REPORT - December 2024

Building back better: Ukraine's transport infrastructure

Lessons from EU funding in Central and Eastern European countries

T&E

Published: December 2024

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Editeur responsable: William Todts, Executive Director

To cite this report
T&E (2024) Building back better: Ukraine's transport infrastructure

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Acknowledgements

We would like to sincerely thank the following people whose contributions made this report more relevant through their wealth of knowledge and experience. András Lukacs, Clean Air Action Group; Anna Ackermann, IISD; Bogdan-Alexandru Chelariu, CEE Bankwatch; Daniel Popov, CEE Bankwatch; Liutauras Stoškus, DVC; Raul Cazan, 2Celsius; Urszula Stefanowicz, Polish Ecological Club Mazovian Branch; and Viktor Zagreba, Vision Zero. The findings and views put forward in this publication are the sole responsibility of the authors listed above.

Executive summary

We look at the priorities and implications of EU transport related cohesion spending for 10 Central and Eastern European countries, after their accession from 2007. To supplement our analysis, we investigate 8 case studies. The lessons learned will be crucial for Ukraine, as it progresses towards EU membership.

A quarter of EU cohesion funds was allocated to transport in CEEs.

Out of €418 billion in cohesion funds, more than €104 billion was allocated to transport. Poland was the biggest beneficiary. The transport share of cohesion funds reduced by more than a third in the 2014-2020 period compared to the 2007-2013 tranche.

Cohesion finance in Eastern Europe has been heavy on road investments.

More than half of transport funds were disbursed to build or reconstruct roads. Twice as much funds were disbursed towards road infrastructure compared to rail. Roads were an easy win for member states for many reasons: underdeveloped road infrastructure, the need to complete the TEN-T networks, political attractiveness, and the simplicity and speed of absorbing the funds. The €57 billion road building programme led to significant growth in motorisation (+90%), passenger car traffic (+68%), emissions (+88%) since 2000. Productivity loss as a result of congestion amounted to more than €600 per person in major CEE cities. Although there was a 60% decrease in road fatalities, 7 CEE states are still lagging behind the EU average.

12x more road kilometres were (re)constructed with EU money compared to rail.

Up to 30,000 km were built or reconstructed with EU money. This compares to 2,600 km of rail. Almost two-thirds of rail projects have not been realised. Rail investment needs a high upfront capital cost and has lengthier implementation compared to road. Increased rail upgrade investments and matching the project and finance timelines will help even the rail-to-road ratio.

Urban transport investment was not on top of the cohesion agenda.

Even though 64% of people in the 10 countries live in urban areas, urban transport and public transportation received just 14% of the cohesion funds. Bus and coach travel demand across the CEE countries barely changed since 2007. Romania bucked this trend, where local governments were interested in investing into zero-emissions urban transport. Meanwhile, Hungarian authorities splurged more than 25% of its cohesion budget into the grandiose metro line project in Budapest, despite an existing bus line operating just above the ground. This was reflected in poor demand projections and high construction costs.

Incentives to put road freight on rail contributes to modal shift.

Road freight volumes in CEEs more than doubled between 2005 and 2022. However, Intermodal rail transport took only 2.5% of the rail freight activity in Poland in 2003. After €895

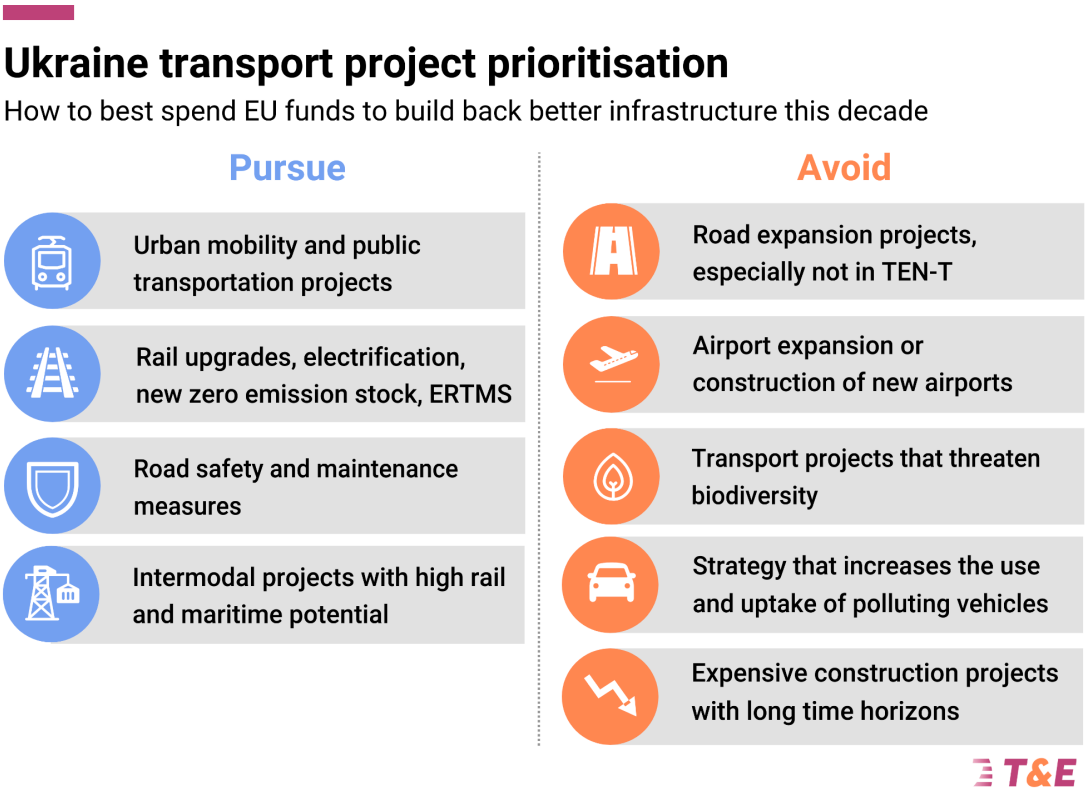
million of EU co-financed intermodal projects, the share of intermodal transport in rail freight rose more than fivefold to almost 14% by 2022.

Some airports received EU money, but not passengers.

€1.1 billion was channelled into airport infrastructure. We found a poor record of value for EU money. Some terminals were underutilised; some airports were built in other airport catchment areas. This contributed to demand dispersion and lower than expected passenger numbers. State aid was then used to support their operation, e.g. Polish Rzeszów or Łódź airports.

Recommendations for Ukraine:

1 Prioritise and exclude projects based on the following framework. Build targeted objectives around projects, making funding conditional on the adoption and implementation of policy measures promoting sustainable transportation. Assign higher weights for sustainable projects in a transport master plan:



2 Systematically collect necessary transportation data and conduct robust data-based analysis of the costs and benefits, socio-economic and environmental impact of shortlisted projects. Estimate necessity and implementation effects using international units of price and up-to-date technical documentation.

3 Implement the “polluter pays principle” in transportation planning and policy. To start with, toll heavy-duty vehicles to generate revenue for road and bridge maintenance and lower emissions. Implement the EU vehicle CO_2 emission standards on new sales.

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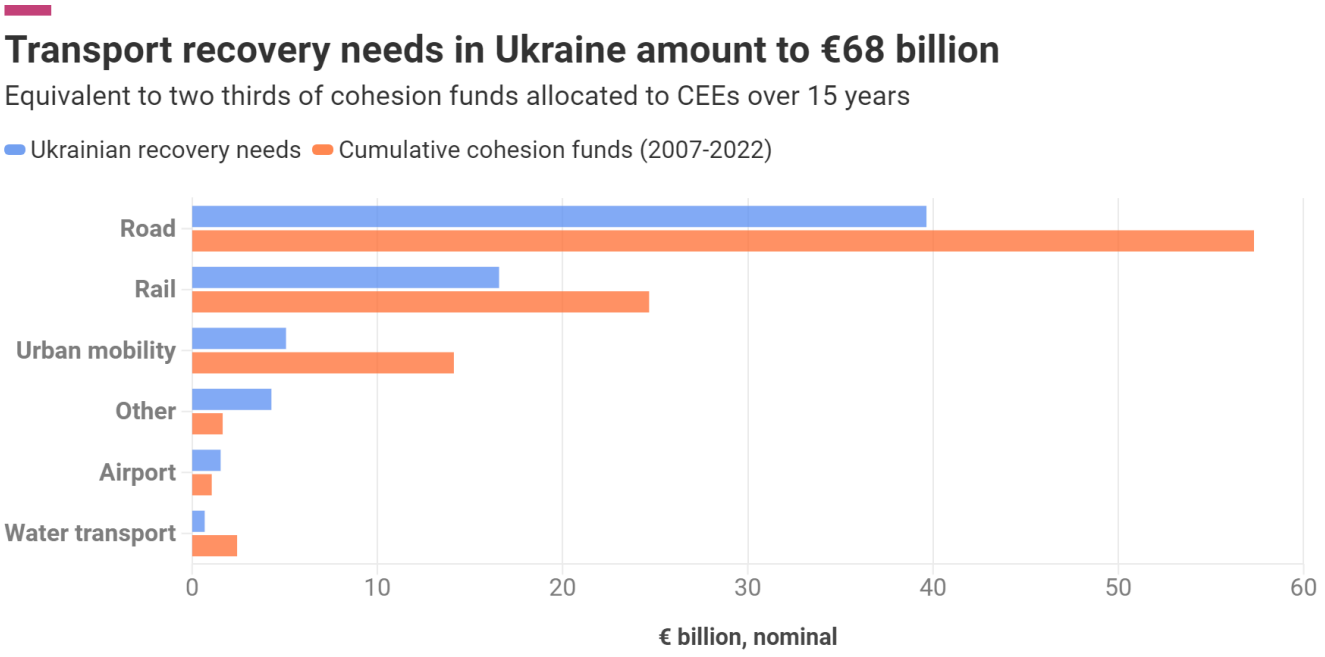
Introduction

Since the outbreak of Russia's large-scale invasion of Ukraine, the EU has been working towards integrating Ukraine into the bloc. This integration is expected to require billions of euros of support. Directing the money flows in a right manner will be hugely consequential for Ukraine's development. Among the latest developments is the establishment of the Ukraine Facility, totaling €50 billion in grants and loans over 4 years from 2024 to help restore damaged infrastructure, provide immediate relief, and assist with restoration goals. The Ukraine Plan, devised by the Ukrainian government and recently approved by the European Commission, lays the foundation for the disbursement of EU funds. Greening transport is an integral part of the reform agenda.

The overall estimated damages to the transport sector reached almost US $34 billion in 2023. In order to rebuild and restore that infrastructure to modern and sustainable standards, the recovery needs comprise over US $73.7 billion in the next decade. The largest concentrations of damage in transport infrastructure are in the road sector followed by railway infrastructure and stock. The Ukraine Facility amounts to almost 50% of the transport cohesion funds allocated to 10 Central and Eastern European (CEE) states.

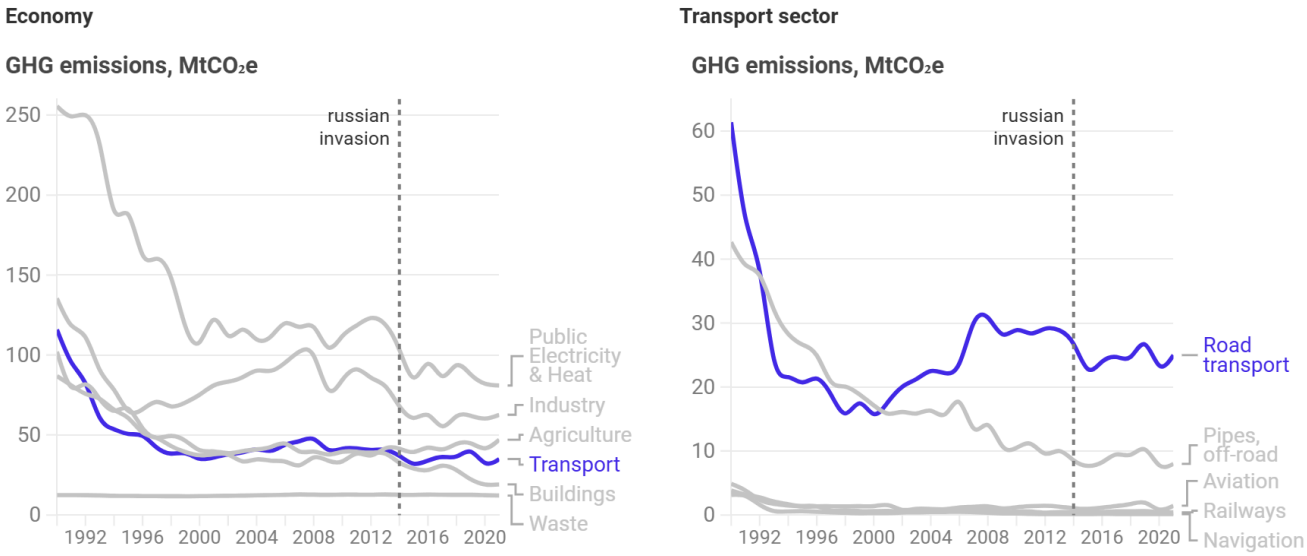


Sources: T&E, EC (2013, 2020), World Bank 2023.
Notes: Assumes €0.92/$. "Other" includes private vehicles, border crossings, debris removal for UA. For Cohesion it is for multimodal

In Ukraine, the transport sector's greenhouse gas (GHG) emissions have reduced by 70% since 1990 to 35 $MtCO_2eq$. in 2021. The dissolution of the Soviet Union in 1991 had an immediate impact on economic activity and thus emissions in the 1990s. Since then, emissions in all sectors have been relatively stable. The Russian invasion in the South and East of Ukraine in 2014 caused another drop in emissions. The share of transport in the overall emission mix remained relatively constant across years, at around 13%. Over 70% of transport emissions come from road transport. As Ukraine pushes for integration into the EU, its economic recovery should be decoupled from oil consumption and emissions.

Road dominates transport emissions in Ukraine

Collapse of the Soviet Union and russian invasion shocks to overall emissions



Source: T&E, UNFCCC • Note: Transport includes international bunkers.

We undertake a critical evaluation of the EU-granted co-finance and of national priorities in the transport system development before and immediately after accession for 10 CEE states, home to 96 million EU citizens. Namely, we look at Poland, Hungary, Czechia, Slovenia, Slovakia, Lithuania, Latvia, Estonia, Bulgaria and Romania in the two funding periods 2007-2013 and 2014-2020. We aim to shine a light on both past mistakes and some of the best-in-class outcomes. We understand that there is a huge gap between where EU finance went in 2004 and where it is today. At the very least, the Green Deal was far from being on the table. However, the impacts of the past carbon-heavy investment into roads and lack of concern for sustainable mobility have left a large trail of environmental consequences for decades to come.

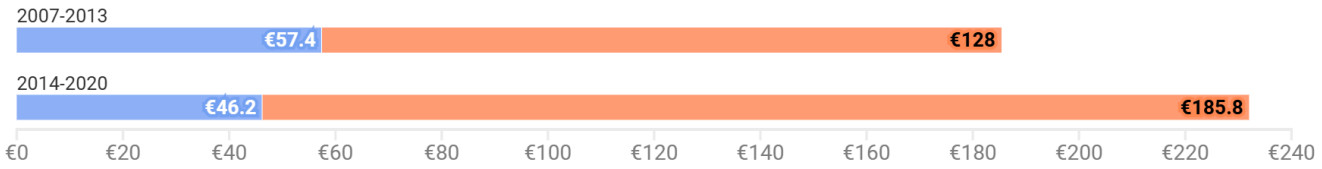
With already overstretched carbon budgets and increasingly relevant strict carbon pricing (emission trading system, ETS2 and carbon border adjustment mechanism, CBAM), it is imperative that we build back better in the candidate states. The climate impact of rebuilding Ukraine's damaged and destroyed transport infrastructure itself is estimated to exceed 14 $MtCO_2e$ - roughly equal to annual emissions from the Dutch car passenger fleet. Some of these emissions could be avoided through better planning, use of modern technologies and materials, and approaching the reconstruction with best EU practices in mind.

