SAVi Sustainable Asset Valuation

A Sustainable Asset Valuation of the Tirana–Durres Railway in Albania

TECHNICAL REPORT

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January 2024

International Institute for Sustainable Development

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Acknowledgements

The International Institute for Sustainable Development would like to thank the European Bank for Reconstruction and Development team—and Harry Karandeinos and Ilir Basha, in particular—for their collaboration on this project and for their support and engagement. We are grateful for the comments of Martin Schäfer (GIZ Albania), Giacomo Pontara, and Daphne Groß-Jansen (German Federal Ministry for Economic Cooperation and Development).

This report is part of a series of SAVi assessments on sustainable transport and mobility projects to raise awareness and inform decision-makers on the use of systemic approaches and simulation to support the transformation toward sustainable mobility.

We are grateful for the financial support of the German Federal Ministry for Economic Cooperation and Development.

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Executive Summary

Purpose of This Assessment and the Sustainable Asset Valuation Methodology

This Sustainable Asset Valuation (SAVi) assessment of the Tirana–Durres railway in Albania is part of a series of SAVi assessments on sustainable transport and mobility projects. The assessments aim to raise awareness of sustainable transport infrastructure investments and inform decision-makers about the use of systemic approaches in supporting the transformation toward sustainable mobility. The assessments integrate the economic value of social and environmental impacts such as health and carbon dioxide (CO_2) emissions and aim to highlight their importance for transport investment decision-making processes.

SAVi is a methodology that provides policy-makers and investors with a comprehensive and customized analysis of how much their infrastructure projects and portfolios will cost throughout their life cycles, taking into account risks and externalities that are overlooked in a traditional cost-benefit analysis. SAVi is

- a combination of systems thinking and different modelling methodologies, spatial modelling, economic multiplier/multicriteria assessments, system dynamics, and financial models;
- customized to each individual infrastructure project, portfolio, or policy;
- co-created with the decision-makers and stakeholders. A multistakeholder approach enables stakeholders to identify the material risks and opportunities that are unique to the projects. This strengthens the capacity of decision-makers and stakeholders to take a systemic approach to investments and increases the likelihood of the uptake, use, and impact of the results of the analysis; and
- based on project-level data (where available), the SAVi database (based on a literature review and data from previous SAVi applications), and best-in-class climate data from the European Union's Copernicus Climate Date Store (built into all SAVi models).

The Tirana–Durres Railway in Albania

The Tirana–Durres metropolitan region in Albania accommodates 37% of the country's population; has the highest population density, with 443 inhabitants per km^2, and accounts for 48% of the country's GDP. According to demographic projections, the region is expected to experience a population growth of approximately 200,000 inhabitants in the next 10 years. Despite being one of the most developed economic areas in the country, the Tirana–Durres region faces significant transportation challenges due to its reliance on road transport and an outdated railway network that has not received adequate investment or maintenance in the last 25 years. The railway network's poor condition, coupled with the rapid growth of the country's road network, has resulted in a steady decline in railway passenger and freight traffic over the years.

To address these transportation challenges, proposals have been made to rehabilitate the Tirana–Durres railway line and establish a new railway connection to Rinas International Airport, with the aim of improving Albania's railway transport by enhancing infrastructure, operations, and safety in the sector.

The railway project's objective is to improve economic performance by facilitating efficient passenger and trade movements while also contributing positively to the environment by reducing the use of polluting transport modes and decreasing CO_2 emissions from the transport sector. The total cost of the Tirana–Durres railway is estimated at EUR 58.78 million. The length of the railway infrastructure is 34 km (JV Railcon, 2015a).

This report discusses the results of a systemic valuation of the Tirana–Durres railway in Albania with the SAVi methodology to illustrate the value of the economic, social, and environmental outcomes of the railway and how they can impact the financial performance of the project.

The SAVi assessment uses a variety of models to estimate not only the investment costs (capital, operations and maintenance [O&M] costs, and revenues) but also the environmental, social, and economic added benefits and avoided costs under a scenario where demand shifts from other transport modes to the railway. The SAVi assessment for the Tirana–Durres railway consists of the following elements:

- a simulation of one railway scenario for the rehabilitated Tirana–Durres railway line and the associated changes in transport use patterns in the region;
- a valuation of eight added benefits and avoided costs related to the railway; and
- an integrated cost-benefit analysis (CBA) of the Tirana–Durres railway, including the added benefits and avoided costs, and a benefit-cost ratio (BCR) for the railway.

Findings

According to the analysis, the Tirana–Durres railway in Albania has a wide range of economic, social, and environmental benefits that are typically overlooked in traditional transport infrastructure assessments.

Primarily, the railway stimulates economic growth, either directly through revenues from railway operation and employment creation or indirectly through avoided vehicle operating costs and time savings. In addition, it delivers considerable social benefits to the region's inhabitants, such as health benefits in the form of increased physical activity and reduced air pollution, as well as a diminishing number of traffic accidents. Lastly, the Tirana–Durres railway will be electric and will result in avoided environmental costs and CO_2 emissions.

Table ES1 summarizes the results of the integrated CBA of the Tirana–Durres railway in Albania. According to the SAVi model, the total net value of the railway is positive, and therefore, the project is profitable from both macroeconomic and societal perspectives. The integrated CBA shows cumulative discounted values over the project period of 30 years (2023–2053) of EUR 270.34 million.

Table ES1. Integrated CBA (discounted values at 3.5%, for the railway scenarios based on a project period of 30 years)

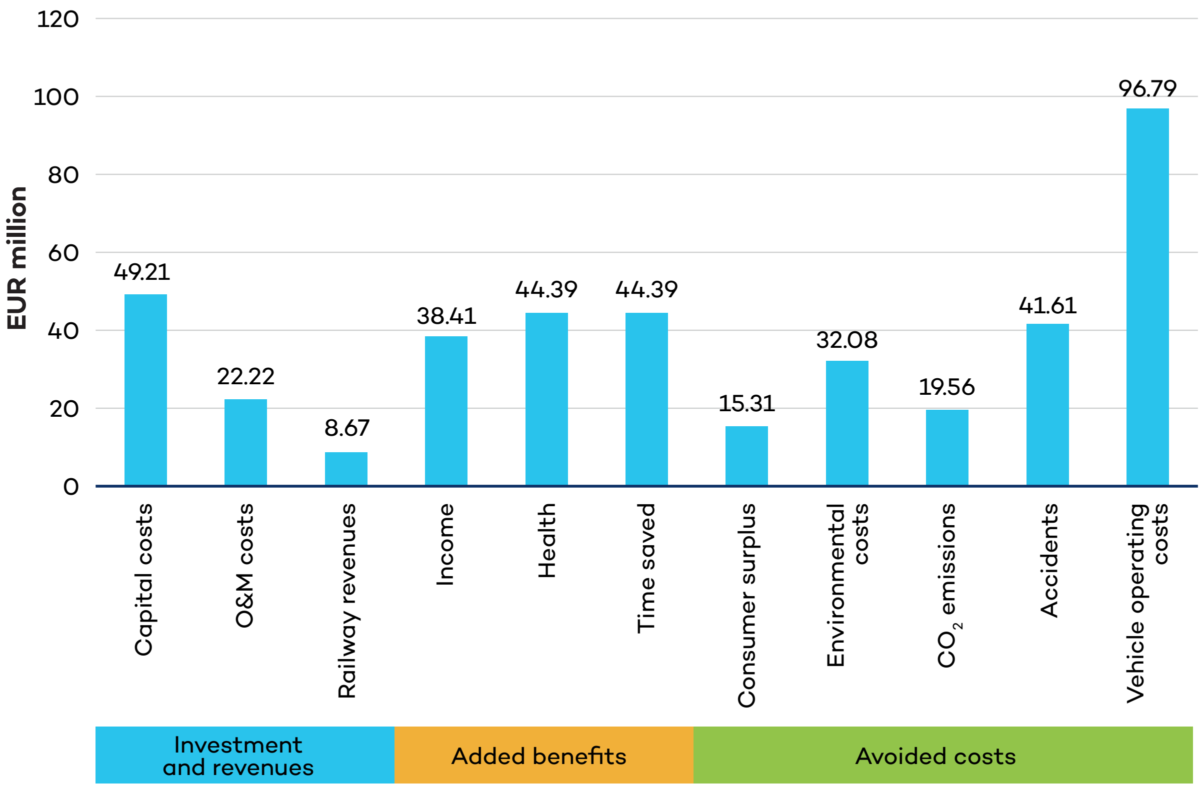
Integrated CBA (discounted at 3.5%)	**Tirana–Durres railway scenario (2023–2053)**
Total investment (EUR million)	**71.42**
Capital costs	49.21
O&M costs	22.22
Total revenues (EUR million)	**8.67**
Revenues from railway operation	8.67
Total added benefits (EUR million)	**143.04**
Income creation from employment	38.41
Health impacts	44.93
Value of time saved	44.39
Consumer surplus	15.31
Total avoided costs (EUR million)	**190.05**
Environmental costs	32.08
CO_2 emissions	19.56
Accidents	41.61
Vehicle operating costs	96.79
Cumulative net benefits (EUR million, undiscounted)	359.31
Cumulative net benefits (EUR million, discounted)	**270.34**
BCR	0.12
Sustainable BCR (S-BCR)	**4.79**

Source: Authors.

As Table ES1 demonstrates, the avoided vehicle operating costs resulting from the rehabilitation of the Tirana–Durres railway show the highest cumulative discounted values, amounting to EUR 96.79 million. The avoided vehicle operating costs include avoided fuel use and avoided maintenance costs as a result of the shift from road to railway transport. In addition, the Tirana–Durres railway will lead to cumulative added benefits from time saved for railway users through reduced traffic and congestion, valued at EUR 44.39 million; added health benefits, including avoided air pollution costs and benefits from physical activity, valued at EUR 44.93; avoided costs of traffic accidents, valued at EUR 41.61 million; and income created from additional railway employment, which amounts to EUR 38.41 million. On the other hand, investment costs for the rehabilitation of the railway are also high, standing at EUR 49.21 million.

Overall, the successful rehabilitation of the Tirana–Durres railway in Albania has the potential to address some of the challenges that keep the region in a car-oriented, high-carbon mobility pathway and transform it into a pilot area for railways and sustainable mobility more generally. The full range of investment costs, revenues, added benefits and avoided costs are clearly demonstrated in Figure ES1 below.

Figure ES1. Monetary values of the investment costs, revenues, added benefits, and avoided costs of the Tirana–Durres railway in Albania.



Source: Authors.

In addition, two different BCRs have been calculated for the SAVi assessment of the Tirana–Durres railway in Albania. The BCR determines the overall value for money of a project. It illustrates the return for every unit (EUR invested) by comparing the project's total benefits with the total costs. In this case, the conventional BCR of the project considers only the tangible impacts (e.g., capital costs, O&M costs, and revenues from the operation of the railway) and amounts to 0.12.

