KTI Institute for Transport Sciences Non Profit Ltd.
Research Centre for Transport Development

Final report

Calculation of eligible costs for single wagonload transport

KTI Institute for Transport Sciences Non Profit Ltd.
Research Centre for Transport Development

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1 Introduction

The regulation regarding state aid rules in the EU is an essential part of the competition policy. Dismantling the obstacles of the free competition, thereby creating the single market within the EU is among the main objectives of the European integration, since the competition is the core requirement of the market economy maintaining it is in the best interest of the Community.

The Community guidelines on State Aid for railway undertakings 2008/C 184/07 (hereinafter referred to as Guidelines) assumes that the railways have unique advantages: they are a safe and clean mode of transport. Rail transport therefore has great potential for contributing to the development of sustainable transport in Europe.

However, it concludes that the rail transport in Europe has an image problem, and there is still a long way to go for rail transport to become sound and competitive. Particularly in the rail freight transport sector there continues to be major difficulties, which call for public-sector action1. Section 6.2. of the Guidelines define the general criteria of the aid for the coordination of transport, under which the compatibility with the Treaty on European Union and the Treaty on the Functioning of the European Union can be ascertained, and section 6.3. sets out the specific forms of aid pursuant to subparagraph 102 the eligible costs are the additional costs for infrastructure use paid by rail transport but not by a more polluting competing transport mode. Pursuant to subparagraph 103 on State aid for railway undertakings, those parts of the "aids provided for the reduction of external costs" can be considered as eligible costs, due to which the external costs can be avoided, because the rail transport is used in the place of another mode of transport.

Article 73 of the Treaty on European Union and the Treaty on the Functioning of the European Union provides that those Aids shall be considered as compatible with the Treaties if they meet the needs of coordination of transport. The European Court of Justice has ruled that this Article "acknowledges that aid to transport is compatible with the Treaty only in well-defined cases which do not jeopardise the general interests of the Community"[2].

In principle, aid, which meets the needs of transport coordination, has to be considered compatible with the Treaties, if they are deemed necessary and proportionate with regard to the aim being pursued. Furthermore, the distortions of competition created by the aid shall not jeopardise the general interests of the Community. In view of the rapid development of the transport sector, and hence the need for coordination, any aid notified to the European Commission has to be limited to a maximum of 5 years, in order to allow the European Commission to re-examine it after 5 years, in the light of the results obtained and, where necessary authorise its renewal.

According to the Guidelines, the authorized aids shall not be cumulated with other state aid or with other forms of Community financing if such overlapping produces an aid intensity higher than that laid down in these guidelines. In the case of aid serving different purposes and

[1] Communication from the Commission, Community guidelines on State aid for railway undertakings (2008/C 184/07), 2008.07.22.

[2] Consolidated version of the Treaty on European Union and the Treaty on the Functioning of the European Union (2012/C 326/01)

involving the same eligible costs, the most favourable aid ceiling will apply.

As regards the railway industry more specifically, aid for the needs of transport coordination can take several forms:

a) aid for infrastructure use (30 % of the total cost of rail transport, up to 100 % of the eligible costs), that is to say, aid granted to railway undertakings which have to pay the expenses for the infrastructure they use, while other undertakings providing freight transport services based on other modes of transport do not have to pay for such expenses;
b) aid for reducing external costs (30 % of the total cost of rail transport, up to 50 % of the eligible costs), designed to encourage a modal shift to rail freight transport because it generates lower external costs than other modes such as road transport;
c) aid for promoting interoperability (50% of the eligible costs), and, to the extent to which it meets the needs of transport coordination, aid for promoting greater safety, the removal of technical barriers and the reduction of noise pollution in the rail transport sector, (hereinafter referred to as "interoperability aid");
d) aid for research and development in response to the needs of transport coordination.

In accordance with Article 105 of the Guidelines, for providing aid for both the use of rail infrastructure and for reducing external costs, the Member State shall provide a transparent, reasoned and quantified comparative cost analysis between rail freight transport and the alternative options based on other modes of transport.

For both aid for rail infrastructure usage and reducing external costs, the aid has to be strictly limited to compensation for opportunity costs connected with the use of rail freight transport rather than with the use of a more polluting mode of freight transport. Since there are several competing options, which cause higher levels of pollution than rail transport, the limit chosen corresponds to the highest cost differential among the various options.