A quarter of cohesion funds to transport

We calculate that the EU contributed €418 billion through cohesion funds for the accession countries since 2007. Assuming an average co-finance rate of 85% in the 2007-2013 period, we estimate €470 billion for all cohesion funding including national contributions.

€418 billion over 14 years to 10 countries in 2 tranches

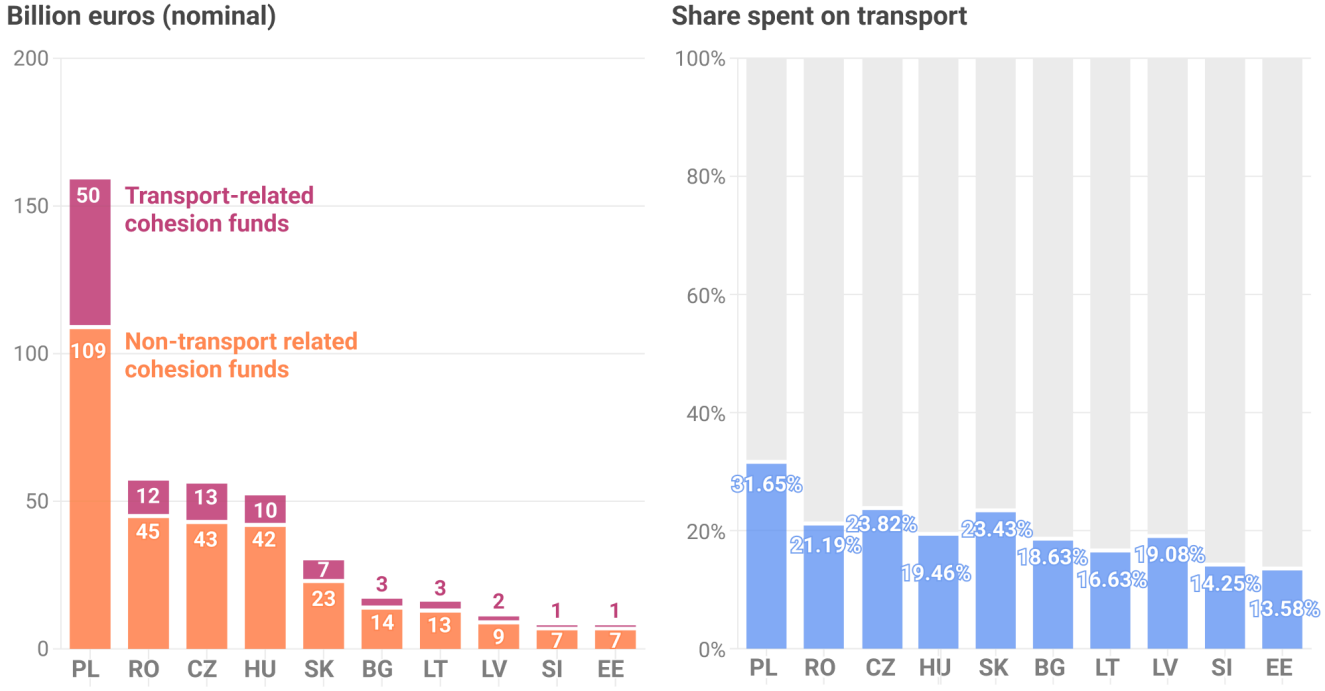
Transport and non-transport related cohesion funds to CEE countries, billions



Sources: T&E, EC (2013, 2020)

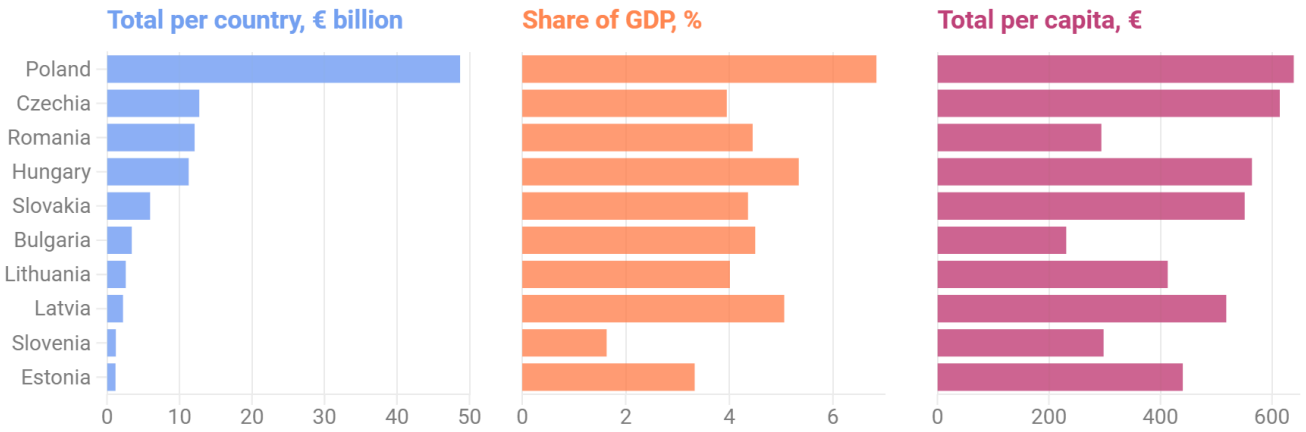
More than 38% of all cohesion funds and almost half of all transport funds were allocated to Poland. The main reasons for this discrepancy between countries are due to the EU cohesion fund allocation methodology and political considerations. If a member state (MS) falls under the category of less developed but has robust growth projections, it will receive more money. The distribution of transport cohesion funds per capita shows smoother shares per country.

A quarter of EU cohesion funds in CEEs spent on transport



Sources: T&E, European Commission (2013, 2020)

Transport cohesion funds distribution

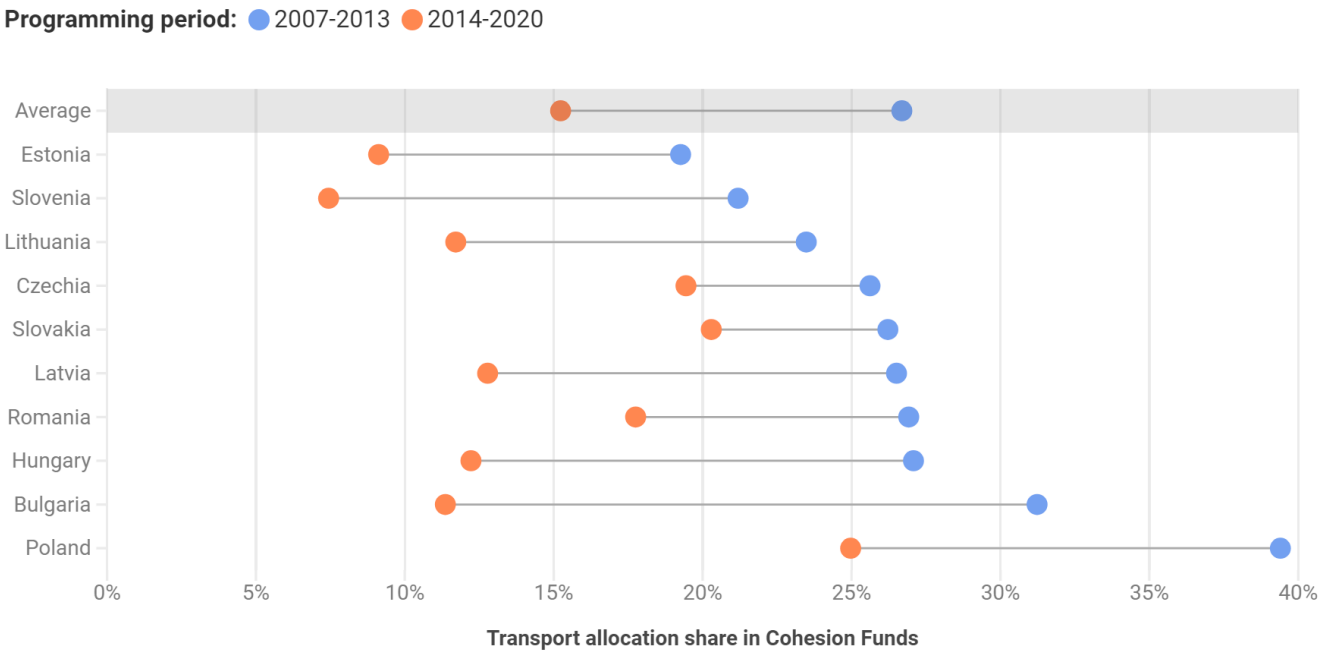


Sources: T&E, EC (2013, 2020), Eurostat

Overall transport related investments took more than €104 billion, or 25% of the total when calculating the 2014-2020 per objective on *Promoting Sustainable Transport*. Note that the figure stands at €101 billion when calculating the contribution per transport mode - see more explanation in methodology. This varied significantly across countries: Poland allocated the highest share for transport while Estonia, the lowest. Over time, the average share of co-financed transportation projects reduced by a third. In 2007-2013 it was 31% and during the 2014-2022 period it dropped to 20%.

Share of transport allocations halved

Transport infrastructure spending is a high priority for new accession countries



Sources: T&E, EC (2013, 2020),

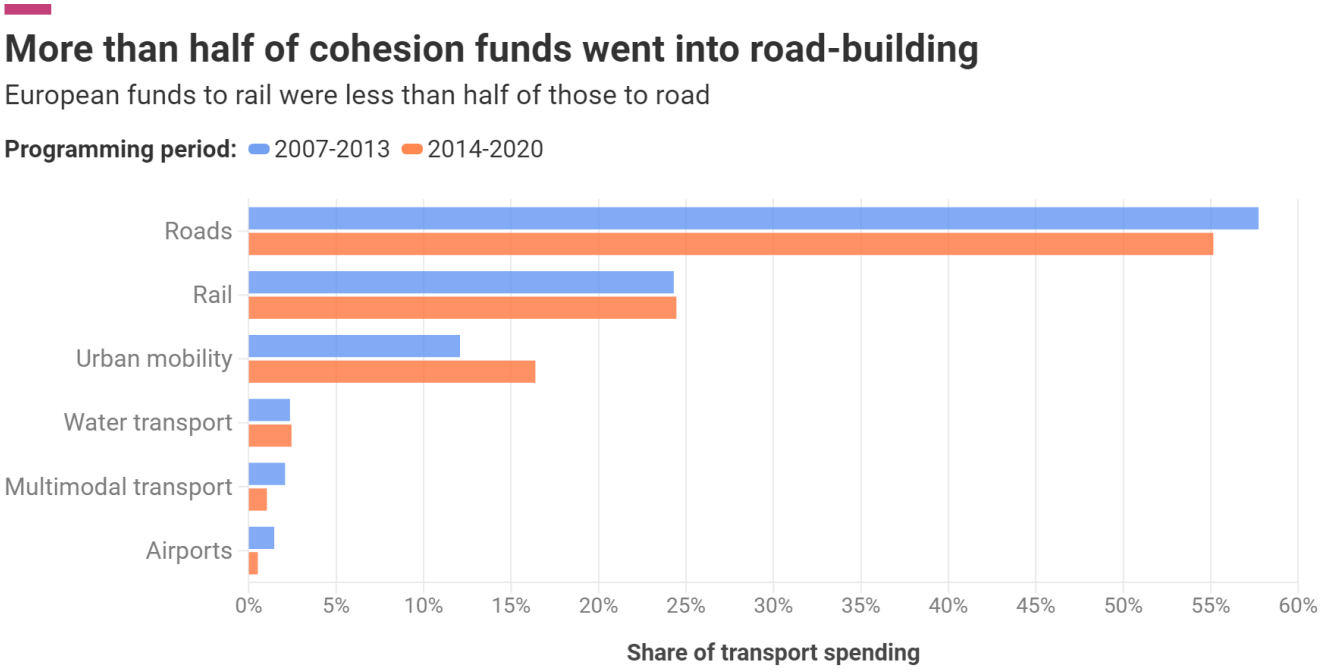
This was partly due to the general increase in allocations and more funds being allocated for other purposes such as competitiveness, environmental protection, and social inclusion. Moreover, in this period additional EU financing instruments were conceived, e.g. Next Generation EU financing with Resilience and Recovery Facility (RRF) at its core as well as Connecting Europe Facility (CEF 1). More detail on the substitution of Cohesion by RRF funds can be found in the Annex 1.

Most EU transport financing used for roads

Twice as many funds were disbursed towards road infrastructure development compared to rail. From expert consultations we held, there were several reasons why allocations for road investments far exceeded those of rail:

- the underdevelopment of the road network
- the need to integrate new MS via TEN-T corridors, which is a major priority for the EU
- the prioritisation of road investment in national strategic documents.

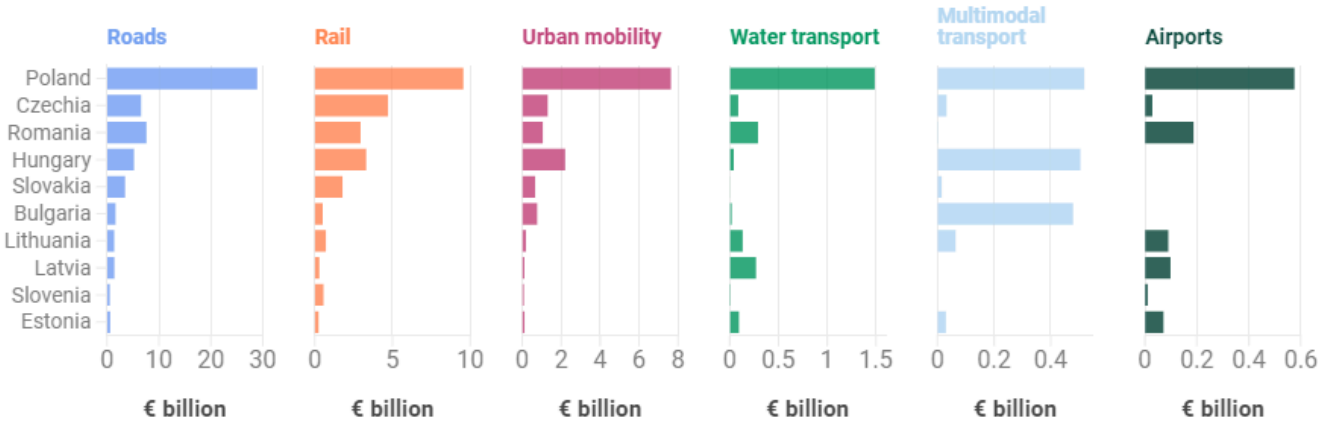
In other words, it has been an easy win to invest in roads. Moreover, railway investment requires high upfront costs and it is more heavy on planning, making it less attractive.



Sources: T&E, EC (2013, 2020)

Poland, Hungary and Bulgaria invested the most EU funds in multimodal transport. However, it is difficult for us to corroborate this allocation with a successful multimodal project undertaking. The EU paid for airport development, such as air traffic management and airport-city connections, under the categories of technology transfer and multimodal transport. Multimodal funds were also used to pay for intermodal projects. This means that the EU contribution for airports could be underestimated and the passenger multimodal transport development - overestimated.

