., DI FRANCESCO, L. 2020. A sustainable evaluation process for investments in the transport sector: A combined multi-criteria and cost–benefit analysis for a new highway in Italy. *Sustainability*. 12, 9854. <https://doi.org/10.3390/su12239854>

- HU, X., CHENG, R., ZHAO, J., ZHOU, X. 2025. Government subsidy-penalty strategy to promote low-carbon multimodal transportation using dynamic-static combination mechanism. *Humanities and Social Sciences Communications*. 12, 762. <https://doi.org/10.1057/s41599-025-05087-1>
- JEON, C., AMEKUDZI-KENNEDY, A. 2005. Addressing sustainability in transportation systems: Definitions, indicators, and metrics. *Journal of Infrastructure Systems*. 11, 31–50. [https://doi.org/10.1061/\(ASCE\)1076-0342\(2005\)11:1\(31\)](https://doi.org/10.1061/(ASCE)1076-0342(2005)11:1(31))
- KARJALAINEN, L. E., JUHOLA, S. 2021. Urban transportation sustainability assessments: A systematic review of literature. *Transport Reviews*. 41, 659–684. <https://doi.org/10.1080/01441647.2021.1879309>
- KAYS, I. n.d. Towards unifying resilience and sustainability for transportation infrastructure systems: Conceptual framework, critical indicators, and research needs. *arXiv preprint*. <https://doi.org/10.48550/arXiv.2208.10039>
- KLINGER, T., KENWORTHY, J. R., LANZENDORF, M. 2013. Dimensions of urban mobility cultures – A comparison of German cities. *Journal of Transport Geography*. 31, 18–29. <https://doi.org/10.1016/j.jtrangeo.2013.05.002>
- LIU, D., CHEN, T., LIU, X., YU, Y. 2019. Do more subsidies promote greater innovation? Evidence from the Chinese electronic manufacturing industry. *Economic Modelling*. 80, 441–452. <https://doi.org/10.1016/j.econmod.2018.11.027>
- LIU, X., DIJK, M., COLOMBO, C. 2024. Improving multilevel policy mixes for sustainable urban mobility transition. *Environmental Innovation and Societal Transitions*. 50, 100808. <https://doi.org/10.1016/j.eist.2023.100808>
- MINISTERSTVO DOPRAVY ČESKÉ REPUBLIKY. 2023b. Operační program doprava – Metodika CBA. *Program Doprava 2021–2027* [Accessed: 15 December 2025] <https://opd3.opd.cz/slozka/metodika-cba>
- MINISTERSTVO DOPRAVY SLOVENSKEJ REPUBLIKY. 2024. Príručka CBA – OPII – Operačný program Integrovaná infraštruktúra. *Operačný program Integrovaná infraštruktúra* [Accessed: 15 December 2025] <https://www.opii.gov.sk/>
- MINISTERSTVO DOPRAVY, VÝSTAVBY A REGIONÁLNEHO ROZVOJA SLOVENSKEJ REPUBLIKY. 2014. Prehľad ukazovateľov OPII – Operačný program Integrovaná infraštruktúra. *Operačný program Integrovaná infraštruktúra* [Accessed: 15 December 2025] <https://www.opii.gov.sk/metodicke-dokumenty/prehľad-ukazovateľov-opii>
- MINISTERSTVO DOPRAVY. 2023a. Kritéria výberu projektů OPD 2021–2027. *Program Doprava 2021–2027* [Accessed: 15 December 2025] <https://opd3.opd.cz/slozka/Kriteria-vyberu-projektu-OPD>
- MKBA. [2025]. Richtlijnen voor de maatschappelijke kosten baten analyse (MKBA). *MKBA*. [Accessed: 16. July 2025] <https://www.mkba-informatie.nl/mkba-voor-gevorderden/richtlijnen/>
- MODIJEFISKY, M., HULSKER, W., SPIT, W., WITMOND, B., KOOPMANS, C. 2024. *Werkwijzer MKBA bij MIRT*. [Accessed 7. 16. 2025] <https://open.overheid.nl/documenten/dpc-e915d0f879b5e3a5fa615d854663d2dc69d0bf7e/pdf>
- PO SEUR. 2015. *Critérios de seleção e respetiva metodologia*. [Accessed: 16 July 2025] <https://poseur.portugal2020.pt/media/3962/metodologia-dos-crit%C3%A9rios-de-sele%C3%A7%C3%A3o.pdf>
- PROJECT EVERYONE. n.d. Goal 11: Sustainable cities and communities. *The Global Goals*. [Accessed: 4 October 2025]. <https://globalgoals.org/goals/11-sustainable-cities-and-communities/>
- REPUBLIC OF SLOVENIA, MINISTRY OF INFRASTRUCTURE. 2017. *Resolution on the National Programme for the Development of Transport in the Republic of Slovenia until 2030*. [Accessed: 15 December 2025] <https://www.gov.si/assets/ministrstva/MzI/Dokumenti/Resolution-on-the-National-Programme-for-the-Development-of-Transport-in-the-Republic-of-Slovenia-until-2030.pdf>
- RICHARDSON, B. C. 2005. Sustainable transport: Analysis frameworks. *Journal of Transport Geography*. 13, 29–39. <https://doi.org/10.1016/j.jtrangeo.2004.11.005>
- RISK WATCH INITIATIVE ESG INDEX. [2025]. Global Corruption ESG Indexes. *Risk Watch Initiative*. [Accessed: 15 December 2025] <http://risk-indexes.com/esg-index/>
- SONG, Y., SAHUT, J.-M., ZHANG, Z., TIAN, Y., HIKKEROVA, L. 2022. The effects of government subsidies on the sustainable innovation of university–industry collaboration. *Technological Forecasting and Social Change*. 174, 121233. <https://doi.org/10.1016/j.techfore.2021.121233>
- STÁTNÍ FOND DOPRAVNÍ INFRASTRUKTURY. 2024. Rezortní metodika pro hodnocení ekonomické efektivnosti projektů. *sfdi* [Accessed: 15 December 2025] <https://sfdi.gov.cz/pravidla-a-metodiky/rezortni-metodika-pro-hodnoceni-ekonomicke-efektivnosti-projektu/>
- TAKMAN, J., GONZALEZ-AREGALL, M. 2024. Public policy instruments to promote freight modal shift in Europe: Evidence from evaluations. *Transport Reviews*. 44, 612–633. <https://doi.org/10.1080/01441647.2023.2279219>
- TRANSPORT INFRASTRUCTURE IRELAND. 2023a. *Project appraisal guidelines – Unit 6.1*. [Accessed: 15 December 2025] <https://cdn.tii.ie/publications/PE-PAG-02020-02.pdf>
- TRANSPORT INFRASTRUCTURE IRELAND. 2023b. *Project appraisal guidelines – Unit 6.2*. [Accessed: 15 December 2025] <https://cdn.tii.ie/publications/PE-PAG-02021-03.pdf>