The Final Report defines the eligible costs and describes the calculation method of the costs.

In the process of drafting the final report, we used the studies[3] on the preparation of the directed financial aid, granted by the EU, for introducing the single wagonload transport train in Austria.

[3] Schieneninfrastruktur Dienstleistungsgesellschaft mbH, Leitfaden für die Gewährung einer Beihilfe des Bundes für die Erbringung von Schienengüterverkehrsleistungen in bestimmten Produktionsformen in Österreich
Aufruf zur Antragstellung auf Beihilfengewährung für den Zeitraum 01.01.2017 bis 31.12.2017, 16.08.2016

2 Calculation of eligible costs for single wagonload transport

In this chapter we will present the methodology for the calculation of the potential amount of aid provided for the railway infrastructure usage and for the reduction of external costs, and we will assess the cost of production and the infrastructure usage of the road freight transport and the single wagonload transport train. As a result of the assessment we will determine the maximum amount of the potential financial aid, which can be provided for the infrastructure usage of the single wagonload transport train.
In the second part of this chapter we will determine the scope of the external costs and we will elaborate the methodology for the calculation of expanses for the national road and rail traffic. As a result of the calculation we will determine the external costs of the single wagonload transport train and the road freight transport, and from the use of these results we will be able to determine the maximum amount of the aids, which can be provided for the reduction of the external costs. Finally, we will summarize the contents of the chapters and we will determine the potential amount of the aids in accordance with the Directive of the European Council.

2.1 Elaborating the methodology for determining the potential amount of aids

The current system of the single wagon load train, including its regulatory environment, cannot ensure the sustainability of the segment, since the rail freight transport companies realise significant losses annually. Due to the fact that it cannot produce the requested results, the segment lacks the essential developments, which would be required for maintaining a high professional standard, requested by the clients, hence the freight transport performance of the single wagonload transport train is gradually decreasing, which increases the volume of the road freight transport.

2.1.1 Methodological base for determining the potential amount of the aids

In accordance with the guidelines of the Commission on State aid for railway undertakings, the following assessments have to be carried out:

- Comparison of the cost of production and the infrastructure usage of rail and road freight transport. The detailed methodology will be described in Chapter 2.2.;
- Comparison of the external costs of rail and road freight transport. The detailed methodology will be described in Chapter 2.4.;

The following costs, which are representative for the railway segment, will be presented:

- freight transport carried out by single wagonload transport train;

Concerning road freight transport:

- Full Truckload freight transport.

The costs will be divided by the following types of traffic (product group categories, for transit it is not applicable):

- domestic;
- export/import.

In the rest of this chapter we will only focus on the methodological base regarding the calculation of the cost of production and the infrastructure usage of rail and road freight transport.
For the calculation of the cost of production and the infrastructure usage for both rail and road freight transport, we created a standard cost model in order to assess, with the use of representative calculations, the results required for the comparison. As the result of the cost calculation, we obtained the unit cost of production in tonnes/km. The presented cost values of the freight transport sector (cost of production) refers to the year 2018.

For identifying and comparing the unit costs of the production and the infrastructure usage of road and rail freight transport, in so far as the cost of road freight transport includes the "door-to-door" transport operation, we shall also determine the unit cost of production of the "door-to-door" operation of freight transport carried out by single wagonload transport train, hence the unit cost of initial and terminal road leg of these operations shall also be determined.

Regarding the road freight transport carried out by heavy goods vehicles, we took into consideration those costs which can be found in relevant literature or received from the Hungarian advocacy associations. The cost calculation of road freight transport also included the costs of short range transport operations, which in the case of rail freight transport are taken into consideration via the cost of the initial and terminal road leg of these operations.
For identifying the unit cost of production of rail freight transport, we used the cost calculation manual of Rail Cargo Hungaria (RHC), which is a market leader in the single wagonload transport train sector with an 87% market share. We are assuming that other actors of the market have similar costs. For respecting business secrecy, the cost model takes into consideration the unit cost of production per tonnes/km, which was deducted from the business model of RHC, and then the results were transposed to the freight transport performance of the other actors of the market. Table 1 contains the different costs, which were used for identifying the cost of production and the use of infrastructure of rail freight transport.