Split of cohesion funds per transportation mode per country



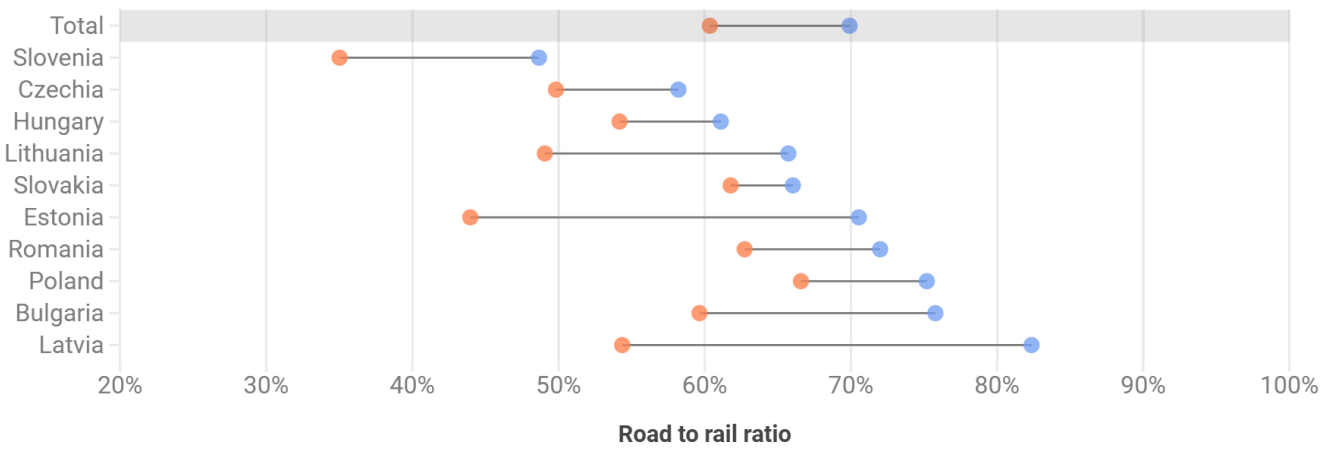
Sources: T&E, EC (2013, 2020)

On average twice as much was spent on roads as rail: over €285 were allocated per person on average in CEE countries for roads and about €123 for rail. Czechia spent the most per capita for rail development. It is likely a key factor that brought Czechia to the top of the World Economic Forum list in terms of railway density and rail performance. We elaborate on this finding in the impact section. Hungary spent the most EU money per capita on urban mobility projects. Of those funds, €473.5 million ended up in what is seen as a controversial metropolitan line in Budapest. Only Slovenia allocated more EU funds to rail than to road. It could be explained by the full completion of the TEN-T road core network as of 2016 due, in part, to the small country size. This went hand in hand with an increase of over 2.8 billion tkm (tonne-kilometres) in rail freight. Rail passenger traffic and its modal share remained constant.

Some positive developments in the modal shift from road to rail happened with the Next Generation EU (NGEU) funds and CEF Transport, in particular. Almost €14 billion were disbursed for around 213 rail projects, including for Rail Baltica, as opposed to €1.3 billion for 36 road projects. This has moderately improved the rail-to-road investment split with a total of €38.5 billion disbursement for rail development. One could trace the problem of path dependency here: Poland, Romania and Slovakia are still lagging behind on their rail ambition even under NGEU funding. During calls for proposals from 2014 to 2022, Polish and Romanian railway development was in the top 5 of the largest CEF project which had a total budget of €2.4 billion. This is a bit less than total Rail Baltica CEF allocations of €2.5 billion. Top 5 largest road projects were also headed by Poland, Hungary and Slovakia with a total budget of €885 million. Other most common project categories sponsored by CEF included the charging infrastructure development, road ITS, port development with onshore electrification. Some of those infrastructure projects had military justification.

Connecting Europe Facility boosts rail spending

Rail Baltica has had the biggest impact in shifting the destination of EU funds



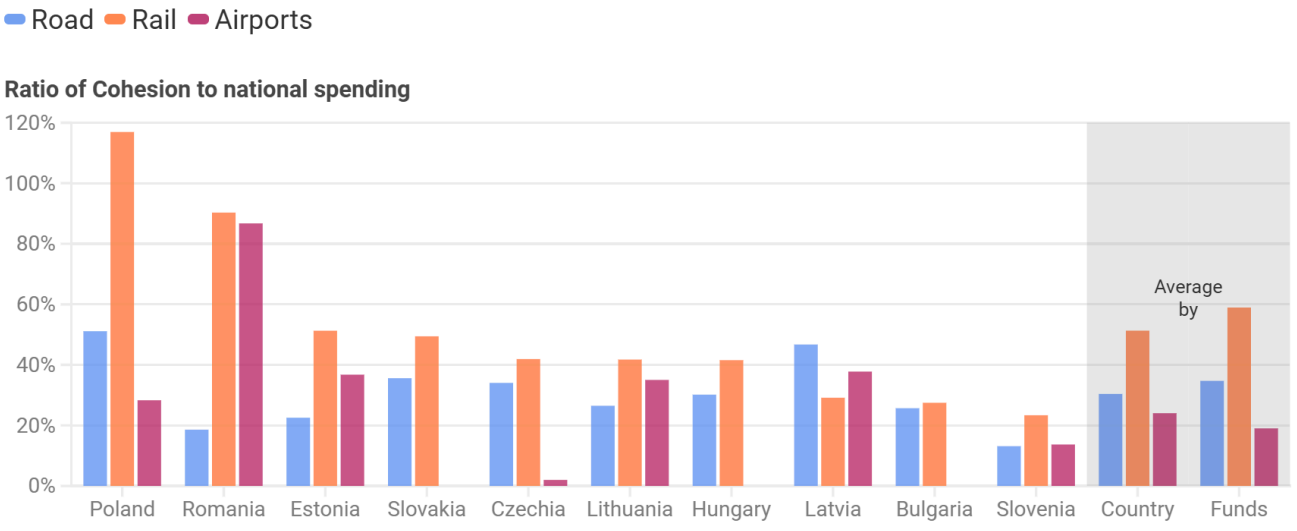
Sources: T&E, EC (2013, 2020), CINEA (2014-2020)
Note: CEF rail funds incl. signalling, retrofitting and studies; excl. intermodal hubs. CEF road funds excl. ITS.

EU funds were 60% of national rail spend

CEE countries invested €212 billion on inland infrastructure: €165 billion on roads, €42 billion on rail and €5.6 billion on airports. EU disbursements, hence, theoretically helped to cover up to 48% of all national transport infrastructure investment. In total, EU funds covered around 35% of all road investment with EU funds, almost 60% for rail and almost 20% for airport spending.

Cohesion funds for rail had absorption problems

Poland received more money for rail than they could spend

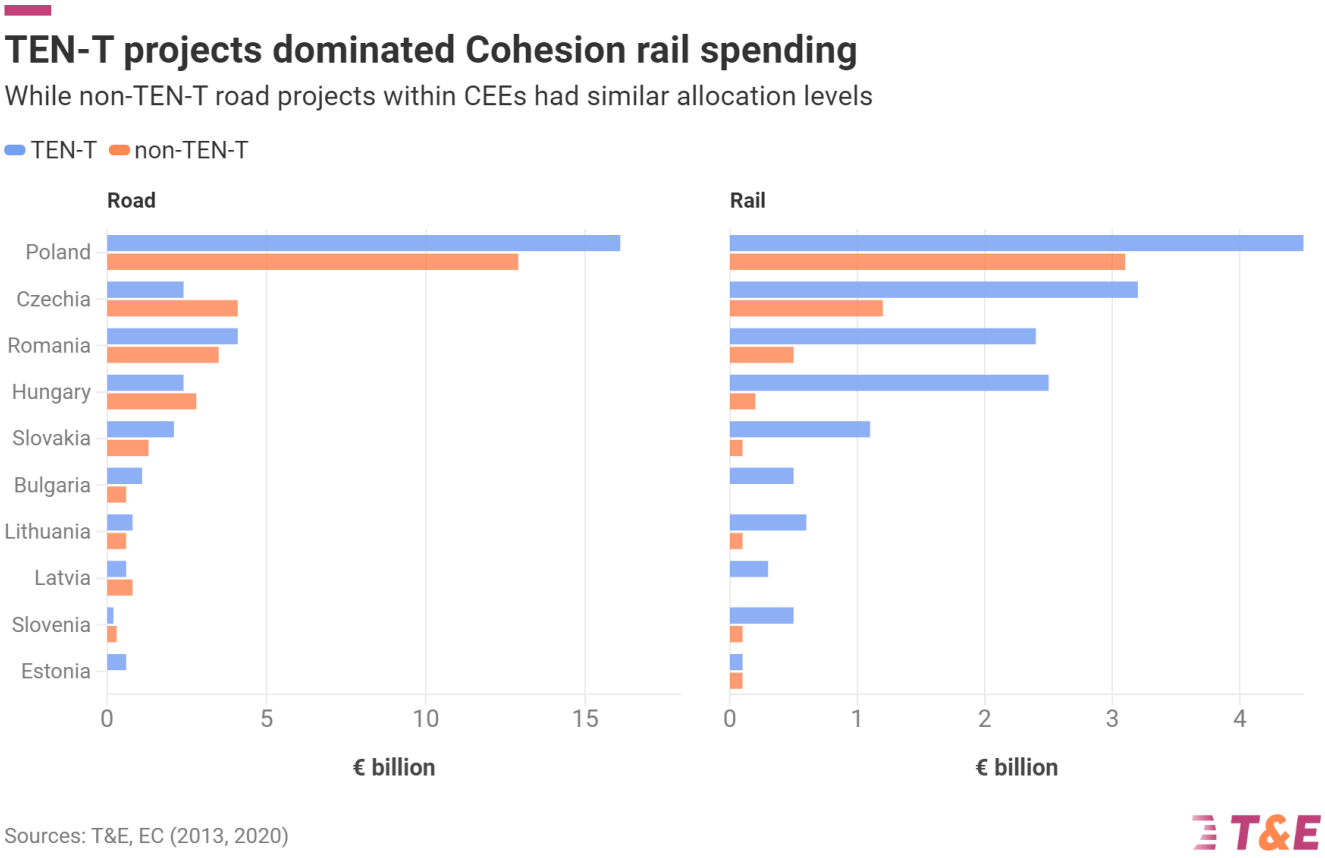


Sources: T&E, EC (2013, 2020), OECD/ITF
Note: Latest Romanian data from 2018.

The EU cumulative contribution towards rail development in Poland stood at €9.5 billion while Polish total expenditure was €8.2 billion. It means that the EU gave around 17% more money to Poland for rail than Poland actually invested. For Romania, over 90% of national rail spending could have been covered by EU co-financing, assuming 100% absorption of the funds. Indeed, railway projects are quite lengthy and it takes time for them to come to fruition. This is coupled with some institutional, regulatory and financial hurdles that prevented full absorption of the EU funds in some member states. In particular, Bulgaria, Slovakia, Romania and Latvia experienced the lowest general absorption rates of the Cohesion funds in the two programming periods. These numbers point to low national ambition on rail development as well as huge potential for modal shift with the helping hand of the EU.

TEN-T investment

EU investment in TEN-T roads was 13% higher than in non-TEN-T roads, which include national, regional, and local roads. For railways, for every euro going into the non-TEN-T rail, there was around €3 of funds going to the TEN-T related infrastructure. Up to €4 billion of the cohesion money was used to purchase locomotives.



There is evidence of some implemented TEN-T projects not living up to the economic and social expectations of benefit. For instance, only 12 of the 22 projects passed the pure cost-benefit analysis (CBA) or efficiency test at a discount rate of 5%. Some projects did not

have any broader EU value in terms of benefits - cost or time savings - for neighbouring countries and did not contribute to the development of the most underdeveloped regions, which is the main idea of the cohesion funding. Some reasons for these shortcomings include overestimation of demand, lobbying and political cycles. While the CBA is important for evaluation of infrastructure projects, it must be coupled with solid data collection and setting of political priorities. As already observed in 2004, "decision-making for these major projects in that period was based on a combination of fear, hope and belief instead of research findings, debate and creativity".

The misallocation of funds could be ameliorated by establishing proper prioritisation frameworks, data-based decision-making and environmental impact assessment. It means accounting for the possible changes in demand for roads given the toll imposed on it and network effects on the alternative routes.

Road construction: discussion of implications

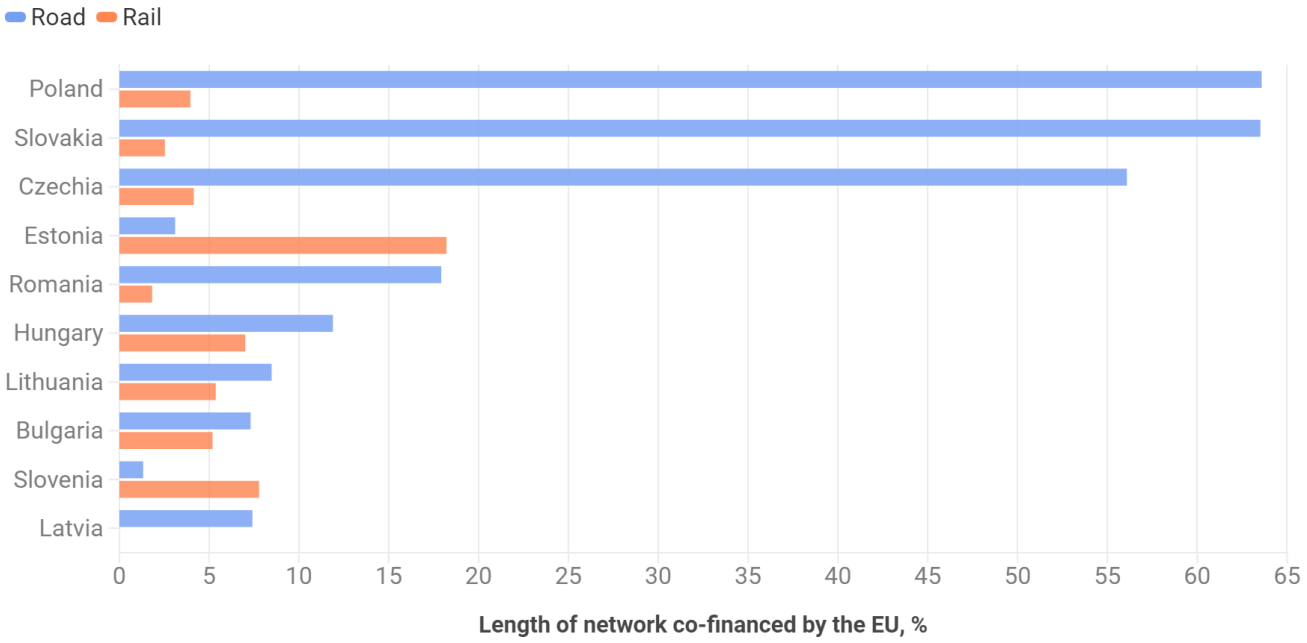
30,000 kilometres of roads were built with EU co-financing

29,605 kilometres of road have been built or reconstructed using cohesion funds in CEE countries. For comparison, it is more than 50% larger than Poland's principal state road network of 19,500 km, or equals to almost 64% of Ukraine's state road network of 46,500 km. This came at a total investment of €57.3 billion from the EU. On average new or reconstructed road investment was €1.94 million per kilometre. For comparison, the average *cost* of construction of 1 km of road in Poland is €9.4 million, equivalent to the EU average.

The cost of motorway and highway construction in Poland dropped by more than 30% while the capital expenditure of the national road authority (GDDKiA) was three times as high as in 2007. The drop in price of road construction could be due to European monetary backing behind road projects (see case study: too cheap to build) as well as the effects of scope. Constructing roads on such a large scale most likely contributed to increased competitiveness of the construction companies and increase in the lower-priced bids as the number of bids submitted in tenders increased by more than twofold. Following this extensive road building exercise supported with EU funds, the Polish government is still bent on constructing more of the same: bypasses and ring roads are now needed to ameliorate the congestion issues that were exacerbated by the initial construction.