However, SAVi's S-BCR, which takes into account the full range of economic, social, and environmental added benefits and avoided costs, amounts to 4.79, which is approximately 40 times higher than the BCR. This calculation demonstrates the importance of valuing these added benefits and avoided costs and ensures that they are being taken into account at critical moments of the decision-making process.

Table ES2. Conventional BCR vs. S-BCR (discounted at 3.5%)

	BCR	S-BCR
Parameters considered	Investment and costs; revenues from railway operation	Investment and costs; full range of economic, social, and environmental added benefits and avoided costs
	0.12	**4.79**

Source: Authors.

The SAVi assessment of the Tirana–Durres railway in Albania primarily demonstrates that the project's benefits outweigh the investment costs. Even under conservative assumptions, the calculated added benefits and avoided costs of the railway (EUR 341.76 billion) exceed, by far, the projected investment costs (EUR 71.42 million). In addition, the comparison of the BCR and the S-BCR demonstrates that when only tangible impacts are considered in the analysis, the project is not economically viable, but when social and environmental non-tangible impacts are also considered, the benefits are significantly higher. All of the above show that the Tirana–Durres railway in Albania is highly profitable from both macroeconomic and societal perspectives.

The SAVi assessment provides benchmark values for policy-makers and public infrastructure planners when it comes to valuing the societal benefits and costs of railways. Table ES3 indicates how different stakeholders and decision-makers can use the results of this assessment.

Table ES3. How different stakeholders and decision-makers can use the results of the Tirana–Durres railway SAVi assessment

Stakeholder	Role in the project	How can the stakeholder use the results of the assessment?
Government	Design, implementation, and finance of the Tirana–Durres railway in Albania	Urban, regional, and national governments can use the assessment results to raise awareness and justify investment and support for sustainable transport projects and strategies, as well as make these assessments a standard or requirement for investment decisions.
Private sector/ industry	Project developers	Businesses and private sector entities can use the assessment results for sustainable transport projects and railway systems, as well as for reporting on sustainability objectives.
Donors and funders	Funding of railway projects	Donors can include the assessment results in their reporting processes to show the impacts of their investments. The assessment results can also be used to raise awareness about the benefits of railway projects, with the ultimate aim of making these assessments a formal requirement.
Civil society organizations	Consultation with government on railway projects	Civil society organizations can use the assessment results to conduct more targeted advocacy for sustainable transport projects. Civil society organizations can also use the assessment results to promote and advocate for integrated solutions for sustainable transport and to raise awareness of their value to society.

Source: Authors.

Integrated assessments such as this one help to make a stronger case for railway infrastructure. Altogether, this assessment has shown that the Tirana–Durres railway advances the realization of sustainable mobility targets in Albania and improves the quality of life of its residents by encouraging more sustainable transport and increasing access to employment opportunities.

Abbreviations

CBA	cost-benefit analysis
CLD	causal loop diagram
CO_2	carbon dioxide
O&M	operations and maintenance
p-km	passenger-km
$PM_{2.5}$	particulate matter with a diameter of less than 2.5 micrometres
SAVi	Sustainable Asset Valuation tool
S-BCR	sustainable benefit-cost ratio
SUMP	Sustainable Urban Mobility Plan
v-km	vehicle-km
VOC	vehicle operating costs
VOT	value of time

Glossary

Benefit-cost ratio: A ratio that determines the overall value for money of a project. It illustrates the return for every unit (USD or EUR) invested by comparing a project's total benefits with the total costs.

Causal loop diagram: A schematic representation of key indicators and variables of the system under evaluation that shows the causal connections between them and contributes to the identification of feedback loops and policy entry points.

Discounting: A finance process to determine the present value of a future cash value.

Indicator: Parameters of interest to one or several stakeholders that provide information about the development of key variables in the system over time and trends that unfold under specific conditions (United Nations Environment Program [UNEP], 2014).

Methodology: The theoretical approach(es) used for the development of different types of analysis tools and simulation models. This body of knowledge describes both the underlying assumptions used as well as qualitative and quantitative instruments for data collection and parameter estimation (UNEP, 2014).

Model validation: The process of assessing the degree to which model behaviour (i.e., numerical results) is consistent with behaviour observed in reality (i.e., national statistics, established databases) and the evaluation of whether the developed model structure (i.e., equations) is acceptable for capturing the mechanisms underlying the system under study (UNEP, 2014).

Net benefits: The cumulative monetary benefits accrued across all sectors and actors over the lifetime of investments compared to the baseline, as reported by the intervention scenario.

Scenarios: Expectations about possible future events used to analyze potential responses to these new and upcoming developments. Consequently, scenario analysis is a speculative exercise in which several future development alternatives are identified, explained, and analyzed for discussion on what may cause them and the consequences these future paths may have on our system (e.g., a country or a business).

Simulation model: Models can be regarded as systemic maps in that they are simplifications of reality that help to reduce complexity and describe, at their core, how the system works. Simulation models are quantitative by nature and can be built using one or several methodologies (UNEP, 2014).

System Dynamics: A methodology developed by J. Forrester in the late 1950s (Forrester, 1961) to create descriptive models that represent the causal interconnections between key indicators and indicate their contribution to the dynamics exhibited by the system as well as to the issues being investigated. The core pillars of the system dynamics method are feedback loops, delays, and non-linearity emerging from the explicit capture of stocks and flows (UNEP, 2014).

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1.0 Introduction

1.1 Mobility Challenges and Transport Strategies in Albania

The Tirana–Durres metropolitan region in Albania accommodates 37% of the country's population, has the highest population density with 443 inhabitants per km^2 and accounts for 48% of the country's GDP. According to demographic projections, the region is expected to experience a population growth of approximately 200,000 inhabitants in the next 10 years (Albanian Government, 2018). Despite being one of the most developed economic areas in the country, the Tirana–Durres region faces significant transportation challenges due to its reliance on road transport and an outdated railway network that has not received adequate investment or maintenance in the last 25 years. The railway network's poor condition, coupled with the rapid growth of the country's road network, has resulted in a steady decline in railway passenger and freight traffic over the years (JV Railcon, 2015a).

To address these transportation challenges, proposals have been made to rehabilitate the Tirana–Durres railway line and establish a new railway connection to Rinas International Airport, with the aim of improving Albania's railway transport by enhancing infrastructure, operations, and safety in the sector. The railway project's objective is to improve economic performance by facilitating efficient passenger and trade movements while also contributing positively to the environment by reducing the use of polluting transport modes and decreasing CO_2 emissions from the transport sector.

Additionally, the Integrated Cross-Sectorial Plan of the Tirana–Durres area (Albanian Government, 2018) aims to respond to the region's socio-economic development over the past 25 years, serving as a guideline for its economic, social, and environmental growth. The plan's primary strategic objectives include

- sustainable economic development;
- improving the quality of life in urban and rural centres;
- improving infrastructure, transport, and mobility in the region; and
- protecting and improving the quality of the natural environment.

The main targets for 2030 for the "Improve infrastructure, transport, and mobility in the region" strategic objective are the following:

- complete the regeneration of the Tirana–Durres railway line and connection to the airport,
- reduce the use of cars by 30%,
- construct 100 km of bicycle lanes,
- increase agricultural road infrastructure by 60%, and
- encourage a 30% increase in public transport that is powered by non-polluting energy sources.

Moreover, the Sustainable Urban Mobility Plan (SUMP) for the city of Tirana includes the following vision for the mobility of the city on the 2030 horizon: "A smart Tirana, responding to community needs as a livable, clean, healthy, attractive city, offering innovative, multi-modal and wide-ranging mobility, available, affordable and equal for everyone" (TRT Trasporti e Territorio, 2020). The SUMP's main objectives include

- sustainable mobility: effectiveness and efficiency of the mobility system, reducing car dependency, making city streets and public spaces compatible with the needs of different users, and optimizing and integrating the different public and private mobility systems.
- economic sustainability: innovation and economic efficiency; promoting the economic efficiency of the distribution of goods; optimizing the use of resources; promoting technological and managerial innovation in transport; and making the environmental, social, and health costs of various transport modes explicit and internalized in public policies.
- social sustainability: equity, safety, and social inclusion; reducing road accidents; increasing awareness about more sustainable transport modes; and improving livability, accessibility, and attractiveness for all users.
- environmental sustainability: quality of the environment, reducing air and noise pollution, carbon dioxide (CO_2) emissions, and energy consumption.

The SUMP's main objectives are followed by key strategies that include fostering public transport, pushing cycling and micromobility, and increasing the flexibility and reactiveness of the urban mobility system in the city (TRT Trasporti e Territorio, 2020).

By promoting the use of public transport and enhancing the efficiency of freight trade, the development of an efficient and eco-friendly Tirana–Durres railway line can contribute directly and indirectly to achieving the objectives mentioned above. It can encourage a transition from motorized transport modes to public transport, thereby reducing the region's carbon footprint and promoting a greener environment. Additionally, it can improve the efficiency of freight trade, leading to increased economic development in the area.

1.2 Purpose of a Sustainable Asset Valuation for the Tirana–Durres Railway

Albania is located in southeastern Europe, covers an area of 28.748 km^2, and has a population of approximately 2.9 million. The capital city of Tirana is home to 800,000 inhabitants. The country's road transport infrastructure is undergoing rapid development; air transport is mainly serviced by the Rinas International Airport in Tirana; and sea transport is accommodated by the ports of Durres, Vlorë, Sarandë, and Shëngjin. The Durres port, located 34 km west of Tirana, is the largest of the four and the primary channel for Albania's imports and exports. Despite being one of the country's most economically developed areas, the Tirana–Durres region experiences significant social challenges and poverty (Albanian Government, 2018). In addition, the region is primarily served by road transport and an outdated Albanian Railway network (JV Railcon, 2015a).

Figure 1. Map of Albania

Source: JV Railcon, 2015a.

The Albanian railway network was constructed between 1946 and 1986 and is currently operated by Hekurudha Shqiptare, a former state-owned operator that became a private company in 2005. The railway network is generally in poor condition due to a lack of adequate investment and maintenance work in the last 25 years. Uncontrolled vegetation growth around rail tracks and poor drainage systems have created wet beds, further deteriorating the railway infrastructure. Rails are in reasonable condition solely because of limited rail traffic. Additionally, passenger platforms and station buildings require renovation and reconstruction since signalling and communication systems are virtually out of operation. The railway was initially designed for freight transportation, resulting in inconveniently located train stations and track alignment for passengers. Trains on the network achieve average speeds of around 40 km/h for a significant portion of the network, with maximum speeds not exceeding 60 km/h. The poor condition of the railway network in Albania, coupled with the fast growth of the country's road network, has resulted in steady decreases in railway passenger and freight traffic over the years (JV Railcon, 2015a).