- UNITED NATIONS SECRETARY-GENERAL'S HIGH-LEVEL ADVISORY GROUP ON SUSTAINABLE TRANSPORT. 2016. Mobilizing sustainable transport for development. *United Nations* [Accessed: 15 December 2025] <https://sdgs.un.org/publications/mobilizing-sustainable-transport-development-18045>
- VELASCO AREVALO, A., GERIKE, R. 2023. Sustainability evaluation methods for public transport with a focus on Latin American cities: A literature review. *International Journal of Sustainable Transportation*. 17, 1236–1253. <https://doi.org/10.1080/15568318.2022.2163208>
- VLADA REPUBLIKE SLOVENIJE. 2016. Uredba o enotni metodologiji za pripravo in obravnavo investicijske dokumentacije na področju javnih financ. *Tax-Fin-Lex*. [Accessed: 15 December 2025] https://www.tax-fin-lex.si/Dokument/Podrobnosti?rootEntityId=aE_e088a48e-587b-4504-be2a-89cd824a0353&createDate=04%2F11%2F2016%2000%3A00%3A00&activeDate=04%2F12%2F2016%2000%3A00%3A00

Contact information

Marie Poláčková: marie.polachova@mendelu.cz,  <https://orcid.org/0000-0002-9014-5961>

Martin Žapka: xzapka@mendelu.cz,  <https://orcid.org/0009-0002-0797-9357>

Barbora Stojanová: bara.stojanova@gmail.com

Appendix

III: Comparison of the degree of bindingness of subsidy criteria

Country	Sensitivity analysis	Risk matrix	Multicriteria analysis (MCA)	External cost (noise, pollution)	Assessment of comfort and perceived quality of infrastructure	Climate emissions	Evaluation of regional development	Impact on secondary markets	Consideration of socio-economic effects (time, safety)
Czechia	5	4	1	5	1	4	1	1	4
Finland	1	1	1	1	1	1	1	1	4
Sweden	5	4	1	5	2	4	2	2	4
Slovakia	5	1	1	5	1	4	1	1	4
Portugal	1	1	1	1	1	1	1	1	4
Ireland	3	4	2	4	1	4	4	1	4
Germany	1	1	4	4	1	4	4	3	4
Austria	3	3	4	4	1	4	5	1	4
Slovenia	1	1	1	1	1	1	1	1	4
France	4	4	1	4	1	4	1	1	4
Netherlands	4	1	1	4	2	4	3	1	3
Belgium	1	1	1	1	1	1	1	1	4
Luxembourg	1	1	1	1	1	1	1	1	4
Denmark	4	1	1	4	1	2	1	1	4

Source: own processing based on analysis and comparison of subsidy requirements (Methodology)