EU funds contributed to a significant share of the network

Share of road and rail network length co-financed by the EU, 2022



Sources: T&E, EC (2013, 2020), Eurostat

Case study: road cost underruns

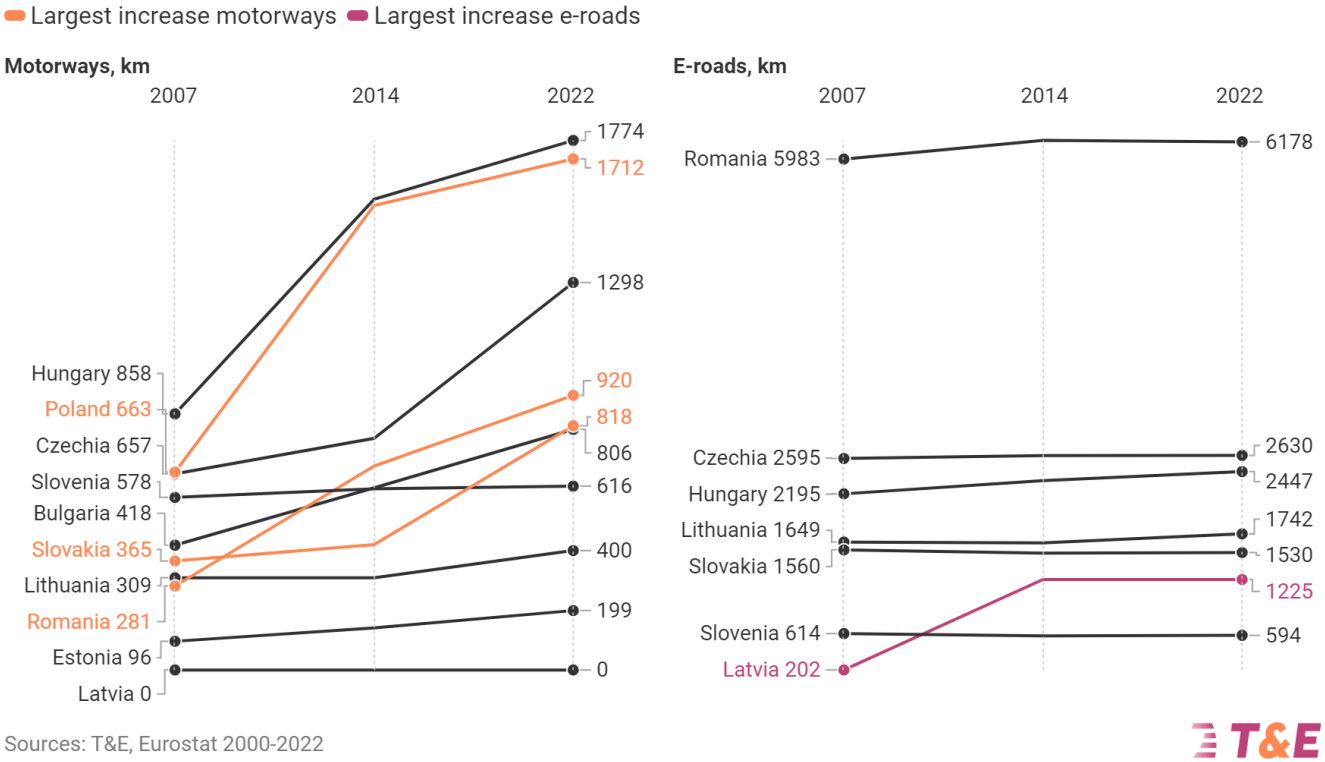
In Poland, cost underruns were observed with greater frequency for the EU co-funded road projects compared to the nationally funded ones (75.3% versus 61.4%). City roads in particular have an average cost underrun of around 20%. The costs also range depending on the investor type: road projects implemented by local authorities are 19.2% less expensive compared to an initial estimate compared to the Polish road state authority (GDDKiA) projects. This could be explained by institutional reasons. As the maximum level of EU co-funding is fixed at 85%, there is an incentive from the government to deliberately overestimate project costs to ensure the project delivery. EU structural funds are usually paid upon successful completion of the investment process. While they cannot be increased to cover the difference between the budgeted and realised costs, there is no penalty for limiting construction activity or downscaling the project. The remaining funds from the EU allocation could be repurposed for other projects in the pipeline. Therefore, there is a strategic incentive for the actors to overestimate costs at the project planning phase. This might explain the cost underruns reported post factum.

In Slovakia, the initial cost estimates for 18 motorway construction projects were higher by around 27%. One reason for this is the lack of historic unit price data and, therefore, inadequate initial cost estimates.

The motorway network doubled

Although EU funding served quite a large push, the full-fledged construction landed in the national hands. More than 4,300 km of motorways and more than 5,800 km of expressways were constructed in the 2007-2020 period. The total road network was thus characterised by a doubling in motorways and average 30% increase in expressways. The highest motorway growth rates were recorded in Poland, Romania and Slovakia. According to the law of congestion, construction of highways on such a scale does not alleviate congestion in cities, but exacerbates it.

Increase in road network length driven by high-speed roads

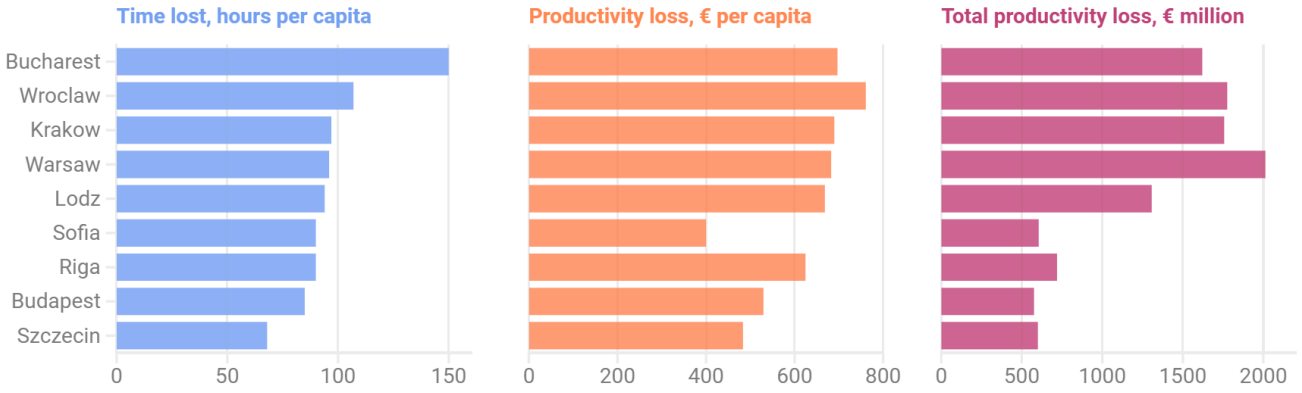


Sources: T&E, Eurostat 2000-2022

We explored the economic cost of congestion in a selection of cities. According to the TomTom traffic index, Bucharest was 8th in the ranking of the most congested cities in the world in 2023. The time lost from congestion in rush hours reached 150 hours per year per vehicle, which resulted in a productivity loss of around €700 per person. On average, €615 is lost in productivity per person in the cities analysed, assuming that the congestion hours often concern work-related commute productivity losses. Hence, total productivity loss in the city region is much higher, rising above €1.6 billion on average, calculated based on the motorisation rates per NUTS2 region and average vehicle occupancy. See our methodology in Annex 3.

Traffic jams costs citizens more than €600 per year

Rush hour congestion related losses in Central and Eastern European cities



Source: T&E, TomTom (2023), Eurostat, World Bank • EU Mobility study 2022

Case study: Bulgaria

Biodiversity and motorways: substitute goods in Bulgaria

The construction of the Struma E79 motorway in Bulgaria is emblematic of streamlining investment without enforcement of proper conditionalities. This is often to the detriment of the environment and people. One of the main sticking issues of this project is that this motorway is qualified as a part of the Orient/East–Med transport corridor, TEN-T priority. It aims to link Sofia with Dresden, Budapest, Istanbul and Thessaloniki.

The corridor through Bulgaria is a Natura 2000 nature site and a habitat for 35 EU protected habitats and 92 EU protected species including the European wolf and brown bear. The 2008 environmental impact assessment (EIA) by the European Commission deemed construction of the motorway through the Kresna Gorge as unacceptable. Therefore, construction of a 13-km tunnel is the only feasible option for avoiding damage to habitats and species in the Kresna Gorge.

Despite this clear EIA conclusion, the EU decided to allocate nearly €343 million for the immediate financing of sections north and south of the Gorge. The consequent splitting of the gorge section aggravated the matter, according to the CEE Bankwatch Bulgarian transport expert, Daniel Popov. Now, the EU could allocate an extra €412 million and provide an EIB loan for sections adjacent to the gorge to be completed absent the conditionality that the tunnel is built. This decision almost foreclosed consideration by the Bulgarian government of alternative routes. The interests of construction companies and the lucrative contracts offered by the government are precluding environmental protection.

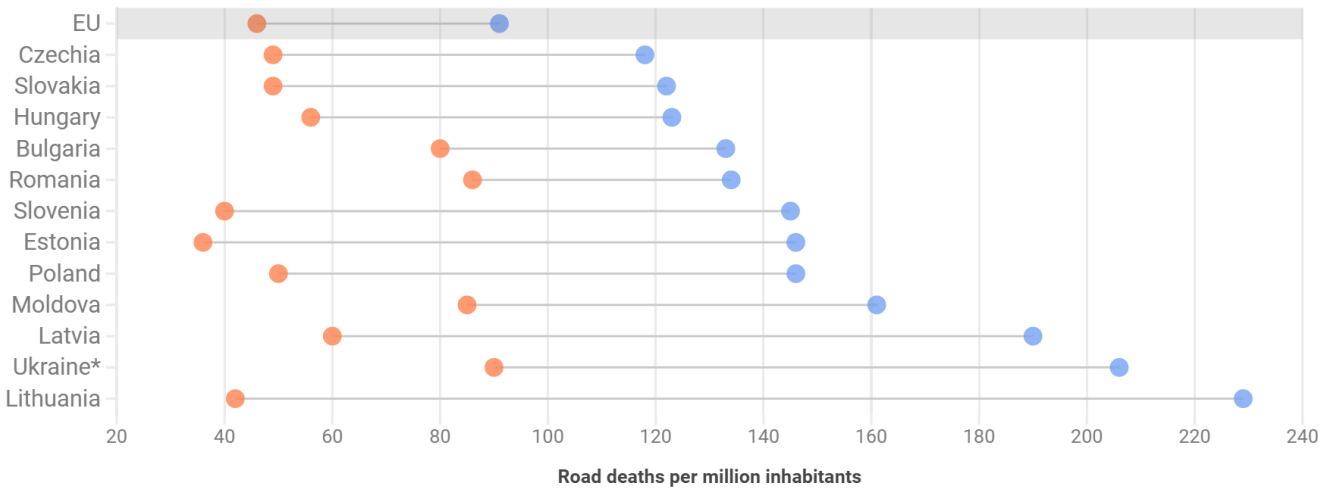
Some CEEs are still lagging behind in road safety compared to EU average

In CEE countries, on average, there was a decrease of over 60% in road fatalities in 2022 compared to 2007. However, most CEE countries, especially Romania, Bulgaria, Latvia, Hungary and Poland are worse than the EU average. In Romania, 86 people per million died from road accidents in 2022. It also ranked 119 out of 141 countries in terms of road quality in 2019. As a comparison, the EU average stands at 46 road fatalities per million inhabitants. In Ukraine, the problem of road safety is acute with 90 deaths per million. Since entering the EU, Lithuania and Latvia, however, managed to boost road safety considerably - respectively, 5.3 times less road fatalities in Lithuania and 3.8 times less in Latvia. Lithuania received an annual European Transport Safety Council (ETSC) Road Safety Performance Index (PIN) Award in 2021 for reducing traffic fatalities. They have done so by implementing a long-term national road safety program, increasing the number of automatic speed cameras on the road, zero-tolerance policy to alcohol and development of cycling infrastructure in Vilnius.

Some research shows that increasing the speed by 10 km/h more than doubles the fatal crash risk. Higher speeds were found to be responsible for 20% to 30% of all fatal road crashes. Another reason for increased accident rates is poor road condition and lack of road maintenance spending. For example, knowing that Bulgarian roads are terribly undermaintained, the European Commission finally included road maintenance under one of the policy objectives on disbursement of EU cohesion funds from 2021.

Road fatalities have reduced significantly since accession

The Baltics and Slovenia have seen the most improvement

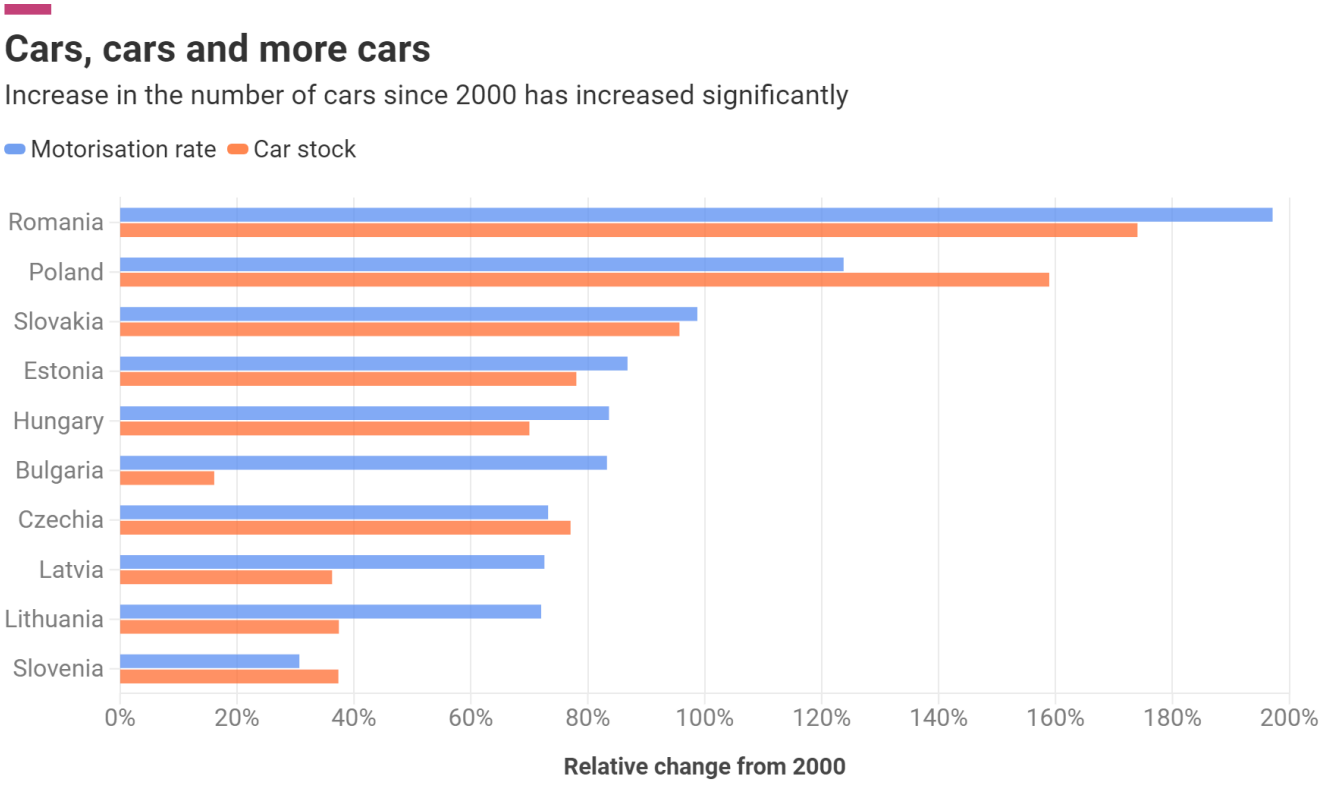


Sources: T&E, OECD, World Bank, Eurostat.
Note: *Ukraine shows 2017.