To address these transportation challenges, proposals have been made to rehabilitate the Tirana–Durres railway line and establish a new railway connection to Rinas International Airport. The project aims to enhance railway transport in Albania by improving infrastructure, operations, and safety in the sector. In 2015, the Albanian Ministry of Transport and Infrastructure signed a contract for the Tirana–Durres railway and the Rinas International Airport connection with JV Railcon under a grant from the European Bank for Reconstruction and Development Technical Cooperation Funds. The railway project aims to improve economic performance by facilitating efficient passenger and trade movements while also contributing positively to the environment by reducing the use of polluting transport modes and decreasing Albania's CO_2 emissions from the transport sector.

Numerous transport studies have been conducted by various entities in Albania, including Hekurudha Shqiptare, the Ministry of Transport, the Institute of Transport, the Albanian Road Authority, the Municipality of Tirana, the Port of Durres, and the Rinas International Airport. These studies have covered topics including railway feasibility and rehabilitation projects, national transport plans, railway development strategies, and master plans for ports and airports.

However, despite these efforts, there has yet to be a comprehensive analysis that clearly demonstrates the multiple economic, social, and environmental benefits of a successful railway project in Albania. Currently, any potential benefits and costs associated with the Tirana–Durres railway are based on anecdotal evidence and evaluations of railway projects from other countries. To strengthen the business case for the Tirana–Durres railway in Albania and encourage public authorities to invest in providing the baseline railway infrastructure, it is essential to accurately estimate and value the added benefits and avoided costs that this specific railway project could provide.

For this purpose, the German Federal Ministry for Economic Cooperation and Development (BMZ) invited the International Institute for Sustainable Development (IISD) to customize the Sustainable Asset Valuation (SAVi) methodology to assess the suggested Tirana–Durres railway in Albania. The developed SAVi model serves to estimate and value the environmental, social, and economic impacts of the railway project, which is achieved through the promotion of a transition from other transport modes to public transport and the enhancement of trade efficiency. The total cost of the Tirana–Durres railway is estimated at EUR 58.78 million. The total length of the railway is 34 km, combining 18.2 km of segregated lanes with 9.2 km of route to be operated in mixed traffic (JV Railcon, 2015a). The SAVi assessment of the Tirana–Durres railway in Albania includes one scenario that is compared to a baseline scenario where the railway would not be implemented. The monetary value of the wide range of economic, social, and environmental impacts that are quantified in this study and generated by changing mobility patterns are termed the "added benefits and avoided costs" of the railway project and are integrated into a cost-benefit analysis (CBA).

The SAVi assessment of the Tirana–Durres railway in Albania is part of a series of nine SAVi assessments on sustainable transport and mobility projects that aim to raise awareness of sustainable transport infrastructure and inform decision-makers on the use of systemic approaches in supporting the transformation toward sustainable mobility.

The next section presents the methodology, including an overview of the causal loop diagram (CLD) (system dynamics model) that was created for this assessment, as well as a summary of the valued added benefits and avoided costs of this assessment. Section 3 describes the scenarios and assumptions. It summarizes demand figures and shifting mobility patterns associated with the railway demand scenarios and then presents the valuation methodologies and data sources used for each added benefit and avoided cost. Section 4 of the report presents the results. The section starts with the integrated CBA table that demonstrates the total cumulative monetary values generated by the railway demand scenarios. The values of the added benefits and avoided costs are integrated into the CBA, which includes capital and O&M expenditures in order to better represent the societal value of the Tirana–Durres railway in Albania. Both parameters are also summarized separately. The last part of Section 4 includes the valuation results for each added benefit and avoided cost. Section 5 concludes by illustrating how the results of the SAVi assessment make a stronger case for the railway by highlighting the added value of integrating economic, social, and environmental parameters into transport assessments.

2.0 Methodology

This section introduces the system dynamics methodology used for this SAVi assessment. It provides an overview of the CLD, as well as a summary of the impacts of the Tirana–Durres railway in Albania from a system dynamics perspective. The second part of this section summarizes the added benefits and avoided costs used in the assessment. A more elaborate description and valuation process of the added benefits and avoided costs is included in Section 3. Some of the limitations of the methodology used are discussed in the concluding Section 5.

2.1 System Mapping

2.1.1 SYSTEMS THINKING AND SYSTEM DYNAMICS

The underlying dynamics of the Tirana–Durres railway in Albania, including driving forces and key indicators, are summarized in the CLD displayed in Figure 2. The CLD includes the main indicators analyzed during this SAVi assessment, their interconnections with other relevant variables, and the feedback loops they form. The CLD illustrates the interconnections of the economy with a wide range of social and environmental parameters while highlighting key dynamics and potential trade-offs emerging from different development strategies envisaged for the Tirana–Durres railway. The CLD is the starting point for the development of the mathematical stock and flow model.

2.1.2 READING A CLD

CLDs aim to capture causal relationships within a system accurately in order to increase the effectiveness of relevant solutions and interventions. Therefore, CLDs establish causal links between variables. CLDs include variables and arrows, with the latter linking the variables together with a sign (either + or −) on each link, indicating a positive or negative causal relation (see Table 1):

- A causal link from variable A to variable B is positive if a change in A produces a change in B in the same direction.
- A causal link from variable A to variable B is negative if a change in A produces a change in B in the opposite direction.

Table 1. Causal relations and causality

Variable A	Variable B	Sign
⬆	⬆	+
⬇	⬇	+
⬆	⬆	−
⬇	⬇	−

Source: Authors.

Circular causal relations between variables form causal, or feedback, loops. These can be positive or negative. A negative feedback loop tends toward a goal or equilibrium, balancing the forces in the system (Forrester, 1961). A positive feedback loop can be found when an intervention triggers other changes that amplify the effect of that initial intervention, thus reinforcing it (Forrester, 1961). CLDs also capture delays and non-linearity. In addition, reinforcing loops tend to increase and amplify everything happening in the system (i.e., action–reaction), whereas balancing loops represent a self-limiting process that aims to find balance and equilibrium. A detailed description of all the reinforcing and balancing loops for the Tirana–Durres railway in Albania is included in Appendix A.

2.1.3 CLD FOR THE TIRANA–DURRES RAILWAY IN ALBANIA

The impacts of the Tirana–Durres railway in Albania that are summarized in Figure 2 cover three main dimensions: social, environmental, and economic.

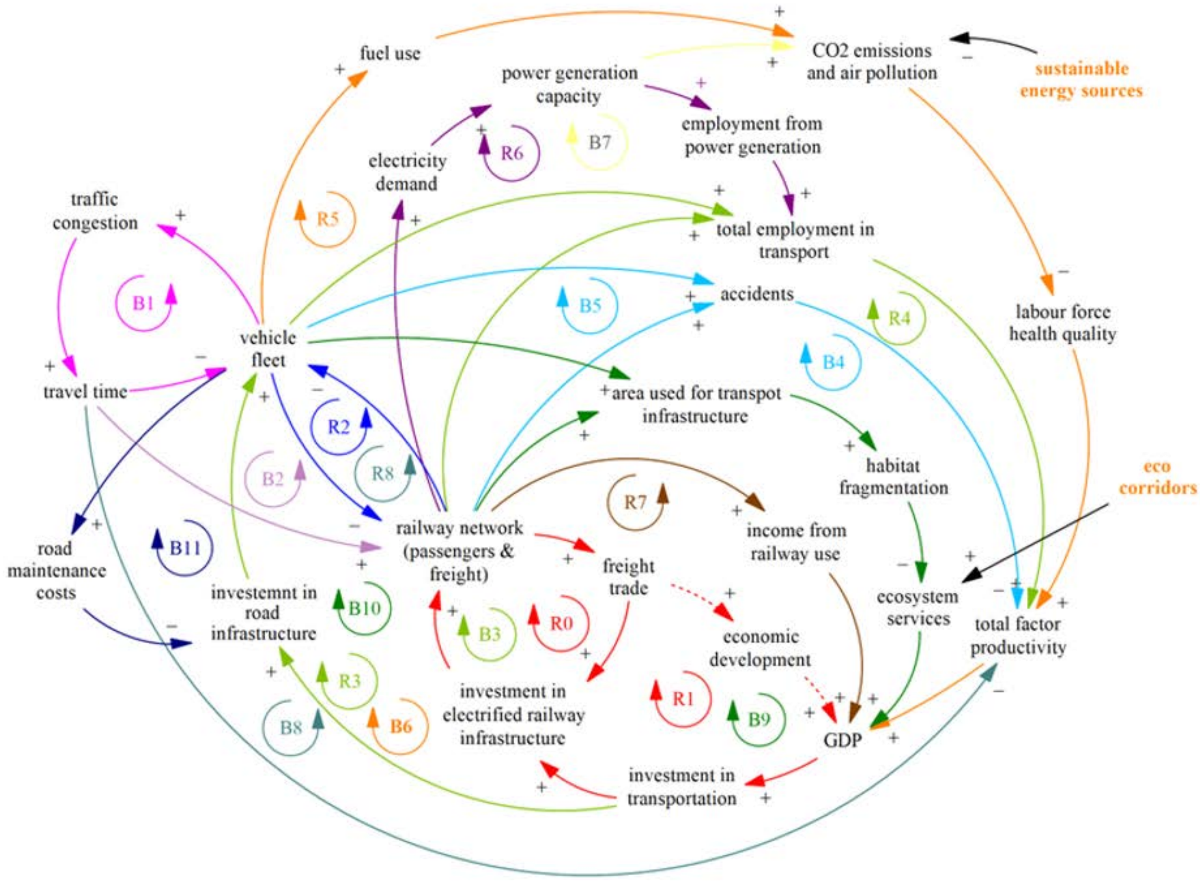
The shift from road transport to railway (R2) in Albania is reinforced by certain dynamics and counteracted by others. Freight demand (R0), economic development due to freight trade (R1), and income from the railway (R7) create economic dynamics that reinforce the use of the railway. From a social perspective, the reinforcing dynamics are represented by employment generation from railway construction and operation (R4), employment generation from electricity demand (R6), and travel time savings (R8). The environmental dynamic that reinforces the use of the railway is the one driven by fuel use from the private vehicle fleet (R5). On the other hand, the dynamic that reinforces the use of road transport is the employment creation from road transport (R3).

Within the CLD structure, counteracting dynamics that create an impact on both road transport and the railway can be observed. The loops that dominate the counteracting dynamics on road transport involve the impacts of traffic congestion (B1), road accidents (B5), fuel use (B6), travel time (B8), land use for transport infrastructure (B10), and road maintenance costs (B11). Finally, the dynamics that can counteract the use of the railway for passengers and freight are the impacts of travel time savings for road transport (B2), employment from road transport (B3), railway accidents (B4), CO_2 emissions and air pollution from power generation (B7), and land use (B9).