Table 1: different elements of the operating costs and the infrastructure charges of rail transport
(source: on the basis of RCH edited by KTI)

Expanses	Detailed expenses
fee of access to network/ use of railway	fee of basic services (fee of providing train path, costs of operation, fee of using the overhead contact line, other charges of access to network), fee of ancillary services (fee of using station, storing trains, weighing, shunting/arranging services provided by the operator of the network), further charges for accessing the network, charges of using terminal tracks, charges of operating a rail track network
traction fee	operating charges paid for the services ordered (charges of continuous availability or charges of occasional traction services, rental charges of a locomotive, availability charges of the locomotive, traction energy charges, capacity availability charges, other contractual charges) expenses of carrying out traction operations by own asset (rental fee of a locomotive, maintenance expenses, remunerations of the drivers)
shunting/arranging charges	shunting energy, ordering a shunting locomotive from a different service provider (not from the operator of the network), expense of the shunting personal
wagon park expenses	wagon maintenance expenses, rental fee of wagons, depreciation costs, user charges of the freight wagon
wagon service fee	wagon inspection charges, border procedure charges (re-consignment charges and charges of adjusting axles to differences of track gauge) transfer expenses, other expenses related to wagon services
business tax and innovation contributions	
other company expenses	expanses of corporate governance, general operating expenses and commercial expenses

The production costs and the infrastructure usage costs are determined by the costs demonstrated in Table 2.

Table 2: different elements of the operating costs and the infrastructure charges of road transport
(source:[4] on the basis of the source, edited by KTI)

Expenses	Detailed expenses
toll	toll and congenstion charges
vehicle related taxes	tax on accidents, road-tax
insurance fees	liability coverage, collision or comprehensive insurance, liability insurance
different expenses related to the availability/operating of the vehicle	lease payments, depreciation, maintenance, servicing
specified personnel costs related to the vehicle	remuneration costs, daily allowances
other expenses related to the operating of the vehicle	onboard IT system, control and communication, fuel
other company costs	

2.1.2 Methodology of determining the amount of eligible aid

Concerning the determination of the maximum amount of eligible aid, we proceed from the Communication of the Commission (6.3.2) (107) [5] [6]:
„The Commission considers that there is a presumption of necessity and proportionality of the aid when the intensity of the aid stays below the following values:
a) for aid for rail infrastructure usage, 30 % of the total cost of rail transport, up to 100 % of the eligible costs;
b) for aid for reducing external costs, 30 % (6) of the total cost of rail transport, up to 50 % of the eligible costs;
c) for interoperability aid, 50 % of the eligible costs."
For the interpretation of the referred paragraph, we shall be aware what is considered eligible by the communication concerning the infrastructure usage and external costs. Regarding the infrastructure usage paragraph 102 provides the answer: "*As regards aid for rail infrastructure usage, the eligible costs are the additional costs for infrastructure usage paid by rail transport but not by a more polluting competing transport mode*." Since the Communication mentions additional costs, we shall define the infrastructure costs of the more polluting competing transport mode (in our case road transport) and the costs of railway infrastructure usage, and 100% of the difference can be compensated.
Regarding the external costs, paragraph 103 defines eligible costs as follows: "*As regards aid for reducing external costs, the eligible costs are the part of the external costs which rail transport makes it possible to avoid compared with competing transport modes..*" In this case we again have to compare it to the competing transport mode, in our case to road transport.

[4] Annmária Horváth, György Karmazin: International road freight transport and haulage, Textbook, Akadémiai Kiadó, 2014. ISBN 9789630595735

[5] Communication form the Commission Community guidelines on State aid for railway undertakings (2008/C 184/07), 2008.07.22.

Those external costs, which can be avoided by the use of railway, are the differences of the external costs of railway and road transport – the ceiling of the aid is 50% of the difference.
Regarding our state aid program, we do not wish to submit aid for promoting interoperability, hence we have not analysed such costs.
Therefore when we determine the ceiling of the aid, we shall identify three cost groups:

- 30% of production cost (unit cost of freight transport), with the acronym: PC30;
- 100% of the difference of the infrastructure usage cost (the difference of the infrastructure usage cost of railway transport and road transport), with the acronym: IUC100
- 50% of the external cost difference (50% of the external costs of road transport and railway transport), with the acronym: ECD50