Road maintenance across the EU dropped by almost half between 2007-2017. So the EU goal to reduce deaths to zero by 2050 could be undermined by MS prioritising new roads over managing, maintaining and improving existing road links. International and EU funds and conditionality allocation should be targeted at the most problematic road sections accompanied by measures to boost road safety, such as radars, inspections, and strategies.

More roads in lock-step with car ownership

Since 2000, the total passenger car stock in CEE countries has increased by around 28 million cars. Motorisation rates per country on average increased by more than 90% in 2022 compared to 2000, or by 231 cars per 1,000 inhabitants. The fastest growing countries in terms of cars per inhabitant and general vehicle stock were Romania, Poland, Slovakia.



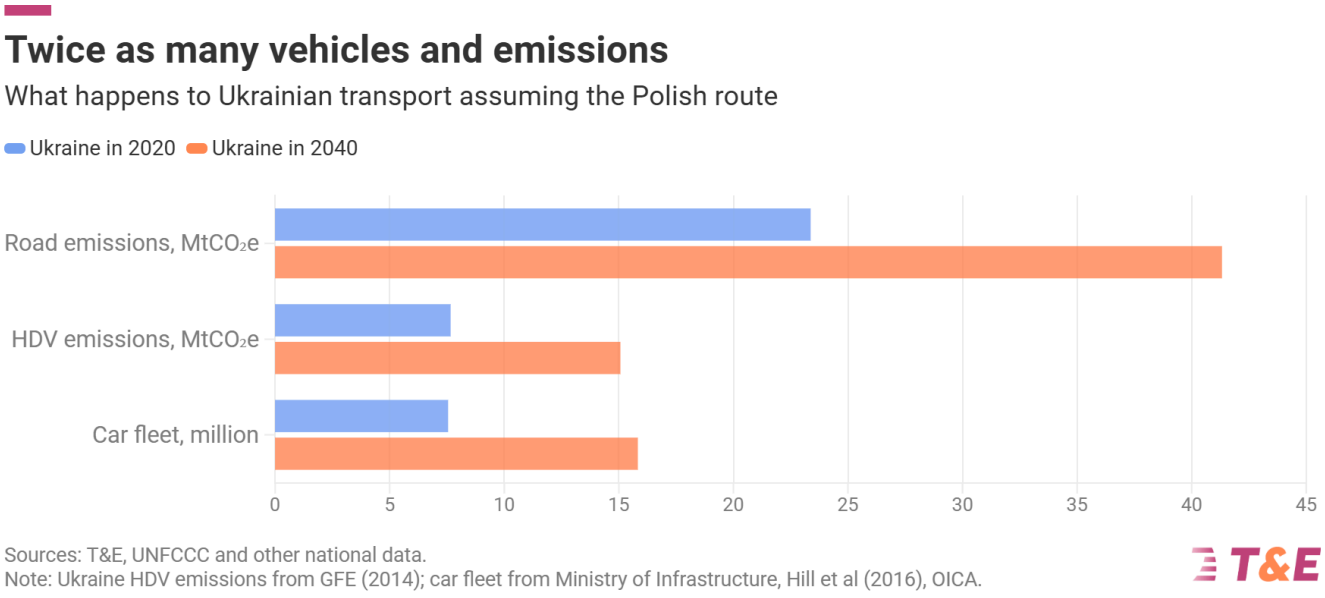
Source: T&E, Eurostat

Motorway expansion, increase in motorisation, rise in car traffic demand and GHG emissions from passenger cars are logically interrelated. For example, we find that for CEE states that in the 2000-2022 period every new kilometre of motorway corresponded to an increase in car ownership of 0.9 cars per 1,000 inhabitants. Similarly, every new car per 1,000 inhabitants corresponded to 0.65 car passenger kilometres driven. The GHG emissions from passenger vehicles increased by almost 90% in total from 2000 to 2021 in CEEs, or by around 38.5 $MtCO_2$ eq. Putting the number into perspective, this is equivalent to annual emissions of around 19.3 million cars. This is also positively correlated with higher motorisation rates per capita.

The highest relative increases in car emissions was recorded in Romania, Bulgaria, Lithuania and Slovakia. A lot of those emissions were also driven by older ICE cars with high diesel shares. On average, since 2007 the number of passenger cars with diesel powertrain rose more than 170% for Romania, Czechia, Hungary, Latvia, Slovenia, and Estonia. Although diesel vehicles emit 20% less carbon dioxide, they emit three times as much nitrogen oxide as petroleum vehicles. With the average car age in the EU at 12 years, the oldest car fleet among CEEs is in Estonia followed by the Czech fleet at 15.6 and Romanian at 15.1. As a rule of thumb, the older the vehicle is, the more fuel inefficient it becomes with more wear and tear to the engine and individual parts affecting the vehicle's safety and polluting potential.

Locking in emissions: what happens if Ukraine follows CEEs route

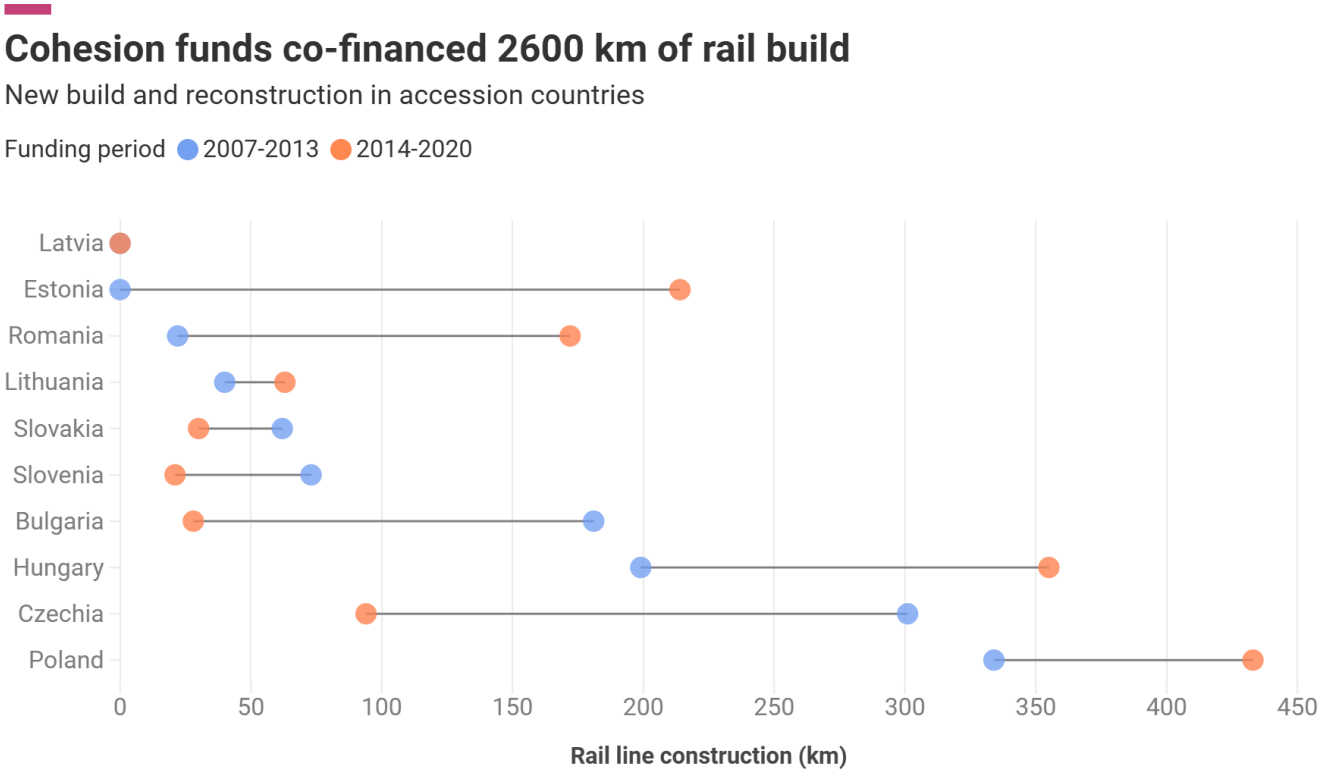
If Ukraine were to increase its car vehicle fleet by almost 110% as Poland did from 2005 to 2020, we could expect over 15 million cars on the Ukrainian roads. An increase of 77% in road emissions as in the Polish case would raise the annual GHG road emissions to over 42 $MtCO_2$ which is similar to the GHG emissions from German trucks in 2020. In Ukraine, with relatively low motorisation rates of 192 per 1,000, the radical increases in car ownership could, therefore, be averted by not funding the motorway expansion, but rather prioritising rail and public transport development and implementing the polluter pays principle to avoid the dieselisation trend of the Eastern neighbours.



Sources: T&E, UNFCCC and other national data.
Note: Ukraine HDV emissions from GFE (2014); car fleet from Ministry of Infrastructure, Hill et al (2016), OICA.

Two thirds of rail lines decided but not built

Since 2007, around 2,622 km of rail have been constructed in the CEE states. EU allocations to rail in the same period amount to €24.7 billion, equating to €9.4 million EU investment per kilometre of rail network. This is more than three times less than an average construction cost across the EU using €30 million per km as a conservative benchmark.

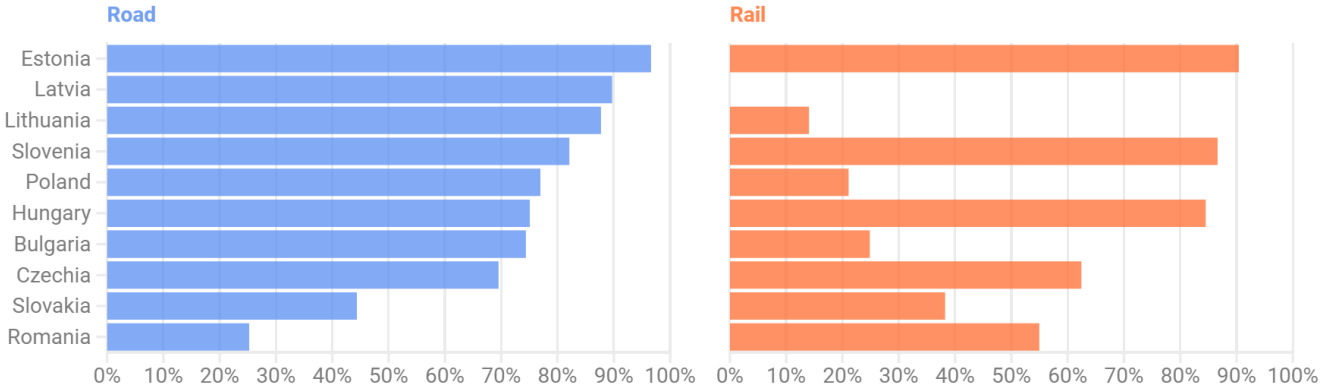


Sources: T&E, EC (2016, 2020)
Note: No indicators provided for Latvia or Estonia (2007-2013 period)

Since 2014 almost two thirds of rail kilometres have not been implemented. For roads, the difference is less dramatic - around 40% of all decided projects in total have not been implemented. Estonia, Slovenia, and Hungary buck the trend with very high implementation rates for rail. With such low levels of cohesion funds absorption, rail projects generally need more time and planning to implement. In order to boost absorption rates for rail projects, alignment of the financing and project implementation timelines are crucial - e.g. by splitting large infrastructure bids into smaller ones or phasing in rail projects through several funding periods. This will avoid the all too common situation where national governments run out of funds and are left with half-baked public goods.

Two thirds of planned rail line construction was not built

Completion rate of Cohesion funded projects highlight rail absorption issues from 2014



Sources: T&E, EC (2020)

Unlike high-speed roads, rail network expansion was found to be rather stagnant. There has been a total decrease of almost 6% in railway line kilometres. At the same time, there has been a 6% increase in the length of electrified lines. Since 2007 and before the pandemic, passenger rail activity in the CEEs increased by 7%. In 2021, rail demand was still 32% less than 2019. The highest increases were seen in Slovakia, Czechia, and Lithuania, with an increase of 83%, 57%, and 46%, respectively. With the highest per capita EU cohesion bill on rail infrastructure and also in general positive rail performance index results, Czechia is doing comparatively better in rail compared to its CEE neighbours. This also reflects the passenger demand for rail services as well as the geocentrality of the country at the crossroads of 3 core TEN-T corridors.

Case study: Czechia

Railway investment in Czechia: the power of an industrial push

The BCG-led study on the Rail Performance Index 2015 and 2012 reveals that higher levels of public investment into rail are positively associated with better rail performance, measured by intensity of use, quality of service and safety. Czechia is the only country among Eastern European countries that features in the second-best tier, with peers including Austria, the Netherlands, Spain, Italy, and Belgium. All other CEE countries perform much worse comparatively.

Purchasing modern rolling stock and decommissioning old inefficient trains often presents a financial challenge. As part of the Operational Programme Transport (2007-2013) state-owned Czech Railway company, České Dráhy (ČD), purchased six electric multiple units (EMUs) for line R13, servicing Brno, Breclav and Olomouc. These trains are well suited for fast interregional transport with a speed reaching 160 km/h. The total value of

the contract was €53.1 million with 85% covered with cohesion funds and 15% from the state budget.

From 2014, there was a continued interest from the government in railway investment and modernisation. Two railway lines in the South Moravian region around the city of Brno were modernised and 37 EMUs purchased to accommodate 22 million passengers annually. The project benefitted from €223 million of cohesion funds, or around 13% of the total rail allocations for 2014-2020 period.

The interest of the Czech government in developing attractive railway systems is not surprising given the massive manufacturing pull from the railway industry and its national champion - Skoda Transportation. More than 30% of its revenues were generated in Czechia as of 2019. Another potential reason for a comparatively well-functioning railway market is liberalised train service. The busiest Czech train route is between Prague and Ostrava with the national operator (ČD), RegioJet and Leo Express competing for passengers. Longer bus and car travel time by highway is another reason for the train route popularity.

Case study: Rail Baltica

A high price to pay?

Rail Baltica is above all a geopolitical project. It was conceived to increase the north-south interconnection between Poland, Lithuania, Latvia, Estonia and indirectly Finland in passenger and freight rail, on the European 1435 mm gauge. At the same time, the project aims to deemphasise the east-west 1520 mm gauge link of those countries to Russia and ensure adequate military logistics for NATO allies.

It is considered to be the largest infrastructure project in the Baltic states in the past 100 years with 870 km of new double track expected to be completed by 2030. It is also part of the North Sea Baltic TEN-T corridor, an EU priority of multimodal cross-border connections. High-speed rail is expected to halve the time of travelling between Vilnius to Tallinn. However, it has its own limitations and problems.

Firstly, the necessary budget has quadrupled in the past 7 years to €24.8 billion, and the project's implementation has been delayed by 5 years. Up to €19 billion on top of the initial estimates of €5.8 billion may be needed as per the estimates of the auditors. This figure depends on the agreement on scope reduction by MS, for example building only one set of tracks or minimal functionality of local stops. The project is financed primarily through the CEF (85%) and national budgets. There is a discussion ongoing to use Portuguese

experience with public-private partnership (PPP) on High Speed Rail (HSR) Porto-Lisbon to attract some private capital. The most recent CBA shows indirect benefits of over €15.5 to €23.5 billion to GDP of the Baltic states and direct net benefit of €6.6 billion. The certainty of the CEF funding, which has so far totaled €2.7 billion, is uncertain beyond 2028. So Member States would need to potentially jump in with their own resources.