Overall, investment in the Tirana–Durres railway stimulates economic growth, either directly through railway revenues and employment creation or indirectly through travel savings and the avoided costs of road accidents and fuel use. From a public sector perspective, higher GDP leads to higher government revenues, allowing the allocation of more resources to railway infrastructure. The Tirana–Durres railway also leads to significant environmental benefits, such as avoided costs of pollution and CO_2 emissions.

The majority of the above-mentioned identified impacts are quantified in the SAVi model. However, where evidence was not available, or effects were negligible, impacts were not included in the SAVi assessment results. The impacts that were not quantified include road maintenance costs, labour force health quality, and habitat fragmentation.

Figure 2. CLD for the Tirana–Durres railway in Albania



Source: Authors.

The CLD presented in this chapter is described in more detail in Appendix A.

2.2 Added Benefits and Avoided Costs

The SAVi assessment provides the monetary valuation of the project-related added benefits and avoided costs of the Tirana–Durres railway in Albania. Table 2 lists all added benefits and avoided costs considered in this assessment, as well as stakeholders and indicators of relevance. Section 3.3 explains in detail how each of these indicators is quantified and includes all data sources and assumptions.

Table 2. Added benefits and avoided costs considered in the SAVi assessment

Added benefit or avoided costs	Stakeholders of relevance (government, households, private sector)	Social, environmental, economic
Added benefits		
Income creation from employment	Government, households	Economic
Health impacts	Households	Social
Value of time saved	Households, private sector	Economic
Consumer surplus	Households	Economic
Avoided costs		
Environmental costs	Households, government	Environmental
CO_2 emissions	Households	Environmental
Accidents	Government, households	Social
Vehicle operating costs	Households	Economic

Source: Authors.

3.0 Scenarios and Assumptions

This section primarily introduces the railway and business-as-usual (BAU) scenarios simulated for the SAVi assessment of the Tirana–Durres railway in Albania, including the associated demand figures and shifting mobility patterns. Subsequently, it examines the underlying valuation methodologies of the SAVi assessment for the railway scenario. This includes the assumptions, data sources, and valuation methodologies of the railway revenues and the nine added benefits and avoided costs valued by the SAVi model. The section is followed by the SAVi assessment results of the Tirana–Durres railway in Albania.

3.1 Scenarios of the Tirana–Durres Railway SAVi Assessment

Table 3 provides an overview of the Tirana–Durres railway scenario simulated for this SAVi assessment and includes the relevant assumptions used. The SAVi assessment consists of the baseline, or the BAU scenario reflecting status quo and the Tirana–Durres railway scenario.

Table 3. Scenarios simulated for the SAVi assessment of the SAVi assessment of the Tirana–Durres railway in Albania

Scenario	Assumptions
BAU scenario	This scenario assumes that there is no rehabilitation of the Tirana–Durres railway section, representing a no-action scenario. Transport will mainly consist of road transport, and the trip projections used are aligned with the "Do-nothing scenario" in the *Financial and Economic Appraisal* of the whole railway network (JV Railcon, 2015b).
Tirana–Durres railway scenario	This scenario assumes the rehabilitation of the Tirana–Durres railway section, with construction starting in 2023 and the railway being operational in 2026. By 2024, 11.3 km of the infrastructure will be built, which will increase to 22.67 km by 2025 and reach 34 km by 2026. The trips in his scenario are presented in the "Do-all" scenario in the *Financial and Economic Appraisal* of the whole railway network (JV Railcon, 2015b). The "Do-all" scenario assumes the rehabilitation of all sections; however, for the current scenario, we consider only the rehabilitation of section 1 (Tirana–Durres) while also considering the generated traffic from the rehabilitation of the rest of the sections. The generated traffic is equivalent to an additional 10% of railway trips.

Source: Authors.

In addition, Tables 4 and 5 show the different mobility shifts in the BAU and railway scenarios, and more importantly, the shift from individual, motorized transport modes to the railway system. This shift is differentiated into two types of railway use: (i) passengers and (ii) freight. The trips modelled for each scenario represent the shift or the additional trips for both railway and road transport, not the total trips. The number of trips for both passengers and railway is generated by the SAVi model based on demand projections from JV Railcon (2015a).

Table 4. Passenger transport trips per scenario simulated for the SAVi assessment of the Tirana–Durres railway

		Transport modes (thousand trips/year)		
Scenario	**Year**	**Bus**	**Cars**	**Railway**
Tirana–Durres railway	2022	266.2	1,038	164.4
	2040	0	0	2,796
	2053	0	0	3,998
BAU	2022	266.2	1,038	164.4
	2040	436.9	1,931	278.4
	2053	709.5	2,750	389.5

Source: Authors.

Table 5. Freight transport tonnes per scenario simulated for the SAVi assessment of the Tirana–Durres railway

		Transport modes (tonnes/year)	
Scenario	**Year**	**Truck**	**Railway**
Tirana–Durres railway	2022	24.8	146.1
	2040	0	298.8
	2053	0	448.5
BAU	2022	24.8	146.1
	2040	57.9	240.7
	2053	89.7	346.2

Source: Authors.

For the two Tirana–Durres railway scenarios, we have assumed that when the railway demand increases, trips shift from individual transport modes to the railway and demand for buses, cars, and trucks goes to zero since the feasibility studies provide only data about the shift.

3.2 Valuation Methodology of Revenues

3.2.1 REVENUES FROM RAILWAY OPERATIONS

Revenues from the use of the Tirana–Durres railway represent the revenues collected from passengers and freight fares during the period of analysis of this assessment. Data from the feasibility studies of the project indicates that for railway, the average railway passenger fare per km was EUR 0.0102 in 2022, which will increase to EUR 0.0647 in 2050 (JV Railcon, 2015b). In the case of freight, the average unit fare per tonne-km is EUR 0.0491 for the entire project period (JV Railcon, 2015b).

The average fare per type (i.e., passengers or freight) is multiplied by the number of passenger-km (p-km) or tonne-km per year until 2050 to calculate the total revenues. The p-km and tonne-km increase as the railway is being built. For instance, in 2023, when the construction starts, there are no trips in the Tirana–Durres railway section. By 2026, the number of trips increases significantly since the railway is fully operational. For passengers, the number of p-km is 59.83 million in 2026. Based on projected numbers of railway trips over time, p-km total 125 million by 2050. In the case of freight, the number of tonne-km is 7.15 million by 2026 and increases to 18.03 million by 2050. These calculations are based on information about trips, trip distance, and occupancy rates from JV Railcon (2015b). For passengers, the occupancy rate per trip per train is 120, and for freight, it is 600 tonnes per train per trip (JV Railcon, 2015b). Additionally, we applied an inflation correction to all the monetary values used in the SAVi model until 2022 since the values in the feasibility studies are from 2014 (Inflation Tool, 2022).

3.3 Valuation Methodologies of the Added Benefits and Avoided Costs

3.3.1 INCOME CREATION FROM EMPLOYMENT

Income creation from employment or discretionary spending represents the amount of money that flows back into the economy in the form of additional consumption. Rehabilitation and operations and maintenance (O&M) of the Tirana–Durres railway project leads to employment creation, which has beneficial socio-economic impacts, such as increased discretionary spending.

To estimate the total income from employment, the employment rate, which includes construction and O&M jobs and the average construction salary in Albania, were considered (JV Railcon, 2015b). An inflation correction was applied to the average construction salary from 2014 to reflect current values.

Moreover, to demonstrate the benefits of income creation that result from the number of jobs created following the rehabilitation of the railway, the latter was multiplied by the average annual salary in Albania. Finally, the income creation was multiplied by the share of discretionary spending (24.1%), which is the share of the salary that people usually spend on categories such as restaurants, sports and leisure, and clothing (Numbeo, 2023).

3.3.2 HEALTH IMPACTS

The shift from motorized transport modes to the railway will have significant positive health impacts. In this SAVi assessment, two different health impacts are grouped together, namely, benefits from increased physical activity and avoided costs of air pollution. The avoided costs of traffic accidents are considered in a separate section.

Primarily, benefits from physical activity arise from the additional time spent walking to and from railway stations. The assumption used in the SAVi assessment is that each railway user will walk 10 additional minutes per day (World Resources Institute & EMBARQ, 2002). The additional distance walked is represented by the additional minutes walked by railway users per day, which is then multiplied by the average walking speed and divided by daily trips, amounting to 2.64 daily trips per person (Dharmowijoyo et al., 2017). The total additional distance walked is then estimated using the additional distance walked per trip and the total annual railway trips. Finally, the economic benefits of walking (0.37 EUR/km) (Gossling et al., 2019) are applied to the above in order to estimate the total economic benefits of physical activity.

In addition to benefits from increased physical activity, the shift from individual motorized, fuel-based transport modes to the use of the Tirana–Durres railway in Albania will reduce the levels of air pollution that are generated by Albania's transport sector. This is primarily due to a reduction in the number of vehicles circulating on the road as a result of the implementation of the railway. The avoided costs of air pollution are estimated using the vehicle-km (v-km) travelled by bus, car, and truck, which are multiplied by the cost of pollution per v-km. The monetary value of air pollution is based on the Victoria Transport Policy Institute (2020), which establishes that the air pollution cost per v-km for interurban petrol passenger cars is between EUR 0.0009 and 0.0015/v-km; for interurban diesel heavy-duty vehicles, it is between EUR 0.085 and 0.214/v-km. The SAVi model assumes the most conservative values in this range, namely 0.0009 EUR/v-km for cars, 0.085 EUR/v-km for buses, and 0.11 EUR/v-km for trucks. For the railway, we assume that the cost is zero since energy is generated from clean, renewable sources. This calculation applies to both passenger and freight railway transport. Finally, to consider the change in the cost of pollution over time, we applied a growth rate of 2% annually until the end of the project in 2053. Transport-related air pollution is likely to decrease over time, regardless of the implementation of the Tirana–Durres railway in Albania, as fossil fuel-powered vehicles will become more energy efficient and will be gradually replaced by electric vehicles.

3.3.3 VALUE OF TIME SAVED

The value of time (VOT) saved represents the economic value of improved mobility resulting from the rehabilitation of the Tirana–Durres railway. The shift from other transport modes to the railway will result in differing travel speeds. In addition, the rehabilitation of the railway can lead to time efficiencies in freight trade. Consequently, the Tirana–Durres railway will lead to either time savings or additional time spent on commuting and freight transportation, depending on the current mode of transportation.

The average travel time for each transport mode was then multiplied by the VOT per hour for Albania to estimate the VOT saved that will result from the implementation of the Tirana–Durres railway and the shift from other transport modes to the railway.
We apply inflation correction to the VOT to reflect current values.