In accordance with paragraph 107 of the Communication of the Commission, railway aid can be provided under two separate headings (leaving aside interoperability):

a) PC30 but may not be more than IUC100 in case of aids provided for the infrastructure usage

b) PC30 may not be more than ECD50 in case of aids provide for the reduction of external costs

Therefore if the State would like to aid both (infrastructure usage and external costs) the sum of the two above mentioned calculation, which may not be more than IUC100+ECD50, is the maximum amount in principle. Hence, the maximum amount of aids are:

- IUC100+ECD50 if PC30>IUC100 and PC30>ECD50
- PC30+ECD50 if PC30<IUC100 and PC30>ECD50
- IUC100+PC30 if PC30>IUC100 and PC30<ECD50
- PC30+PC30 if PC30<IUC100 and PC30<ECD50

In chapters 2.2 and 2.3 we will determine the infrastructure usage costs of road transport and railway transport and the production cost of railway transport (unit cost). In chapters 2.5 and 2.6 we will make the same comparison with regard to the 50% of external costs and the unit costs. Chapter 3 will contain a complete summary of the different methods.

2.2 Determining the production costs and the costs of infrastructure usage of road and rail freight transport

Besides the different methodological footings presented in chapter 2.1, on the basis of data provided by relevant participants of the market, we will model and calculate the sectoral production costs and the infrastructure usage costs of the single wagonload transport, and we will compare the results with similar results of the road freight transport sector. Given the characteristics of the single wagonload transport we assumed that the characteristics of the market are well represented by RCH, which is dominant on this market, hence we only examine the change of costs to this company, furthermore the transit of single wagonload transport is not applicable nationally, hence we will only demonstrate domestic and export/import transport operations (to product group categories).

2.2.1 The production cost and the infrastructure usage cost of road freight transport

The production costs and the infrastructure usage costs of road freight transport was examined by the use of the previously demonstrated method. The examined costs are applicable for the year 2018. FTL in road freight transport is equivalent to the single wagonload transport, hence we will use it for our analysis. On the basis of national practice on the domestic market, the working load of a EURO V vehicle (fuel consumption 30 l/100 km, runs apx. 6500 km/month, 70% of which is carried out on toll roads, 30% on expressways, 40% on main roads) with a maximum permissible weight of 40, with 4 or 5 axles is 15 tonnes. Concerning the different costs in domestic voyages, we take Table 3 into consideration.

Table 3: Vehicle expenses regarding the examination of the production costs of FTL (source: [6] and [7] on the basis of the source, edited by KTI)

Fixed costs (Ft/month)			**Variable costs (Ft/month)**		
Type of operations	**Domestic**	**Type of operations**	**Domestic**	**Type of operations**	**Import/ Export (International)**
tax (accident, road)	15 000	tax (accident, road)	15 000	tax (accident, road)	75 000
insurances	100 000	insurances	100 000	insurances	45 000
vehicle (lease / depreciation)	500 000	vehicle (lease / depreciation)	500 000	vehicle (lease / depreciation)	6 000
on-board IT system	8 000	on-board IT system	8 000	on-board IT system	1 080 000
remuneration of the driver	700 000	remuneration of the driver	700 000	remuneration of the driver	
general company costs	250 000	general company costs	250 000	general company costs	
total domestic: 2 454 000	1 573 000	total domestic: 2 454 000	1 573 000	total domestic: 2 454 000	
total foreign: 3 056 000		total foreign: 3 056 000		total foreign: 3 056 000	1 206 000

The expenses of the domestic part of international (exp/imp) transport operations and the solely domestic transport operations are basically the same. Regarding the expenses of international operations mainly the remuneration of the driver and to a lesser extent the OBU service charges together with the charges of different maintenance services cause the difference. The road infrastructure usage cost arise from the toll charges the domestic prices of which are summarized in Table 4. During the examination process we only took into consideration domestic toll charges.