The projections of the passenger and freight volumes would not be economically sustainable. EY 2017 CBA study found that only 4.6 million passengers per year are expected by 2030, limited by the population density in the Baltic states, while the International Transport Forum found the breakeven demand volume for the cost-efficient HSR is around 9 million passengers per annum, albeit without considering societal benefits of reduction in air and noise pollution and congestion. In terms of freight modal shift, there is a maximum potential demand of about 30 million tonnes per year. To realise this potential, there should be an efficient system of road tolling in place as well as an efficient infrastructure management model. These costs and questionable benefits have been compared to the high-speed line (HS2) in the UK.

Urban transport: discussion of implications

Bus demand soared in Romania

62 million people, or 64% of the population of CEE countries, live in cities, towns and suburbs. Urban mobility projects had a cumulative expenditure of €14.1 billion. It constitutes around 14% of the whole cohesion bill. Bulgaria allocated the highest share of its transport spending on urban mobility with one of the most successful projects being the upgrades to the central bus station in Varna, creation of the bus rapid transit (BRT) and integrated ticketing system.

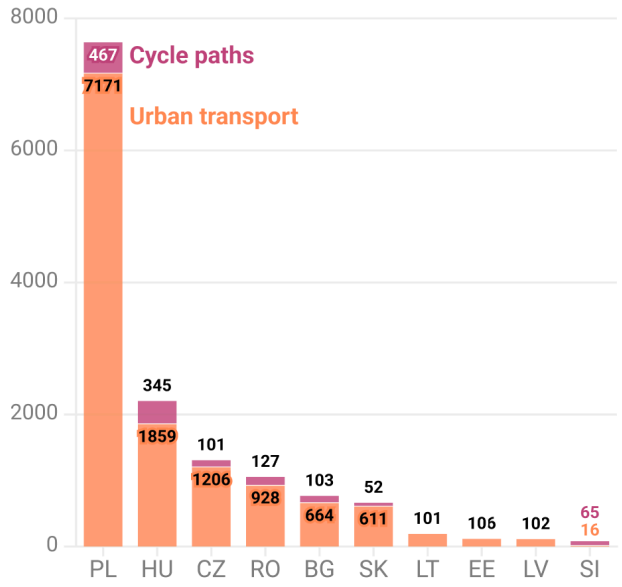
Hungary allocated almost 20% of the total transport spending into urban transport. A large proportion of this could be attributed to one project: the Budapest metro line 4 construction. This was a megaproject that could have been avoided for its overestimated demand and wallet size (see case study on Hungary). On the metropolitan line 3, millions likely found its way into the hands of Russian oligarchs.

Before the pandemic, bus and coach travel demand across the CEE countries has been roughly constant since 2007. In 2021, overall demand was still 41% below 2019. These averages mask significant variation between countries. Before the pandemic, Bulgaria, Poland, and Slovakia lost 20%, 24% and 28% of activity, while countries like Czechia, Hungary, Estonia and Slovenia saw modest growth. However, Romania with over 120% increase in bus passenger traffic was a notable exception. With only 9.3% of EU cohesion spending going into urban mobility in Romania, there was a keen interest on the ground from the local authorities to promote cleaner and more sustainable mobility (see case study box).

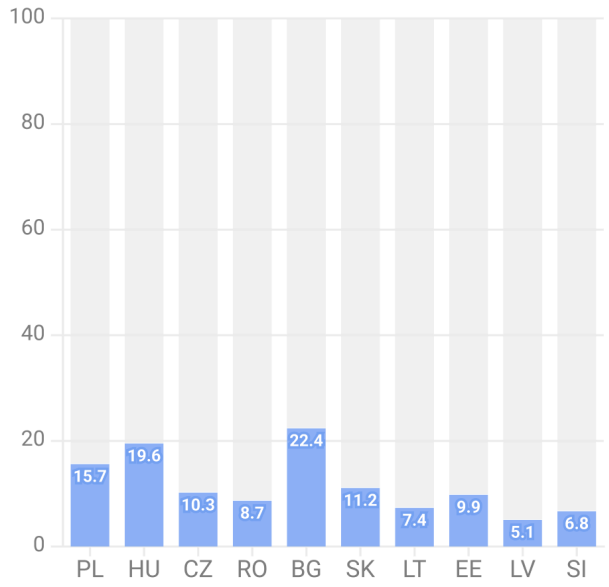
€14 billion on urban mobility projects

Cohesion spending on projects for residents in cities

€ million



% urban mobility share of transport total



Source: T&E, EC (2013, 2020)

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Case study: Romania

Small investment, big impact: urban mobility in Romania

One of Romania's priorities under the Regional Operational Programme (ROP) 2014-2020 eligible for EU funding was the promotion of sustainable urban mobility. Concretely, the programme's goal was to improve "urban public transport by attracting 140 million additional passengers per year in less developed regions". Romania recorded a 1.4 billion increase in passenger-kilometres for buses and coaches between 2014 and 2021. Before the covid pandemic hit, in 2019, the increase equaled approx. 8.4 billion pkm, a stark contrast with an average decrease of over 4 billion pkm in CEE states.

A noteworthy project involved replacing 30 old diesel buses in Cluj with new electric equivalents, while in parallel developing a new bus line to deal with the congestion in the city. The project cost was €17.6 million, with 72% sponsored by the EU. As a result of the project, travel time decreased by 22%. The technical speed of the buses increased from 9 to 28 km/h. The number of bus passengers' increased by 35%. Battery electric buses produce zero tailpipe pollution during operation, a huge step-up from the euro 0 diesel buses circulating previously. The battery electric buses reduced GHG emissions by a factor of 2.6. Even in the winter months, when the energy needs for electric buses are higher

T&E

compared to warmer periods, according to this study, they emit 29t CO_2 in well-to-wheels (WTW) in December, which is almost half the amount for diesel-powered vehicles.

In short, compared to the billions spent on motorways, as little as €12.7 million given by the EU and invested into sustainable urban mobility is able to contribute effectively and without delay to GHG savings, decrease air and noise pollution.

Case study: Hungary

More does not mean better: metro lines in Budapest

The €1.3 billion project - the M4 line in Budapest - has been marred in criminal investigations including local and European authorities and did not manage to reach the demand potential predicted by the feasibility study. The first cost estimate for the construction equaled €471.4 million. Ultimately, the project cost around €1.31 billion, or almost three times as much. The European Anti-Fraud Office (OLAF) found that €714.4 million worth of contracts - or over 60% - on the project were affected by financial irregularities, prominently including such big players as a French rolling stock manufacturer, Alstom, or Austrian construction company Strabag. Metro 4 line construction is the largest development project in Hungary during its EU membership and the biggest corruption scandal. Of the total cost, €473.5 million was financed by the EU's Cohesion Fund, €507.3 million from the Hungarian government, and €204.3 million by the City of Budapest, of which €39.3 million was from an EIB bank loan.

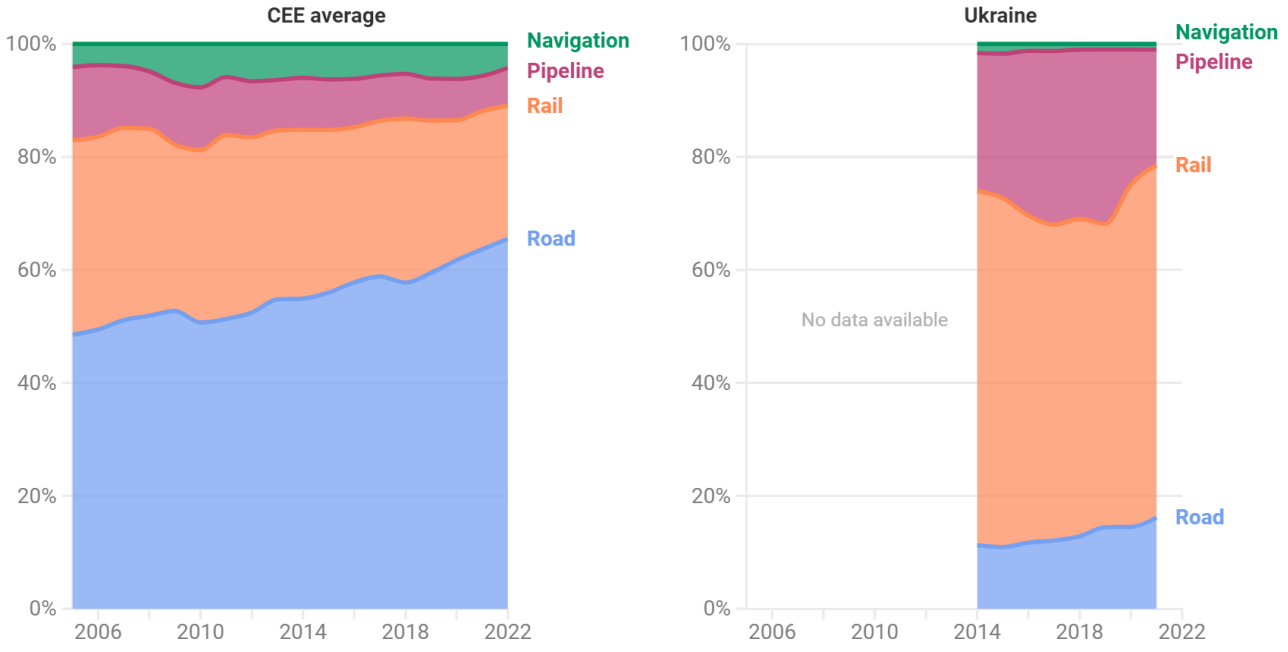
One of the main arguments against this mega construction was an existing well-developed bus line on the same route as the metro. The bus trip between the stations took around the same time as the metro trip, creating a useless duplication of routes and risking demand overestimation. To stimulate the demand for this line, an idea of the congestion charge was voiced as a way to deload the congested city of Budapest. This idea was also in line with an agreement between Hungarian authorities and the EU Commission on the provision of EU funds for the metro line construction. This conditionality has been contemplated by the local authorities in the form of zone-based charging toll but so far not implemented. Failure to deliver the charge, however, could result in the obligation of the government to at least partial repayment of the EU subsidy. T&E member, Clean Air Action Group in Hungary, are actively campaigning for the Budapest authorities to implement the urban road pricing system that has a potential to significantly improve air quality in Budapest.

Road freight doubled

As CEEs ascended, there was a growth in trade and transportation services due to the integrated market and increased investment volumes. Polish cabotage to Germany grew from 221 mln tkm in 2005 to 16.6 bln tkm in 2022. Lower labour cost, increased trade and logistics following accession because of free trade agreements between EU and accession states played a role for the hauliers from Poland, Romania, Bulgaria, and Lithuania to become prominent players on the freight transport operations market. As an example, wage costs of the Polish truck driver constitutes in 2019 quite a significant chunk, or more than 20% of the operating cost for a 40-tonne HGV operated on long distance international routes. Freight volumes of national entities by country of registration more than doubled in 2022 compared to 2005, an increase of 406 billion tkm. Territorial haulage volumes increased by a total 74.3% in the same period. In total, trucks added 29.4 $MtCO_2e$ in 2021, an increase of almost 139% in emissions compared to the baseline of 2000. With more than 50% share in the 2021 CEE emissions, the largest contributor to GHG emissions from heavy duty vehicles (HDVs) on the roads is Poland. Given the small share of trucks in the overall vehicle fleet with an average of 11% across CEEs in 2022, it clearly shows the GHG intensity of road freight. Meanwhile, the rail freight volumes for CEEs decreased in total by 6%.

Road freight activity has been increasing

Share of freight activity in tonne-kilometres



Source: T&E, EU Transport Statistical Pocketbook (2024) • Ukrstat
Note: Navigation for CEEs is inland waterways only. For Ukraine, statistics include coastal shipping

Intermodal transport underutilised

Intermodal transport refers to container transport that utilises multiple transport modes, such as road, rail, waterways, sea, and air, without the need to remove and place the contents in a different unit. As of 2015, the total intermodal transport in the EU stood at 534 billion tkm. Out of 3,092 billion tkm in 2015 of international intra-EU and domestic freight, it constitutes around 17%.

Intermodal freight, however, is more sustainable compared to its only road leg component. Freight trains emit up to 80% less GHG per tkm. They cause fewer external costs such as accidents, air pollution, noise, congestion, and habitat damage. For comparison, the total annual external cost of HDVs is €78 billion as opposed to €5 billion for electric or diesel rail freight. Using the EEA specific CO_2 emissions from rail at 21 gCO_2/tkm, road at 75 gCO_2/tkm and maritime at 51 gCO2/tkm, shifting only 5% of long haul road freight to rail, defined as trips over 300 km, could result in 3 $MtCO_2$ emissions savings. Shifting 5% road freight to maritime transport would produce around net 0.53 $MtCO_2$ of emissions savings.

Some of the main barriers behind the lower utilisation rates of intermodal transport included the lack of clearly set intermodal targets and strategy, missing infrastructure and facilities to handle goods and lack of real-time information-sharing about terminal capacity for freight forwarders. This correlates with a higher cost of handling intermodal goods with some estimates showing 50% markup on the logistics cost compared to the road freight.

Meanwhile, ERDF, CEF and CF allocations for the whole EU intermodal transport between 2014-2020 amounted to €1.1 billion. While for the all-encompassing category of "multimodal transport" in CEEs, which accounts for airport-road connections, but also for some share of intermodal disbursement, the figure stands at €1.65 billion. Poland, Hungary and Bulgaria each took roughly €500 million of that. As of 2020, Germany with its grant incentives for intermodal project beneficiaries has over 5 intermodal terminals per 10,000 km^2 while Poland only 1-2 and still lacking an intermodal strategy (see case study Poland). In Ukraine, the development of sustainable intermodal options is compelling due to the large distances for goods transport, existing inland waterways, ports and rail potential.

To introduce further incentives to shift long-haul freight from roads, distance-based tolling measures for heavy-duty vehicles should be introduced together with intensified development of road cameras and weigh-in-motion systems to control the vehicle weights. These fall under a category of intelligent transport systems (ITS). The introduction of an HDV toll has a potential to reduce GHG intensity of freight:

- by decreasing the number of empty headings of trucks;
- by promoting modal shift to rail or waterways for freight like in Switzerland
- by improving road maintenance and associated decrease in the vehicle fuel consumption.

We calculate that the Polish government could profit from additional €1 billion in budgetary

income from tolls by implementing the distance-based toll rates at the rate of Germany, at €0.18 per km in 2022 instead of only €0.06 per vehicle kilometre ceteris paribus. These additional revenues could be used to invest in road maintenance, in road construction and rehabilitation, and avoid concession contracts - as they could produce further difficulties with the implementation of more climate neutral EU tolling legislation and often entail higher than expected public investment cost. This is because a lot of those arrangements from CEE experiences end up being renegotiated, resulting in the government having to pay more to the private entity to maintain and operate the road infrastructure, in part, because the private actor overestimated the demand on the tolled road.

Case study: trucks to trains in Poland

Intermodal transport with rail legs in Poland transported 1.35 billion tkm in 2006, or 2.53% of the rail freight. In 2022, it was already 8.61 billion tkm, or 13.78% of the total rail freight performance. So the intermodal volumes grew more than five-fold. In twenty foot equivalent units (TEU) transported, they increased from 412 million TEU in 2006 to 2,800 million TEU in 2022. The average distance of goods travelled with intermodal rail leg decreased from 364 km in 2018 to 329 km meaning that shorter distances to transport goods were more frequently covered by rail freight.