To calculate the time spent on transportation, we multiplied the average travel time per trip for each assessed transport mode, which is calculated using data on the average trip length and travel speed of different transport modes in Albania (JV Railcon, 2015b). The same approach was used to calculate the total VOT for freight transport.

The analysis does not differentiate railway users based on income and socio-economic background. If a dominant share of users is connected to a specific income class, this will impact the calculation of the economic VOT saved, which is based on the average value between the values for business and leisure in Albania.

3.3.4. CONSUMER SURPLUS

Consumer surplus is defined as "the excess of users' willingness-to-pay over the prevailing generalized cost of transport for a specific trip" (JV Railcon, 2015b). Consumer surplus represents the net benefits that new transport users perceive that they acquire by undertaking a trip that would not be possible by any transport means without the rehabilitation of the railway. In summary, consumer surplus reflects the net benefits perceived by using the railway system, which are added to the prices already paid for it.

In the feasibility studies, this cost is calculated using two components: (i) the savings in fares and (ii) the savings in the VOT. In other words, both the cost of transport and the VOT are considered before and after the rehabilitation of the railway. In this assessment, the total consumer surplus is the sum of the consumer surplus from generated traffic or the cost of transport and the consumer surplus that relates to the VOT. This calculation is applied only for passenger trips, not for freight trips.

For the consumer surplus of the cost of transport, the unit value of the consumer surplus of the cost of transport is multiplied by the p-km generated from the rehabilitation of the railway (all sections). The unit value of consumer surplus amounts to EUR 0.0015/p-km by 2026 and increases progressively, reaching EUR 0.0223/p-km by 2050.

For the consumer surplus that relates to the VOT, the unit value of consumer surplus is multiplied by the passenger trips generated from the rehabilitation of the railway (all sections) and the average travel time per trip. The unit value of consumer surplus is established as 50% of the unit VOT for passengers, which is EUR 6.01/hour by 2026, increasing progressively to 10.48 EUR/hour by 2046, after which date, the unit consumer surplus with respect to VOT is considered constant.

3.3.5 ENVIRONMENTAL COSTS

The environmental costs modelled in this SAVi assessment consider six different environmental impacts of road traffic included in the JV Railcon (2015b) feasibility study: (i) air pollution, (ii) noise, (iii) climate change, (iv) upstream and downstream processes (for construction of the infrastructure and production of fuel and vehicles), (v) nature and landscape, and (vi) solid and water pollution.

In the SAVi model, the total environmental cost is the sum of the different environmental costs by transport mode. To estimate the environmental cost by transport mode, the v-km travelled by different transport modes is multiplied by the unit of environmental cost per v-km. This unit of environmental cost for cars is EUR 0.0263/v-km; for buses, it is EUR 0.1166/v-km; and for trucks, it is EUR 7.8772/v-km (JV Railcon, 2015b).

3.3.6 CO_2 EMISSIONS

The introduction of the Tirana–Durres railway will lead to a shift away from individual, motorized, fossil fuel-based transport modes to railway transport. This shift will be accompanied by a reduction in the number of vehicles in the region and a subsequent reduction in CO_2 emissions generated from its transport sector.

The CO_2 emissions were calculated by multiplying the v-km travel by the different transport modes and the emissions factors that correspond to each transport mode. The emissions factors are based on a prior SAVi assessment undertaken for a bus rapid transit system in Dakar, Senegal, and the values are presented in Table 6. Finally, the cost of CO_2 emissions is estimated by multiplying the emissions generated by each transport mode by the cost of emissions per tonne. The cost of emissions in the SAVi model for 2020 is EUR 29.82/tonne (Nordhaus, 2017), increasing at a rate of 2% per year, based on assumptions by Conseil Exécutif des Transports Urbains de Dakar (2017).

Table 6. CO_2 emission factors per vehicle type

Transport mode	Fuel consumption (tonnes CO_2/km)
Cars	0.00018
Bus	0.0009
Truck	0.00045
Railway	0

Source: Bassi et al., 2019.

3.3.7 ACCIDENTS

The valuation of traffic accidents is calculated using accident data from the JV Railcon (2015b) feasibility study. The annual number of accidents in Albania prior to the implementation of the Tirana–Durres railway per accident severity is shown in Table 7. Annual accident rates following the implementation of the railway are estimated based on changing accident risk levels. The number of accidents is assumed to decrease if the number of motorized v-km is reduced.

Table 7. Annual number of accidents in Albania prior to the implementation of the Tirana–Durres railway

Type of accident severity	Road accidents in Albania average, 2009–2014
All accidents type	1,794 accidents/year
Fatal accidents	324 deaths/year
Injuries	2,069 injuries/year

Source: JV Railcon, 2015b

Moreover, the risk of accidents (accidents per million v-km) is provided by the JV Railcon (2015b) feasibility study of the Tirana–Durres railway shown in Table 8.

Table 8. Risk of accident per severity per million v-km

Type of accident severity	Value (accidents/million v-km)
All accidents type	0.6980
Fatal accidents	0.1262
Injuries accidents	0.8049

Source: JV Railcon, 2015b

The next step in valuing the avoided costs from a reduction in the number of accidents as a result of the implementation of the railway is to estimate the economic value of accidents by accident severity. Fatal accidents imply that human lives are lost and are consequently valued the highest among the three accident categories. Table 9 provides an estimate of the monetary value of fatal, minor, and major accidents.

Table 9. Valuation of accidents per accident severity

Cost of accidents per severity	Cost per accident (EUR/accident)
Fatal accident	588,748
Major injury	87,163.2
Minor injury	43,581.6

Source: JV Railcon, 2015b.

3.3.8 VEHICLE OPERATING COSTS

The rehabilitation of the Tirana–Durres railway will lead to a shift from individual, motorized, fossil fuel-based transport modes to railway transport, resulting in a diminishing number of vehicles on Albania's roads. This shift will lead to avoided maintenance costs for private vehicles, as well as fuel savings. The combination of those two costs is termed vehicle operating costs (VOCs) in this SAVi assessment. VOCs also consider the socio-economic cost of gasoline and other operating costs, such as lubricants, maintenance costs, and costs of road vehicle tires (JV Railcon, 2015b). In the SAVi model, total vehicle operating costs combine VOCs derived from passenger transport (cars and buses) and VOCs derived from freight transport (trucks).

The operating costs per transport mode are calculated by multiplying the v-km travelled, which is provided by the model, and the VOCs per km per transport mode included in the feasibility study (JV Railcon, 2015b). The vehicle operating cost for cars is EUR 0.2005/v-km, and for both buses and trucks, it is EUR 0.4383/v-km.

4.0 Results

This section describes the results of the SAVi assessment. The first part of this section presents the integrated CBA table for the Tirana–Durres railway, which includes the discounted values at 3.5%, as shown in Table 10. It is an integrated analysis because, in addition to the railway's conventional investment costs (capital and O&M costs) and revenues, the valued economic, social, and environmental added benefits and avoided costs are integrated into the analysis. The second part of this section includes a comparison between the conventional project finance analysis and the integrated analysis to demonstrate the importance of valuing the multiple added benefits and avoided costs. The last part of this section provides a summary of all economic, social, and environmental added benefits and avoided costs that have been quantified, as well as the valuation results for each added benefit and avoided cost of the Tirana–Durres railway demand scenario independently.

4.1 Integrated CBA

Table 10. Integrated CBA (discounted values at 3.5% for the railway scenarios based on a project period of 30 years)

Integrated CBA (discounted at 3.5%)	Tirana–Durres railway scenario (2023–2053)
Total investment costs (EUR million)	**71.42**
Capital costs	49.21
O&M costs	22.22
Total revenues (EUR million)	**8.67**
Revenues from railway operation	8.67
Total added benefits (EUR million)	**143.04**
Income creation from employment	38.41
Health impacts	44.93
VOT saved	44.39
Consumer surplus	15.31
Total avoided costs (EUR million)	**190.05**
Environmental costs	32.08
CO_2 emissions	19.56

Integrated CBA (discounted at 3.5%)	Tirana–Durres railway scenario (2023–2053)
Accidents	41.61
Vehicle operating costs	96.79
Net benefits	
Cumulative net benefits (undiscounted) (EUR million)	415.51
Cumulative net benefits (EUR million, discounted)	**270.34**
BCR	0.12
Sustainable BCR (S-BCR)	**4.79**

Source: Authors

An integrated CBA provides a more holistic view for assessing whether the Tirana–Durres railway generates net benefits and can be considered a worthwhile investment from a societal perspective. This is because the integrated CBA considers both conventional costs and revenues, as well as added benefits and avoided costs. A project period of 30 years is considered to highlight the railway's net benefits and provide a reference point for the overall investments required for the wider railway infrastructure. The cumulative net benefits for the railway scenario indicate the maximum number of investments that are viable for the railway infrastructure in order to consider the entire railway worthwhile from a societal point of view.

The undiscounted net results for the railway scenario yield cumulative benefits of EUR 415.51 million and can be found in Appendix C. Once a discount factor is applied to future costs and benefits, the SAVi net results are naturally lower. A discount factor of 3.5% is applied to all economic, social, and environmental indicators of this assessment, including investment and costs, revenues, added benefits, and avoided costs, as per *The Green Book* guidance (UK Government, 2022).

Following the application of the discount rate, the Tirana–Durres railway scenario yields cumulative benefits of EUR 270.34 million, as shown in Table 10. Moreover, the S-BCR of the railway scenario is 4.79.

The next chapters will examine the different parts of the integrated CBA independently, differentiating between the conventional project finance benefits, costs, and revenues and the valued economic, social, and environmental added benefits and avoided costs. In the later chapter, the valuation results for each added benefit and avoided cost are demonstrated in more detail.

4.2 Summary of Investment Costs and BCRs

The SAVi assessment of the Tirana–Durres railway in Albania starts with the conventional investment costs and revenues. As shown in the first part of the integrated CBA in Table 11, the investment costs include capital and O&M costs, which are always incorporated in a conventional project finance analysis, and revenues include those from the operation of the railway. Table 12 displays only the capital expenditures, the O&M expenditures, and the revenues of the railway as cumulative values over the project period.

Table 11. Capital costs, O&M costs, and revenues of the Tirana–Durres railway scenario (discounted at 3.5%)

CBA	Tirana–Durres railway scenario (2023–2053) (EUR million)
Investment and costs	**71.42**
Capital costs	49.21
O&M cost	22.22
Total revenues	**8.67**
Revenues from railway operation	8.67

Source: Authors.