There were some EU initiatives aimed at supporting intermodality in Poland. From 2000 to 2013, the total contribution to the development of intermodality in the west-central Greater Poland region amounted to more than €632 million with €171.4 million of EU contribution, so on average 27%. This region accounts for 14.35% of investment expenditures for intermodal terminals and 31.24% excluding the seaport investment. The money went in similar proportions both to the inland and seaside terminals with a smaller percentage of around 16% of total allocated for rolling stock purchases. Under the Operational Program 2014-2020, €262.8 million in total together with EU contribution went into intermodal transport, The majority of funds went into purchases of rolling stock and less into 9 terminals. CLIP, one of the largest logistics companies, was one of the beneficiaries.

One of the most recent big intermodal projects with a total value of 202.3 million PLN, or €48.3 million, co-financed by the European Union from the Cohesion Fund under the Operational Program Infrastructure and Environment 2014-2020 in Poland is Rail Mega Hub CLIP, in Jasin near Poznań. It is designed to handle up to 8 trains simultaneously with an annual throughput capacity of 533,000 TEU. For comparison, it will become the fourth largest terminal in terms of capacity after the maritime Baltic Hub Container terminal in Gdansk, BCT and Container terminals in Gdynia. For loading semi-trailers onto wagons without using reach stackers or cranes the company has introduced the special loading system - Modalohr which will allow to intensify the rail shipments of semi-trailers on the Bettembourg (Luxembourg) – Swarzędz (Poland) route. This, the company claims, will allow them to save more than 6 $ktCO_2$ monthly.

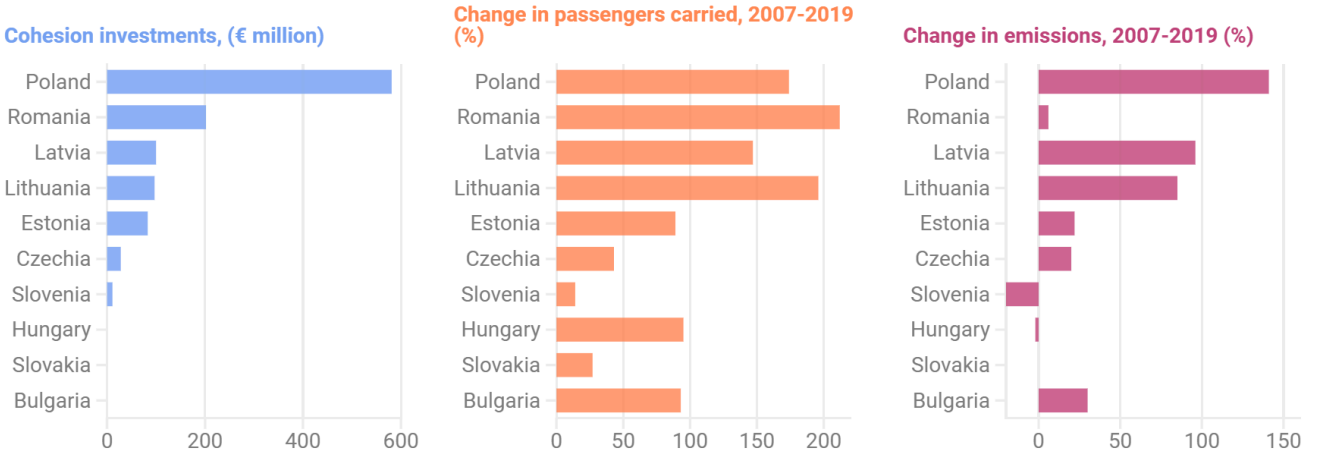
€1 billion went into airports

€1.1 billion of EU cohesion funds was channelled into airport infrastructure. Countries that benefited the most were Poland (almost €582 million), Romania, Latvia and Lithuania. CEE countries have boosted their airport capacity by building new terminals and runways. For example, EU funds contributed to the construction of Warsaw Modlin airport in 2012 and Bydgoszcz in 2014. However, some airport projects had a poor record value for money. The European Court of Auditors (ECA) study found that the utilisation rate of terminals was below the minimum benchmark after EU-funded expansion in Tallinn and Tartu airports in Estonia and Rzeszow airport in Poland.

Building and maintaining an airport diverts the much needed funds from low-carbon alternatives and creates additional demand for this energy-intensive transportation mode. This is especially the case with competing airports, which are located not far from each other. As a result of demand dispersion, one benefits from much higher numbers in passengers than the other. For example the airport in Lodz carried only 357,300 passengers in 2023 as opposed to Warsaw Airport with 3.4 million, although they are located only 140 km away from each other. This is despite the fact that Lodz airport was expected to have the largest passenger turnover. This suggests the need for the proper catchment area analysis in future investment planning to avoid double counting demand projections. Polish Rzeszów or Łódź airports also had to rely on state aid for infrastructure development and operation.

Airport investments increase passengers and emissions

Poland, Romania and Baltics out spent their peers



Sources: T&E, Eurostat, EC (2013, 2020), UNFCCC
Note: Emissions cover domestic and international scope.

Ukraine is currently holding talks with EU and American regulators to strategically open the sky

for civilian aviation at least for some airports in the West and Kyiv Boryspil. Some operators such as Polish LOT and Ryanair have already expressed their interest in resuming operations. The absence of a government-insured national operator and over €1.7 billion in reconstruction needs for airport infrastructure presents a challenge for the Ukrainian government. In 2021, Ukrainian airports Odesa, Lviv, Boryspil and Kyiv carried 11.8 million passengers over a period of 9 months, which over a year would be comparable to passenger numbers in Czechia. We recommend a strategic approach to airport reconstruction. It means calculating the expected demand volumes and the environmental cost of the project.

Case study: Hungary
EIB lending to Budapest Airport: a loan to fall

The European Investment Bank granted a €200 million loan for the expansion of Budapest's Liszt Ferenc International Airport in 2018. The plan was to increase passenger traffic by 50% over the next decade or so. In 2012 total passenger volumes were at 8.4 million annually and in 2019 they reached 16.1 million, a 91% increase. In 2023, passenger volumes were 10% lower than the 2019 peak. Hungary has the third most annual aviation passengers amongst the CEE countries. Its main airports are Budapest and Debrecen.

The EIB's internal complaints procedure found that there had been no proper environmental impact assessment conducted on the airport expansion with little to no engagement with the local community. The subsequent report concluded that before project implementation, there should have been at least screening conducted and measures suggested on how to deal with the increase in noise pollution. For example, the EIB should have had conditionality for its loans to ensure the government would mitigate the physical damage caused to houses - such as cracked walls and ceilings. The depreciation of property values from the increased noise pollution that caused health issues should have been anticipated.

Another issue that concerned not only NGOs but also European Anti-Fraud Office (OLAF) investigators was the seamless transfer of the former Vice President of EIB to a post at the Budapest Airport executive board without respecting the 12 month cooling-off period. The anti-fraud office alleges that the person might have received personal benefits from approving the loan.

Conclusions and recommendations

Cohesion funds were distributed based on the level of member state development and its economic growth expectations. Transport took a quarter of these funds. Roads were favoured over other types of investment for various reasons, the main one being the ease of absorbing money. Countries had more problems using up all the available funds for rail projects as they take a lot of time and planning to implement. As a result, the rail network stagnated, while fast roads thrived. Most of the rail money went into TEN-T rail projects. For roads, the distribution between TEN-T and non TEN-T investments was more even.

We saw that road investments led to an increased car ownership, passenger traffic and congestion with corresponding increase in emissions. There were, however, some improvements in the road safety. With the intensified logistics and open borders, road freight increased with national carriers performing much more transport from the East to the West. Intermodal transport projects promoting freight modal shift were not high on the agenda. Airports funds had questionable value based on the low demand projections. On the contrary, urban mobility projects - smaller in scale and managed locally - if executed properly, contributed successfully to transport emissions reduction and increased quality of public transport.

Our key learnings that Ukraine should heed from the €100 billion of EU funds that went to CCEs is:

1. Early strategic planning of transport projects is important as they get a large share of funding once the money becomes available;
2. Robust estimation of predicted demand on the transport mode makes a difference between sensible and unnecessary construction;
3. Smaller scale and decentralised projects typically lead to better outcomes than expensive and large undertakings with high expectations;
4. Extensive road building locks in long term demand and emissions from road transport.

The transport projects that Ukraine should prioritise this decade are those focused on urban transport, rail upgrades and electrification, road safety and maintenance and intermodal projects with high shift potential. Ukraine should avoid new road and airport construction and expansion and expensive construction projects with long time lines. For more specific policy recommendations, please consult the recommendation boxes below. EU stakeholders include the EU Commission, EU MS, EIB (European Investment Bank), EBRD (European Bank for Reconstruction and Development).

General recommendations for sustainable transport development in Ukraine

For EU stakeholders:

- Uphold conditionalities on the funds' disbursement that concerns the impact on environment and biodiversity. Do not disburse funds in case of violation, or ask for retribution of the sum.
- Establish performance criteria - in particular environmental or efficiency based metrics - to enable targeted disbursement through decentralised and transparent funds.
- Enforce the requirement for data-based analysis and strategic environmental assessment (SEA), environmental impact assessment (EIA), and alignment with the EU Taxonomy and do no significant harm (DNSH) principle for major transportation projects as a conditionality for funds disbursement and allocation.
- Provide technical assistance and capacity-building on the investment prioritisation and cost-benefit calculations in the context of transport decarbonisation.
- Ensure and promote public participation in the consultation at the project conception phase, especially for large infrastructure projects with potentially significant environmental and social externalities.
- Ensure stable funding for projects and assist national governments to establish the best management frameworks by sharing lessons learned from previous infrastructure projects.

For the Ukrainian government:

- Systematically collect, store and publicise relevant transportation and projects data.
- Use international price methodologies for tenders and project documentation.
- Ensure transparency and adequate public consultation during project development.
- Develop and implement credible measures to counter externalities stemming from the project, such as air, noise, and pollution.
- Measure the ex ante implementation effects of the transportation projects with regards to their demand, climate and socio-economic impacts by conducting data-based analysis, SEA (EIA), aligning the investment with the EU Taxonomy and DNSH principle.

Road transportation in Ukraine

For EU stakeholders:

- Prioritise TEN-T core network road projects. Do not use EU funds for road network expansion projects outside the TEN-T network. Road building contributes to congestion and emissions lock-in.
- Make EU funds conditional on improvements to road safety and ensure dedicated funding for road maintenance, which contributes to road safety.

For the Ukrainian government:

- Implement and enforce a comprehensive distance-based road tolling system on heavy-duty vehicles compliant with the Eurovignette directive. Avoid concession contracts, particularly long term contracts with guarantees of traffic and revenues.
- Implement the EU 2030 and 2035 light duty vehicle (LDV) CO_2 standards and the 2030, 2035 and 2040 HDV CO_2 standards that cover the sale of new vehicles.
- Prioritise road safety and maintenance, corresponding improvements to road infrastructure and intelligent transport systems (ITS) as well as developing a robust regulatory framework.

Rail projects

For EU stakeholders:

- De-prioritise the construction of high speed lines as they are much more expensive and emphasise speed over connectivity.
- Prioritise rail investments that integrate the Ukrainian rail network into that of the EU, including modernisation of rolling stock, electrification, and signalling.
- Allocate funds to support rail maintenance and performance.
- Provide financial support to develop transshipment facilities, including cranes and sidings for the intermodal hubs that aim at modal shift aligned with emission reduction and performance criteria.

For the Ukrainian government:

- Prioritise rail investments that integrate the Ukrainian rail network into that of the EU, including modernisation of rolling stock, electrification, and signalling.
- Establish a sound evidence-based regulatory framework for promotion of intermodality with an increased share of rail and waterway freight transport. This strategy should outline the legislative steps and targets required to maximise the shift of road freight to rail or inland waterways.
- Enact measures to have real-time data-sharing with authorities and logistics operators on intermodal terminal capacity. This would alleviate delays, which are major investment hurdles.

Urban transport

For EU stakeholders:

- Give greater priority to sustainable urban mobility investments. These can include the replacement of old diesel buses, the development of bike paths and rapid urban transportation systems.
- Disburse funds based on criteria that align with decarbonisation goals, connectivity - for example transport poverty reduction - and other performance metrics
- Allow local government entities to apply directly for funding.

For the Ukrainian government:

- Allow local government entities to apply directly for EU funding and give them direct responsibility for achieving their sustainable urban mobility plans and outcomes.
- Prioritise urban mobility and public transport investment over road investment.
- Avoid duplicating urban transport infrastructure if there is a well-functioning connection in place. Consider the case of the Budapest metro, for example.

Airports

For EU stakeholders:

- Do not allocate EU funds for airport expansion and capacity increase.

For the Ukrainian government:

- Strategically approach airport reconstruction weighing the expected demand volumes and the environmental cost of the project.
- Focus primarily on international connections instead of domestic.
- Perform a proper demand and catchment area analysis before investing in airport infrastructure. This will avoid constructing or expanding airports that due to their proximity, will disperse the demand between each other, for example in Poland.

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Annexes

Annex 1

Cohesion funds: background information

Cohesion funds aim to reduce disparities between various regions with different levels of development. They are allocated in a 7-year cycle together with the multi-annual strategic planning. In this report, we included the following funds to calculate the total:

- European Regional Development Fund - ERDF
- Cohesion Fund - CF
- European Social Fund - ESF
- European Agricultural Fund for Rural Development - EAFRD
- European Maritime, Fisheries and Aquaculture Fund - EMFF
- Youth Employment Initiative - YEI

The eligibility criteria are decided based on gross national income (GNI) per capita. Those member states whose GNI per capita is below 90% of the European average are considered to be eligible for disbursements of the funds. For recently acceded member states, the financial contributions are capped at 3.6% of their gross domestic product (GDP) for the period 2007-2013 and at 2.5% for the period 2014-2022. Member states are usually responsible for preparing, implementing, monitoring and evaluating the programmes. For this purpose, MS usually produces National Strategic Reference Frameworks (NSRF) and operational programmes. After the European Commission's approval, the projects are chosen, managed and operated by each MS. The EU financial allocations are determined based on relative socio-economic conditions such as GDP per capita, unemployment rates, educational level. The Commission encouraged the development of national cost-benefit analysis (CBA) frameworks, having also provided the *Guide to Cost-Benefit Analysis* as well as a methodology to be used. This includes a financial discount rate of 5%, as a benchmark to compare the discounted benefits, as well as social discount rates according to different target regions.

Other financing instruments for new member states

There has been some pre-accession help disbursed in funds to new MS (particularly, PHARE and ISPA were earmarked for infrastructure investment, SAPARD for rural development). PHARE, ISPA and SAPARD were substituted by the Instrument for Pre-Accession Assistance in 2007. For example, around €40.8 billion for new member states were released for the period 2004-2006. Between 2000 and 2003, €13.2 billion were disbursed in pre-accession expenditure.

Cohesion and RRF: substitution effects

It is difficult to say conclusively that there was a large substitution effect observed between the Cohesion and RRF funding in MS for the 2014-2020 period. Due to the absence of national co-financing conditionality in RRF investments, some member states such as Spain, Greece,

Italy and Romania, moved their mature projects from Cohesion to RRF finance to be completed in the following 2021-2027 period.

Annex 2: justification of recommendations

Why does Ukraine need to prioritise transport projects in general?

Firstly, given that transportation projects alone require plenty of money in spending for recovery and being under the severe budget constraint, Ukraine would need to prioritise the allocations to transport projects one way or another. It is best if the transport priorities would be shaped by their economic, social and environmental sustainability. Moreover, promotion of sustainable projects before the capital expenditure stage can help to avoid the need to allocate an operational budget on projects of poor choice in the future. For instance, investing in a new highway will also incur socio-economic costs of accidents, road maintenance, increased cost of congestion and induced traffic demand resulting in higher environmental damage. So it is time to choose wisely now.