It is important to differentiate between a conventional BCR and an S-BCR, as indicated in Table 12. The conventional BCR is based on estimates of only tangible parameters that are considered in conventional transport infrastructure assessments, such as capital costs, O&M costs, and revenues from railway use. The S-BCR considers the project from a societal point of view and is based on an estimate of the full range of economic, social, and environmental added benefits and avoided costs. As indicated in Table 12, the conventional BCR is lower than the S-BCR.

Table 12. Conventional BCR vs. S-BCR (discounted at 3.5%)

	BCR	*S-BCR*
Parameters considered	Capital costs, O&M costs; revenues from railway operations	Investment and costs; full range of economic, social, and environmental added benefits and avoided costs
Scenario	Tirana–Durres railway scenario	Tirana–Durres railway scenario
	0.12	**4.79**

Source: Authors.

4.3 Summary of Added Benefits and Avoided Costs

The SAVi assessment of the Tirana- Durres railway in Albania calculates monetary values for a range of added benefits and avoided costs arising from the rehabilitation and use of the railway. Table 13 excludes the investment cost and revenue sections of the integrated CBA and summarizes the cumulative net values of the added benefits and avoided costs over the 30-year project period. In addition, for each valued-added benefit or avoided cost, the table shows which stakeholders are the most relevant and whether social, environmental, or economic indicators are the most suitable. A discount factor of 3.5% is assumed for added benefits and avoided costs. The discounted net value of the current railway scenario, excluding investment costs and railway revenues, amounts to EUR 333.09 million.

Table 13. Summary table of valued added benefits and avoided costs of the railway scenarios (discounted at 3.5% and cumulative, 2023–2053)

Costs and benefits	Tirana–Durres railway scenario (2023–2053) (in EUR million)	Stakeholder of relevance	Social, environmental, economic
Total added benefits	**143.04**		
Income creation from employment	38.41	Government, households	Economic
Health impacts	44.93	Households	Social
Value of time saved	44.39	Households, private sector	Economic
Consumer surplus	15.31	Households	Economic
Total avoided costs	**190.05**		
Environmental costs	32.08	Households, government	Environmental
CO_2 emissions	19.56	Households	Environmental
Accidents	41.61	Government, households	Social
Vehicle operating costs	96.79	Households	Economic
Cumulative net benefits (discounted)	**333.09**		

Source: Authors' calculations.

4.4 Valuation Results for Revenues

4.4.1 REVENUES FROM RAILWAY OPERATIONS

The introduction of the Tirana–Durres railway will lead to increased revenues collected from passengers and freight fares. As mentioned in Section 3.2.1, the average railway passenger fare per kilometre is used for passenger trips and increases from 2023 to 2053, whereas for freight, the average unit fare per tonne-km is used and stays constant throughout the project period. Information on trips, trip distance, and occupancy rates are found in the JV Railcon (2015b) feasibility study. The discounted, cumulative revenues from railway operations over the project period are valued at EUR 8.67 million. Annual values of revenues from railway operations for selected years are summarized in Table 14.

Table 14. Annual values of revenues from Tirana–Durres railway use (discounted at 3.5%)

	2025	2030	2035	2040	2045	2050	2053	Cumulative (2023–2053)
Annual values of revenues Tirana–Durres railway (EUR million)	0.00	0.12	0.16	0.21	0.26	0.83	0.87	8.67

Source: Authors.

4.5 Valuation Results per Added Benefit and Avoided Cost

4.5.1 INCOME CREATION FROM EMPLOYMENT

Rehabilitation and O&M of the Tirana–Durres railway will lead to employment creation, which has beneficial socio-economic impacts, such as increased discretionary spending. The latter represents the amount of money that flows back into the economy in the form of additional consumption. It has been assumed that the jobs created as a result of the railway are additional.

Moreover, additional discretionary spending per year from income generation from both rehabilitation and O&M jobs has been considered in the calculation of the total annual income creation. The total cumulative income creation from employment from 2023 to 2053 amounts to EUR 38.41 million. Table 15 shows the annual values of income creation from employment for selected years.

Table 15. Annual values of income creation from increased employment (discounted at 3.5%)

	2025	2030	2035	2040	2045	2050	2053	Cumulative (2023–2053)
Annual values of income creation from employment from the Tirana–Durres railway (EUR million)	0.78	1.11	1.00	0.92	0.86	2.37	2.48	38.41

Source: Authors.

4.5.2 HEALTH IMPACTS

The implementation of the Tirana–Durres railway rehabilitation project in Albania leads to significant health benefits from increased levels of physical activity and reduced air pollution levels resulting from the shift from individual, motorized transport modes and from road freight transport to railway transport. The total cumulative net health benefits amount to EUR 44.93 million.

Primarily, the Tirana–Durres railway leads to increased levels of physical activity for railway users who spend additional time walking to and from railway stations. The additional minutes per day walked, the average walking speed of railway users, and the number of railway trips were considered in the estimate of the total economic benefits from physical activity. Values represent the cumulative net health benefits resulting from increased physical activity from the new mobility pattern compared to the baseline. Annual values of benefits resulting from the increased physical activity of railway users are indicated in the first row of Table 16.

In addition, if transport users in Albania shift from individual motorized, fuel-based transport modes to the use of railway transport, the number of vehicles on the road will decrease, and subsequently, the level of air pollutants emitted by vehicles will decrease. Table 18 provides the annual avoided health costs from reduced pollution levels caused by the shift from individual transport modes to the railway. **Only emissions from fuel combustion are assessed and valued. Emissions originating from upstream supply chain stages for fuel production are not assessed; hence, transport modes, such as the metro and railway, are not associated with any health costs since no fuel combustion takes place during transport use**. Consequently, shifting from these transport modes to the railway does not result in reduced air pollution costs.

Table 16. Annual values of health impacts, including health benefits from increased physical activity and avoided air pollution costs (EUR million, discounted at 3.5%)

	2025	2030	2035	2040	2045	2050	2053	Cumulative (2023–2053)
Annual values of benefits from physical activity	-0.02	0.14	0.13	0.14	0.14	0.38	0.40	5.23
Annual values of avoided air pollution costs	-0.59	0.88	0.93	1.00	1.07	3.29	3.77	39.70
Total annual values of health impacts	-0.61	1.02	1.06	1.13	1.21	3.67	4.16	44.93

Source: Authors.

4.5.3 VOT SAVED

The VOT saved represents the economic value of improved mobility resulting from the Tirana–Durres railway. The shift from other transport modes to the railway will result in differing travel speeds; hence, the project will lead to either time savings or additional time spent on commuting and freight transportation.

According to the railway scenario, the cumulative VOT saved over the project period is valued at EUR 44.39 million. Assumptions used for calculating the monetary value of time saved are explained in Section 3.2.3. Annual VOTs saved for the Tirana–Durres railway scenario are summarized in Table 17.

Table 17. Annual values of benefits from time saved due to improved mobility (EUR million, discounted at 3.5%)

	2025	2030	2035	2040	2045	2050	2053	Cumulative (2023–2053)
Annual VOTs saved from the Tirana–Durres railway	1.16	0.76	0.91	0.99	1.06	3.20	3.56	44.39

Source: Authors.

4.5.4 CONSUMER SURPLUS

Consumer surplus represents the net benefits that new transport users perceive that they acquire by undertaking a trip that would not have been possible without the rehabilitation of the Tirana–Durres railway. It adds value to the prices already paid for using the railway for commuting or freight. Consumer surplus is estimated using two components: (i) the savings in fares and (ii) the savings in the VOT. The discounted, cumulative values of consumer surplus from 2023 to 2053 amount to EUR 15.31 million. Annual values of consumer surplus for the Tirana–Durres railway for selected years are shown in Table 18.

Table 18. Annual values of benefits from consumer surplus due to improved mobility (EUR million, discounted at 3.5%)

	2025	2030	2035	2040	2045	2050	2053	Cumulative (2023–2053)
Annual values of consumer surplus of the Tirana–Durres railway	0.00	0.28	0.30	0.37	0.46	1.36	1.51	15.31

Source: Authors.

4.5.5 ENVIRONMENTAL COSTS

Environmental costs include the following environmental impacts according to the JV Railcon (2015b) feasibility study: i) air pollution, (ii) noise, (iii) climate change, (iv) upstream and downstream processes (for construction of the infrastructure and production of fuel and vehicles), (v) nature and landscape, and (vi) solid and water pollution. The cumulative discounted environmental costs of the Tirana–Durres railway over the project period are valued at EUR 32.08 million, and annual environmental costs are demonstrated in Table 19.

Table 19. Annual values of environmental costs (EUR million, discounted at 3.5%)

	2025	2030	2035	2040	2045	2050	2053	Cumulative (2023–2053)
Annual values of avoided environmental costs of the Tirana–Durres railway	-2.98	1.10	1.00	1.02	1.05	2.92	3.14	32.08

Source: Authors.

4.5.6 CO_2 EMISSIONS

The implementation of the Tirana–Durres railway will lead to a shift from an individual, motorized transport model and from road freight to the Tirana–Durres railway, resulting in a reduction in the number of vehicles on Albania's roads. This shift will be accompanied by a reduction in CO_2 emissions generated from Albania's transport sector. The valuation approach is described in more detail in Section 3.3.6. The cumulative avoided costs of CO_2 emissions that result from the implementation of the Tirana–Durres railway amount to EUR 19.56 million. Table 20 shows the annual values of avoided CO_2 emissions costs.

Table 20. Annual values of avoided CO_2 emissions costs (discounted at 3.5%)

	2025	2030	2035	2040	2045	2050	2053	Cumulative (2023–2053)
Annual values of avoided CO_2 emissions costs of the Tirana–Durres railway (EUR million)	-0.11	0.43	0.44	0.48	0.53	1.57	1.76	19.56

Source: Authors.

4.5.7 ACCIDENTS

The Tirana–Durres railway will lead to a shift from individual, motorized, fossil fuel-based commuter and freight transport modes to the railway, diminishing the number of vehicles circulating on the roads of Albania and hence reducing the number of traffic accidents.

The SAVi model distinguishes between three levels of accident severity: fatal, major injuries, and minor injuries. Different values have been applied for the monetary valuation of each severity type. The avoided costs of accidents in Albania after the implementation of the Tirana–Durres railway by accident severity are estimated using data on the number of accidents per year, the risk of accidents (accidents per million v-km), and the economic value of accidents by accident severity. More details on accident statistics and risk levels in Albania are explained in Section 3.2.7 of this report.

The total cumulative avoided accident costs amount to EUR 41.61 million. The annual avoided costs of accidents are summarized in Table 21.

Table 21. Annual values of avoided accident costs (EUR million, discounted at 3.5%)

	2025	2030	2035	2040	2045	2050	2053	Cumulative (2023–2053)
Annual values of avoided accident costs of the Tirana–Durres railway	-0.17	1.13	1.03	1.08	1.11	2.97	3.11	41.61

Source: Authors.

4.5.8 VEHICLE OPERATING COSTS

The rehabilitation of the Tirana–Durres railway will lead to a shift from individual, motorized, fossil fuel-based transport modes to railway transport, resulting in a diminishing number of vehicles on Albania's roads. This will result in avoided private vehicle maintenance costs and fuel savings, which are used to estimate the avoided cost of fuel use in the SAVi assessment. Both of those impacts are included in the total VOCs. The calculation of VOCs includes the v-km travelled per transport mode and differentiates between vehicles used for passenger transport (cars and buses) and freight transport (trucks). Results show that cumulative discounted avoided vehicle operating costs from the rehabilitation of the Tirana–Durres railway in Albania amount to EUR 96.79 million over the project period. Annual values are summarized in Table 22.

Table 22. Annual values of avoided vehicle operating costs (EUR million, discounted at 3.5%)

	2025	2030	2035	2040	2045	2050	2053	Cumulative (2023–2053)
Annual values of avoided vehicle operating costs of the Tirana–Durres railway	-0.46	2.64	2.40	2.50	2.59	6.94	7.28	96.79

Source: Authors.

5.0 Conclusions

The main objective of the SAVi assessment is to inform transport infrastructure planners about the positive impacts that the Tirana–Durres railway can have in the region. The results represent not only investment costs and revenues found in conventional transport infrastructure assessments but also a variety of economic, social, and environmental added benefits and avoided costs that show the societal value of sustainable transport infrastructure such as the Tirana–Durres railway.

The SAVi assessment demonstrates the importance of carrying out integrated assessments that quantify these added benefits and avoided costs, as they indicate the investment worthiness of the project for the government and for citizens.

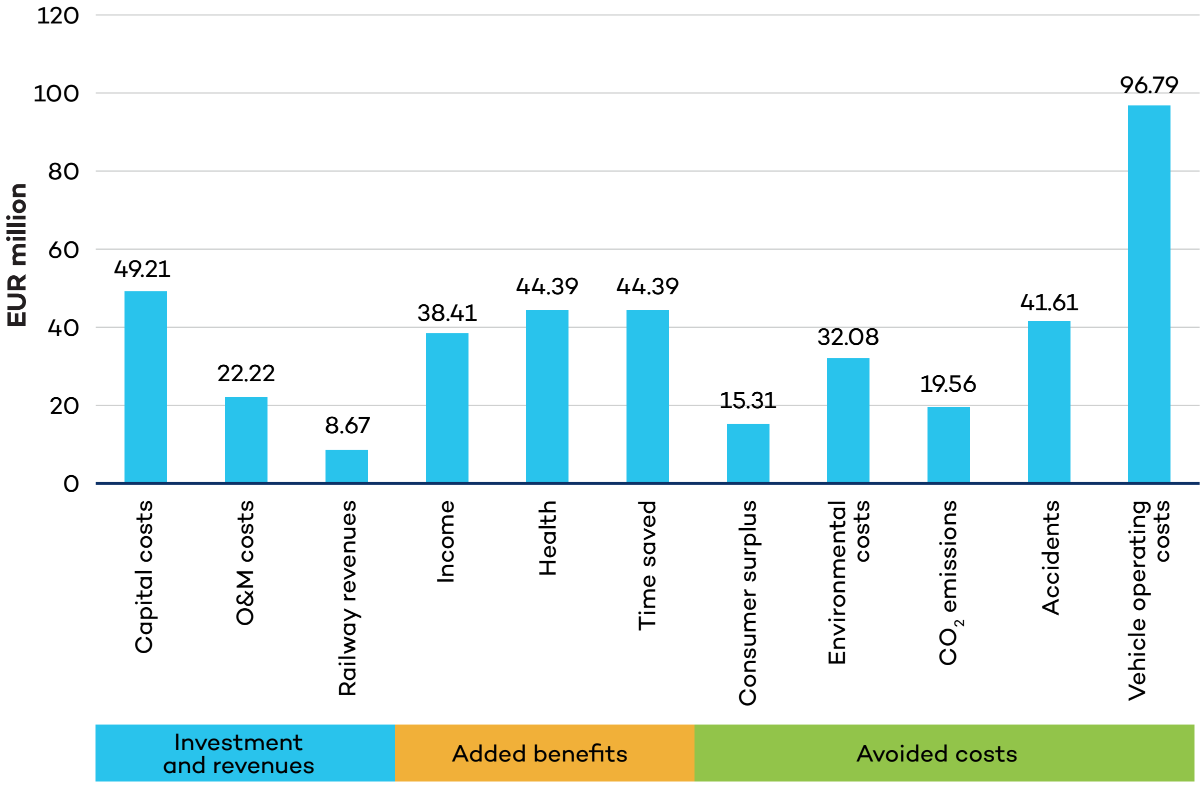
In this SAVi assessment, the wide range of economic, social, and environmental added benefits and avoided costs of the rehabilitation of the Tirana–Durres railway are assigned a financial value and are integrated into the CBA. The value of the railway is considerably higher when the value of added benefits and avoided costs are integrated into the CBA. This is demonstrated by the difference between the conventional BCR, which is based on an estimate of only parameters that are used in conventional transport assessments, such as investment costs and revenues, and the S-BCR, which includes the full range of economic, social, and environmental benefits and costs. In this case, the BCR is 0.12, which compares to a S-BCR of 4.79.

Overall, the Tirana–Durres railway stimulates economic growth, either directly through revenues from railway operations and employment creation or indirectly through avoided VOCs and time savings. In addition, it delivers considerable social benefits to the region's inhabitants, such as health benefits in the form of increased physical activity, reduced air pollution, and a diminishing number of traffic accidents. Lastly, the Tirana–Durres railway will be electric and reduce CO_2 emissions.

Over the 30-year project period, the rehabilitation of the Tirana–Durres railway will lead to cumulative discounted net results of EUR 270.34 million.

Altogether, this assessment has shown that the Tirana–Durres railway advances the realization of sustainable mobility targets in Albania. In addition, the Tirana–Durres railway delivers the transport policy objectives defined in the Integrated Cross-Sectorial Plan of the Tirana–Durres area and its transport sector targets by 2030. All of the results from the SAVi assessment, including investment costs, revenues, added benefits, and avoided costs, are demonstrated in Figure 3.

Figure 3. Monetary values of the investment costs, revenues, added benefits, and avoided costs of the Tirana–Durres railway in Albania



Source: Authors.

Some of the benefits that the Tirana–Durres railway in Albania will provide include the following:

- **Economic benefits through vehicle operating cost savings, railway revenues, and employment creation:** The rehabilitation of the Tirana–Durres railway in Albania will lead to significant savings in vehicle operating costs resulting from avoided maintenance and fuel use costs. According to the SAVi results, the cumulative vehicle operating cost savings over the 30-year period is valued at EUR 96.79 million. Moreover, the railway will lead to increased government revenues through the purchase of fares by transport users, amounting to EUR 8.67 million. In addition, the Tirana–Durres railway will create employment, which has beneficial socio-economic impacts such as income creation and increased discretionary spending, which represents the amount of money that will flow back to the economy in the form of additional consumption. The total cumulative income creation from employment amounts to EUR 38.41 million.
- **Improvement of traffic congestion and transport efficiency:** The use of the Tirana–Durres railway will improve traffic conditions and enhance the efficiency of movement in Albania, as evidenced by the VOT saved, which amounts to EUR 44.39 million cumulatively over the project period.

- **An increase in health benefits and a decrease in fatality events:** The valued health benefits associated with increased physical activity and reduced air pollution are further indications of the improved quality of life for the inhabitants of the Tirana–Durres region, resulting from the availability and use of the railway system. The total cumulative net health benefits over the project period amount to EUR 44.39 million. Furthermore, the Tirana–Durres railway will contribute to reducing fatality rates in Albania, resulting from the shift from motorized transport modes to the railway, which will reduce the number of vehicles on the road. The total cumulative avoided costs of accidents over the project period amount to EUR 41.61 million.
- **Reduced environmental costs and CO_2 emissions:** The SAVi results demonstrate that the shift from motorized transport to using the Tirana–Durres railway contributes to reduced environmental costs and vehicular emissions. Results show cumulative environmental cost savings amounting to EUR 32.08 million and reductions in CO_2 emissions valued at EUR 19.56 million.

Based on the above, the SAVi assessment demonstrates that the biggest benefits of the rehabilitation of the Tirana–Durres railway system in Albania are the avoided vehicle operation costs, which include avoided costs of maintenance and fuel use. The railway project will also lead to considerable time savings, avoided costs of traffic accidents, and income creation from employment. The successful rehabilitation of the Tirana–Durres railway has the potential to address some of the challenges that keep the region in a car-oriented, high-carbon mobility pathway and transform Albania's capital city and biggest port into a pilot region for railways and sustainable mobility more generally.

Limitations of the methodology used for this SAVi assessment are related to the valuation and quantification of some qualitative indicators. While the CLD (qualitative model) can identify a wide range of impacts, not all can be quantified due to the lack of data and literature that supports their valuation or limitations in their scope. This is the case for indicators such as GDP, labour force health quality, and habitat fragmentation. However, it could be possible to link SAVi to another model and determine other indicators or dynamics where the feedback loops can be represented more explicitly (e.g. macroeconomic/dynamic model to estimate GDP). The application of the SAVi methodology allows for diverse performance assessments beyond what has been applied for valuing the Tirana–Durres railway in Albania and provides insights to government, citizens, and investors on the different value-creation elements of railway systems. This can inform future sustainable mobility strategies and help make the case for better transport investments in cities and regions, as well as identify sources of funding/financing that match the different financial and social returns of the project.

Lastly, this assessment solely focuses on the Tirana–Durres railway connection and does not consider its integration with Tirana's urban public transport system or Albania's wider national railway network. Integration with urban and regional transport networks will amplify some of the positive impacts that are assessed in this study. It remains challenging, at this stage, to make assumptions about such wider positive impacts. This could be a subject for future research and an expanded modelling exercise.

Overall, this assessment demonstrates the importance of valuing the wider benefits of transport investments and integrating them at critical points of the planning and decision-making process for infrastructure investments.

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Appendix A. CLD Description of the Tirana–Durres Railway Project in Albania

Reinforcing loops (R)

R0 is a reinforcing loop that explains how investment in railway infrastructure is driven by freight demand. The more investment in electrified railway infrastructure, the bigger the railway network and freight trade. The more freight trade, the larger the share of the budget will be destined for investment in the railway infrastructure.

R1 represents the investment in railway driven by economic development. An increase in the investment in railway infrastructure generates an increase in the railway network and the volume of freight trade. The increase in freight trade incentivizes economic development, and economic development increases GDP, which increases investment in transportation and railway infrastructure next time around. The dotted arrows in this loop mean that the relationship exists, but the evidence is not clear enough to claim it as certain within the assessment context.