Secondly, transport areas we highlighted as priorities are already reflected to some extent in the EU legislation. Hence, Ukraine needs to hop on this legislative train before it is too late. The focus on sustainable mobility promotion and rail investment is in line with the EU legislation, in particular, recent TEN-T revision. For example, it makes Sustainable Urban Mobility Plans mandatory for at least 424 EU urban nodes by 2025, highlights modal shift for passenger transport and prioritises multimodality.

Why prioritise urban mobility?

The top of our investment recommendations is urban mobility and public transportation. Currently, it is at the bottom of Ukraine Plan priorities. An average age of trams of over 30 years and speeds below 15 km/h, outdated rolling stock and infrastructure, and inconsistent regulatory framework, Ukraine needs to start taking urban mobility seriously.

- ➔ It should start from implementation of the public Service obligation regulation 1370/2007 to make public transportation systems more efficient, harmonised and environmentally friendly.
- ➔ As in the case with Romania, a simple purchase of the zero-emission stock (buses, trolleybuses or trams) could be hugely beneficial, although it does not require the same levels of financial investment as large infrastructure projects. This goes to show a small investment can have a big impact.

Investing in public transportation will enable efficient and affordable transport options in cities. This can impact a high proportion of people in their daily lives. For Ukraine, this is especially important, given that due to war and economic circumstances. The proportion of the population in Ukraine living in poverty increased from 5.5% to 24.1% in 2022, according to World Bank. Removing bottlenecks to access to the job market, healthcare and education by ensuring

infrastructure accessibility for the population in the lower income category will greatly benefit both commuters and the economy.

Why prioritise rail infrastructure?

Rail investments feature high on the agenda for the Ukrainian government at the moment due to the need to integrate the Ukrainian and EU rail networks in line with recent TEN-T revision. However, upgrading the TEN-T rail networks and rolling stock is included together with urban mobility into a "potential investment area" instead of being unequivocally highlighted as the priority for the government.

- ➔ From the €350 million that Ukraine are expected to be budgeted for for 2026-2027 transport projects for the reconstruction, restoration, modernisation and upgrade of damaged and destroyed transport infrastructure facilities, there is no specifics on the amount to be allocated to rail. Moreover, one of the investment categories are roads and aviation. As we show with this report, rail networks should be properly developed and maintained to achieve modal shift and avoid negative environmental consequences as well as to allow for the economies of scale in freight transport.
- ➔ For rail to become more attractive and more competitive, the Ukrainian government needs to establish institutional frameworks that balance the issue of liberalisation with efficiency and accessible public service provision, i.e. as achieved in Czechia.

Why prioritise road safety?

More than 9700 civilians died from the Russian invasion from February 2022 to September 2023, and over 3000 people from car crashes in 2023. Ukraine needs major investments into road safety: road cameras and road maintenance for the most problematic road sections, audits, inspection, speeding regulations, statistics-sharing, awareness campaigns, action plans etc. Both the EBRD and the EIB had some projects initiated that aimed to help alleviate the accident and fatality rates on Ukrainian roads. The situation, however, did not get better, as currently roads are dual-use arteries for military logistics. To ensure efficiency of funds utilisation, the EU should require road safety to be prioritised in the partnership agreements with UA.

Why prioritise intermodal projects?

Intermodal projects could be risky and expensive to execute without additional financial support from the government. The EU and Ukraine should collaborate on providing financial support and establishing regulatory frameworks for businesses that are willing to do that if their investment is expected to shift road freight to rail or inland waterways.

Why does Ukraine need to measure and analyse data on transport?

Data-driven and assessed investment will contribute positively to the reconstruction of Ukraine in many ways. Firstly, collecting, storing, systematising and analysing data concerning transportation in general along with the costs and benefits of transport projects, in particular, will enable better decision-making and project selection. It will also enable Ukraine to conduct ex post assessments of the project's feasibility and compare the predicted output to the realised one. In case of the big divergence, lessons learnt could be drawn and applied to the following project conception.

Secondly, making this data public contributes to transparency and accountability. This is one of the concerns raised by international partners when investing into Ukrainian green recovery under the umbrella term "business-enabling environment". Ensuring transparency will lead to a more robust system of checks and balances giving meaningful space for the voices of civil society, attracting the private sector and potential investors. It will in turn hold the government even more accountable for the decisions taken. Creation of the DREAM platform, digitalisation of procurement through PROZORRO tendering system and adoption of fixed prices, international measurement methods (primarily CESMM) for roads are steps in the right direction. They should be used indiscriminately towards all projects.

Thirdly, conducting data and environmental impact analysis of transportation projects will help donors, investors and government assess the necessity, outcomes and sustainability of the intended infrastructure construction. It will avoid the carbon lock-in effects of the unnecessary and polluting projects. So it should be a conditionality under the disbursement of any funds to Ukraine. Unfortunately this requirement was dropped from the Ukraine Facility Plan. Bulgarian motorway development and EIB loans to Hungary showed that this makes the monitoring and conducting sustainable recovery very difficult. However, the "do no significant harm" (DNSH) principle was mentioned in the Plan, particularly in the section on road development. The definition and modalities of its application, therefore, should be consistent with the EU Green Taxonomy Regulation 2020/852 (article 17).

Finally, making robust cost and benefit estimates, comprehensive risk assessment, scope management and change control for the project could help avoid cost overruns resulting from inaccurate initial estimates as they entail an increased risk for failed project delivery and fiscal burden for the state.

Why does Ukraine need to implement the polluter pays principle?

For LDVs: Since there have been legislative initiatives on the state level that made second-hand car imports from abroad possible under a more preferable taxation regime, after 2035, when the ban on new petrol and diesel car sales takes effect, we could expect an immediate spike in the number of those vehicles in the Ukrainian market. They already take more than 75% of the

primary car market as a conservative estimate. The EU ambition to get rid of the *burners* accompanied by the legislative loopholes or vacuum from the Ukrainian side would result in intensification of import flows of higher-emission older vehicles to Ukraine. This is why Ukraine requires more ambitious enforceable CO_2 targets for LDVs and schemes that promote disposal of the older and less efficient vehicles. Otherwise, it risks becoming the *dumping ground* for more polluting vehicles as some CEEs experience loudly implies with the past trends of dieselisation.

For HDVs: EU countries represent a patchwork of different road tolling rules and network coverage on HDVs. Schemes include distance- or time-based vignettes, with varying fees based on Euro class CO_2 emissions. For future candidate states it is important to implement road pricing according to the EU legislative guidelines and based on the implementation of the "polluter pays" principle. This makes sense for several reasons:

- the potential for raising funds to sponsor further decarbonisation activities and investments into green recovery;
- Need to sponsor road maintenance costs and bridge rehabilitation. This is already a problem in Ukraine given the dual use of roads, tunnels and bridge infrastructure for military, civilian and trucking purposes;
    a) Heavy-duty vehicles with high undistributed gross vehicle weight put an excessive stress on the bridge and decrease its functional lifespan.
    b) Since the development of the weigh-in-motion systems in Ukraine is only beginning to unfold, it is important to prevent further damage to the already "tired" bridge infrastructure.
- The contribution to the greening of the trucking industry and provision of incentive for companies to buy zero-emission vehicles: battery electric or fuel cell on green hydrogen;
- Compliance with the EU legislation and Eurovignette reform on HDV road charging
    a) The most recent revision of the Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructure, known as the Eurovignette Directive, included the requirement for the vignettes, or time-based charging, to be phased out in favour of the distance-based tolls by 2032 at the latest.
    b) From 2024, the recent revision requires national governments to apply CO2-based tolling for HDVs, or varying tolls, e.g. infrastructure charges, according to pollutant emission standards.

In terms of modality of implementation, we recommend ensuring the wide coverage of the road network by the toll as well as avoiding concession contracts. In case this is not possible, make sure that the toll for HDVs will be accounted for at the preliminary negotiation stage.

Annex 3: Methodological notes

Conversion rates

Used from the official ECB reference rates (1999 to 2023/4)
€1 = 4.1850 zł (PLN)
€1 = 381.85 Ft (HUF)
€1 = 27.891 Kč (CZK)
€1 = $1.09 (USD)

Categorisation of funding mechanisms

The information on the cohesion funds is provided in two time tranches: 2007-2013 and 2014-2020. We aggregated the provided information by priority descriptions per mode of transport. Accounting only for the EU contribution, the total transport cohesion stands at €101.3 billion when calculating per mode. This amount increases to €104 billion when calculating the 2014-2020 period relying on the objective *promoting sustainable transport*. Accounting both for national and EU contribution in 2014-2020, this amount rises to €109 billion. The average EU co-finance rate for transport-related expenditures stood at around 85%, based on the reporting during the 2014-2022 period. This number is in nominal terms, i.e. it is not adjusted for inflation, as per all monetary figures used in this report.

The following table details the categories that fell under our definition of transportation investments.

Modes of interest (cohesion period 2007-2013):	*Modes of interest (cohesion period 2014-2020):*
Roads: 20 - Motorways 21 - Motorways (TEN-T) 22 - National roads 23 - Regional/local roads **Rail** 16 - Railways 17 - Railways (TEN-T) 18 - Mobile rail assets 19 - Mobile rail assets (TEN-T) **Airports** 29 - Airports **Water transport** 30 - Ports 31 - Inland waterways (regional and local)	**Roads:** 028 - TEN-T motorways and roads - core network (new build) 029 - TEN-T motorways & roads - comprehensive network (new) 030 - Secondary road links to TEN-T road network (new build) 031 - Other national and regional roads (new build) 032 - Local access roads (new build) 033 - TEN-T reconstructed or improved road 034 - Other reconstructed or improved road **Rail:** 024 - Railways (TEN-T Core) 025 - Railways (TEN-T comprehensive)

32 - Inland waterways (TEN-T) **Urban mobility** 24 - Cycle tracks 25 - Urban transport 52 - Promotion of clean urban transport **Multimodal transport** 26 - Multimodal transport 27 - Multimodal transport (TEN-T)	026 - Other Railways 027 - Mobile rail assets **Airports:** 037 - Airports (TEN-T) 038 - Other airports1 **Water transport:** 039 - Seaports (TEN-T) 040 - Other seaports 041 - Inland waterways and ports (TEN-T) **Urban mobility:** 043 - Clean urban transport infrastructure & promotion 090 - Cycle tracks and footpaths **Multimodal transport:** 035 - Multimodal transport (TEN-T) 036 - Multimodal transport

To calculate the transport share in the total cohesion allocations:

- for 2007-2013, we aggregated the cohesion data per fund ERDF/CF/ESF per MS
- For 2014-2020, we aggregated the cohesion data per fund ERDF/ESF/CF/EAFRD/EMFF/YEI per MS

To calculate the transport share, we calculated the cohesion allocations per economic activity or theme:

- for 2007-2013, economic activity *transport*
- for 2014-2020, the theme *Network Infrastructures in Transport and Energy* or objective *Promoting sustainable transport and removing bottlenecks in key network infrastructures*

Some allocations for transport were under the *construction* category in the 2007-2013 period (e.g. funds for railway construction). While others - under the *Low-Carbon Economy* theme or *Multiple Thematic Objectives* in the 2014-2020 period (e.g. urban transportation). Hence, we double checked the allocation for transport with our per category calculations that we mentioned above. Note that some transport-related allocations were also included in the cohesion funds under other priority descriptions, such as *intelligent transport systems*, but were not included in our calculations per mode. Despite these discrepancies, the overall deviation in terms of transport share calculation was rather limited - under 1%, floating around 24% and 25% share of transport in total cohesion allocations of CEE states in the 2007-2020 period.

On the CEF allocations - the latest period available was analysed for the Subprogramme CEF Transport - 2014-2023 with latest data from May 2024. As of May 2024, the total EU funding under CEF Transport to CEEs equaled €16.7 billion.

The following table is a classification dictionary for TEN-T:

2007-2013	Category	2014-2022	Category
20 - Motorways	roads	028 - TEN-T motorways and roads - core network (new build)	TEN-T roads
21 - Motorways (TEN-T)	TEN-T roads	029 - TEN-T motorways & roads - comprehensive network (new)	TEN-T roads
22 - National roads	roads	030 - Secondary road links to TEN-T road network (new build)	roads
23 - Regional/local roads	roads	031 - Other national and regional roads (new build)	roads
16 - Railways	railways	032 - Local access roads (new build)	roads
17 - Railways (TEN-T)	TEN-T railways	033 - TEN-T reconstructed or improved road	TEN-T roads
18 - Mobile rail assets	locomotives	034 - Other reconstructed or improved road	roads
19 - Mobile rail assets (TEN-T)	locomotives	024 - Railways (TEN-T Core)	TEN-T railways
		025 - Railways (TEN-T comprehensive)	TEN-T railways
		026 - Other Railways	railways
		027 - Mobile rail assets	locomotives

Detail on Ukrainian recovery needs

The following table is a classification dictionary for Ukrainian recovery needs and cohesion allocations. Note that the multimodal transport category for cohesion allocations was classified under the category “Other”:

Category	Need (in USD million)	category
Road bridges (national roads)	$7,270.6	Road
Road bridges (local roads)	$898.0	Road
Motorways, highways and other national roads	$21,526.8	Road
Oblast and village roads	$5,091.5	Road
Communal roads	$7,065.0	Road
Airports	$1,677.5	Airport
Railway tracks, bridges, stations and electrical	$13,637.9	Rail
Railway rolling stock	$2,522.4	Rail
Railway equipment and other assets	$1,430.7	Rail
Private vehicles	$4,205.4	Other
Ports and inland waterways infrastructure	$688.8	Water transport
Urban public transport (rolling stock, infrastructure, depots, maintenance vehicles)	$5,241.4	Urban mobility
Debris removal	$189.1	Other
National road and bridge repair	$624.2	Road
Local road and bridge repair	$413.9	Road
Communal road and bridge repair	$201.1	Road
Equipment for repair and maintenance of national and regional roads and bridges	$0.8	Road
Railway infrastructure repair	$272.2	Rail
Railway rolling stock and equipment	$148.2	Rail
Urban transport infrastructure repair	$72.1	Urban mobility
Urban transport rolling stock and equipment	$197.8	Urban mobility
Border crossing point expansion	$255.4	Other
Inland waterways infrastructure repair and Danube River port expansion	$52.4	Water transport
Aviation	$1.5	Airport

Category	Need (in USD million)	category
Total	**$73,684.7**	

Productivity loss resulting from congestion during rush hours

Formula used to calculate the productivity loss per person:

*Congestion loss per person = hours lost * hourly wage * labour force participation (%) * total employment or (1-% unemployment rates)*

Formula used to calculate the total productivity loss:

*Congestion loss total = congestion loss per person * number of vehicles (motorisation rates per 1,000 * number of inhab. / 1000) * vehicle occupancy*

Assumptions:

1. We base on the assumption that the hours lost in traffic annually reflected in TomTom index could have been applied productively in a work-related manner. The index calculates the hours lost in rush hour driving a 6 minute or 10 kilometre journey that occurs when people commute to or from work twice per day. The index reports the cumulative hours lost per year of 230 roundtrips.
2. We base on the assumption that the city-level motorisation rates are comparable to the NUTS2 motorisation rates. So in some cases, it could lead to over or underestimation of the number of passenger vehicles active in the city. We apply average vehicle occupancy per country to the city scenario, as this is the data we found available.

Some examples:

1. In Wroclaw the productivity loss per person is higher than in e.g. Bucharest, which ranked higher in terms of hours lost, because the labour force participation and the labour wage is higher in Wroclaw.
2. In Warsaw, the total productivity loss is higher than in Bucharest because motorisation rates are higher, so more people could be potentially affected by the increased congestion, or ultimately they themselves contribute to it by using cars to commute.