The R2 loop represents the demand shift dynamics between road transport and railway transport. An increase in the number of railway network users (passengers and freight) generates a decrease in vehicle fleet use, which in turn generates an increase in railway network use.

The R3 loop describes how investment in roads is driven by employment from roads. An increase in the investment in road infrastructure generates an increase in the vehicle fleet. An increase in the vehicle fleet increases the total employment in transportation, which increases the total factor productivity, resulting in a higher GDP. An increase in GDP increases the investment in transportation, increasing investment in road infrastructure again.

The R4 loop describes how investment in the railway is driven by employment in the railway. An increase in the investment in railway infrastructure generates an increase in the railway network, which increases the total employment in transportation. An increase in total employment from transport increases GDP, increasing investment in transportation and increasing investment in railway infrastructure next time around.

The R5 loop represents the investment in railway driven by fuel use from vehicle fleets. An increase in investment in railway infrastructure increases the railway network and decreases the vehicle fleet. A decrease in the vehicle fleet generates less fuel use and less CO_2 emissions and air pollution, which results in better health quality in the labour force. An increase in health quality produces an increase in the total factor productivity, increasing the GDP and investment in transportation and railway infrastructure.

The R6 loop describes the investment in railways driven by employment from electricity generation. An increase in the investment in railway infrastructure generates an increase in electricity demand and power generation capacity, which increases employment from power generation. An increase in employment generates an increase in total factor productivity, resulting in an increase in GDP, which increases the investment in transportation and railway infrastructure next time around.

The reinforcing loop R7 describes how the investment in railway infrastructure is driven by income from railway use. An increase in the investment in railway infrastructure generates an increase in the size of the railway network and an increase in the income from railway use. The increase in income increases GDP, which increases investment in transportation and investment in railway infrastructure next time around.

The R8 loop describes how investment in railway infrastructure is driven by travel time. The more investment in railway infrastructure, the more railway network use and the smaller the vehicle fleet, which results in less traffic congestion and travel time. Less travel time translates into more total factor productivity, given that people have more time for personal/labour activities. More total factor productivity generates more investment in transportation and railway infrastructure next time around.

Balancing loops (B)

The B1 balancing feedback loop shows the impact of traffic congestion on the vehicle fleet. The bigger the vehicle fleet, the more traffic congestion and travel time. Increasing the travel time decreases the number of vehicles willing to travel, decreasing the vehicle fleet on the road.

The B2 loop represents the impact of travel time on the use of the railway. The more use of the railway network use, the smaller the vehicle fleet on the roads and the less traffic congestion. The less traffic congestion, the less travel time, and the less travel time, the less use of the railway network. This is under the assumption that if the travel time decreases, people will tend to use their private vehicles again (in the case of passenger demand).

The B3 loop reflects the impact of employment from roads on investment in the railway. An increase in investment in railway infrastructure increases the size of the railway network and decreases the vehicle fleet, generating a decrease in total employment in transport. A decrease in employment from transport generates a decrease in total factor productivity and, in turn, in GDP, decreasing the investment in transportation and the investment in railway infrastructure as a result.

The B4 loop represents the impact of accidents on investment in railway. The more investment in railway infrastructure, the more railway network use and accidents. The more accidents due to transportation, the less total factor productivity and GDP, which decreases the investment in transportation and railway infrastructure as a result.

The B5 loop represents the impact of accidents on investment in road infrastructure. The more investment in road infrastructure, the bigger the vehicle fleet and the more accidents. The more accidents from transportation, the less total factor productivity and GDP, which decreases the investment in transportation and road infrastructure as a result.

The B6 loop reflects the impact of fuel use on investment in road infrastructure. The more investment in road infrastructure, the more vehicle fleet and fuel use. The more fuel use, the more CO_2 emissions and air pollution, and the less labour force health quality. The less health quality, the less total factor productivity and a lower GDP, which reduces the investment in transportation and road infrastructure next time around.

The B7 loop explains the impact of CO_2 emissions and air pollution from power generation on investment in railways. An increase in investment in railway infrastructure generates an increase in the railway network use and electricity demand. An increase in electricity demand increases power generation capacity, CO_2 emissions, and air pollution. An increase in emissions decreases the labour force health quality and the total factor productivity as well, decreasing GDP. A decrease in GDP generates a decrease in investment in transportation, resulting in a decrease in the investment in railway infrastructure.

The B8 loop represents the impact of travel time on investment in road infrastructure. The more investment in road infrastructure, the more vehicle fleet and traffic congestion, which translates into more travel time. More travel time generates less total factor productivity since people have less time for resting, leisure activities, and working. As a consequence, the less total factor productivity, the less investment in transportation and road infrastructure.

The B9 loop shows the impact of land use on investment in railways. The more investment in railway infrastructure, the bigger the rail network and area used for transport infrastructure, generating more habitat fragmentation and reducing ecosystem services. A reduction in ecosystem services reduces GDP, which reduces investment in transportation and railway infrastructure next time around.

The B10 loop shows the impact of land use on investment in road infrastructure. The more investment in road infrastructure, the bigger the vehicle fleet and the more area used for transport infrastructure, generating more habitat fragmentation and reducing ecosystem services. A reduction in ecosystem services reduces GDP, which reduces investment in transportation and road infrastructure next time around.

The B11 loop represents the impact of road maintenance on investment in road infrastructure. The more investment in road infrastructure, the bigger the vehicle fleet, and the bigger the vehicle fleet, the higher the road maintenance costs, which reduces investment in road infrastructure as a consequence.

Appendix B. Main Assumptions and Data Sources Used in the System Dynamics Model

Table B1. Overview of key assumptions used in the SAVi assessment of the Tirana–Durres railway in Albania SAVi Assessment

Parameters for calculating added benefits and avoided costs				Level of data collection			
Added benefit or avoided cost	**Indicator**	**Value**	**Data source**	**Project-specific**	**Urban/ regional**	**National**	**International**
Revenues from railway use	Railway: Average passenger fare per kilometre of trip (EUR per passenger-km)	0.0102 in 2020, 0.0664 in 2050	JV Railcon (2015b)	X			
	Railway: Average unit fare per tonne-km (EUR per tonne-km)	0.0491	JV Railcon (2015b)	X			
	Inflation factor from 2014–2022	1.21	Inflation Tool (2022)				X
Income creation from employment	Total construction rate (persons per year)	847 in 2023; 1,1110 in 224; 911 in 2025	JV Railcon (2015b)				
	Operations and maintenance employment rate (persons/year)	220 in 2023; 222 in 2024; 1,155 in 2028; 1,902 in 2052	JV Railcon (2015b)	X			

Parameters for calculating added benefits and avoided costs				Level of data collection			
Added benefit or avoided cost	**Indicator**	**Value**	**Data source**	**Project-specific**	**Urban/ regional**	**National**	**International**
	Share of discretionary spending	24.1%	Numbeo (2023)			X	
Health impacts	Additional time spent walking	2.75 minutes	World Resources Institute & EMBARQ (2002)				X
	Average number of daily trips in Albania (from a study in Bandung, Indonesia)	2.64 trips	Dharmowijoyo et al. (2017)			X	
	Economic benefits of walking per km	EUR 0.37/km	Gossling et al. (2019)				X
	Monetary value of air pollution	EUR 0.0009–0.0015/v-km for cars, EUR 0.085 and 0.214/v-km for heavy-duty vehicles	Victoria Transport Policy Institute (2020)				X
Value of time saved	Travel speed	Passenger transport: 85 km/h for buses and 100 km/h for cars, 100 km/h for railway. Freight transport: 75 km/h for trucks, 63.75 km/h for railway	JV Railcon (2015b)	X			

Parameters for calculating added benefits and avoided costs				Level of data collection			
Added benefit or avoided cost	**Indicator**	**Value**	**Data source**	**Project-specific**	**Urban/ regional**	**National**	**International**
	Average distance travelled per trip for Tirana–Durres	33.2 km for passengers and 34 km for freight	JV Railcon (2015a)	X			
	Value of time of railway	EUR 11.04/h in 2023 and EUR 20.96/h in 2046 for passenger transport, EUR 0.84/tonne-h in 2023 and EUR 1.6/ tonne-h in 2046 for freight transport	JV Railcon (2015b)	X			
Consumer surplus	Unit value of consumer surplus	0.0015 EUR/passenger-km in 2026 and 0.0223 EUR/p-km in 2050	JV Railcon (2015b)	X			
Environmental costs	Unit of environmental cost	EUR 0.0263/v-km for cars, EUR 0.1166/v-km for buses, EUR 7.8772/v-km for trucks	JV Railcon (2015b)	X			
CO_2 emissions	CO_2 emission factors by transport mode	Cars – 0.00018, buses – 0,0009, trucks – 0.00045	Bassi et al. (2019)		X		
	Cost of emissions per tonne	EUR 29.82/tonne	Nordhaus (2017)				X
	Annual increase of emissions per tonne	2%	Conseil Exécutif des Transports Urbains de Dakar (2017)		X		

Parameters for calculating added benefits and avoided costs				Level of data collection			
Added benefit or avoided cost	**Indicator**	**Value**	**Data source**	**Project-specific**	**Urban/ regional**	**National**	**International**
Accidents	Average number of road accidents in Albania (2009–2014)	1,794	JV Railcon (2015b)	X			
	Risk of accident per severity per million vehicle-km	0.6980	JV Railcon (2015b)	X			
	Cost of accident per accident severity	588,748 for fatal accidents, 87,163.2 for major injury, 43,581.6 for minor injury	JV Railcon (2015b)	X			
	Vehicle operating costs	EUR 0.2005 v-km for cars, EUR 0.4383/ v-km for buses and trucks	JV Railcon (2015b)	X			

Appendix C: Undiscounted Integrated Cost-Benefit Analysis

Table C1. Integrated cost-benefit analysis (CBA) (undiscounted values for the railway scenarios based on a project period of 30 years)

Integrated CBA (undiscounted)	Tirana–Durres railway scenario (2023–2053)
Total investment costs (EUR million)	**92.99**
Capital costs	58.78
Operations & maintenance (O&M) costs	34.21
Total revenues (EUR million)	**12.52**
Revenues from railway operation	12.52
Total added benefits (EUR million)	**209.50**
Income creation from employment	56.85
Health impacts	66.29
Value of time saved	64.03
Consumer surplus	22.33
Total avoided costs (EUR million)	**286.49**
Environmental costs	50.33
CO_2 emissions	28.76
Accidents	62.35
Vehicle operating costs	145.05
Cumulative net benefits (undiscounted) (EUR million)	**415.51**
Benefit-cost ratio	0.12
Sustainable benefit-cost ratio	**4.79**

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Published by the International Institute for Sustainable Development.

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