[6] European Union: Case study analysis of the burden of taxation and charges on transport. Final report, European Commission Directorate-General for Mobility and Transport, 2017. ISBN 978-92-79-76740-1, doi: 10.2832/523280
7 Horváth Annamária, Karmazin György: Nemzetközi közúti árufuvarozás és szállítmányozás. Tankönyv, Akadémiai Kiadó, 2014. ISBN 9789630595735

Table 4: Regarding the expenses of infrastructure usage of FTL per vehilce (source: on the basis of the data of the National Toll Payment Services Plc., edited by KTI)

Expressway (Ft/km)	**Main road (Ft/km)**
102,34	63,84

2.2.2 Production cost and infrastructure usage cost of single wagon load train

Based on the data provided by the infrastructure managers, the largest railway undertaking (RCH) with the largest (~ 90% share) traffic performance of single wagon was included in the study. Among the cost elements of the production and infrastructure usage costs of single wagon load train, we take into account the provisions of the RCH cost calculation regulations (Table 5).

Table 5: Cost elements taken into account in the analysis of the production cost of single wagonload transport and the cost of infrastructure usage (source: own editing based on RCH)

different elements of operating costs:			**different elements of infrastructure charges:**	
operating cost (user charges of wagon; depreciation)	charges of providing train path	charges of providing train path	charges of providing train path	charges of using station
own traction operating expenses	operating costs per train km	operating costs per train km	operating costs per train km	charges of storing trains
operating charges paid for the services ordered	operating costs per gtkm	operating costs per gtkm	operating costs per gtkm	charges of weighing
shunting/arranging charges (including costs of energy and charges of different services ordered from other rail companies)	charges of using the overhead contact line	charges of using the overhead contact line	charges of using the overhead contact line	other charges of access to network
wagon maintenance costs	charges of using terminal tracks	charges of using terminal tracks	charges of using terminal tracks	operating costs of privet siding
rental cost of wagon	private wagon expenses	loading/unloading by road transport operation		

Production costs and infrastructure usage costs can be calculated by grouping and summarizing the cost elements presented above.

Production costs

T1. production costs related to the main activity of the railway undertaking:

T1.1. traction fee: operating fee (wagon use; depreciation), own traction operating expenses (locomotive rental fee, maintenance costs, traction energy fee, personal costs of train drivers), operating fee paid for ordered services (continuous availability or ad hoc traction service charges, locomotive rental, locomotive availability fee, traction energy fee, capacity availability fee, other contractual fees). Traction charge expenditures were determined based on direct data from RCH.

T1.2. shunting/sorting fee (all shunting/sorting costs including energy, except for the shunting/sorting costs ordered from the Infrastructure Manager), the value was determined directly from the RCH data supply

T1.3. wagon pool expenses: wagon maintenance cost, wagon rental cost, wagon depreciation cost, wagon usage fee. The wagon pool cost was determined for the completeness of the wagon fleet serving single carriage traffic based on the data provided by RCH

T1.4. wagon service fees: wagon inspection fee, costs related to border crossing (transshipment cost, Záhony gauge switch), transfer service fee, other general costs related to wagon service at the operational level in the regions, expenditures were determined from the RCH data

T1.5. general operating and commercial costs: costs of activities directly serving the core business, based on the aggregate value reported by RCH.

T1.6. business tax and innovation contribution

T1.7. corporate governance costs: costs of administrative activities indirectly related to the main activity. The cost of corporate governance was determined based on RCH data

T2. private wagon costs (if a railway's wagon is not used): time-weighted, cost-per-unit, transport capacity unit of private wagons used for each type of traffic (the daily fee for wagons suitable for the carriage of goods in bulk is approximately EUR 12, in the order of magnitude 5/6 of which can be attributed to them, while the daily rate for wagons with special transport tasks for the remaining transport capacity was set at EUR 22, the useful time base expressed in wagon days to be calculated from the time of loading to the time of unloading, the average time value was taken from the data available from the RCH register),

T3. costs of terminal operations (lifting, servicing): in case of export / import traffic, assuming two lifts at one end point, based on the lifting fee table of Rail Cargo Terminal-BILK (lifting fee of a 20-45 foot container is 11 thousand HUF) and the turnover of goods treated in the type of traffic, expressed in TEU

T4. shunting/sorting charge on the own-account railway network: it is assumed that there is no significant difference for each of the contracting railway undertakings, therefore we take the specific value of RCH.

T5. road loading/removal fee: the cost of short-distance transport is approximately equal to the production cost of domestic truck load transport, and the obligation to pay tolls is waived.

- **Infrastructure usage costs**

I1. network access/track usage fee:

I1.1. basic service fees: route insurance fee, train-based fee for traffic fee, gtkm-based fee for traffic fee, catenary system usage fee, other network access fees, recorded as data from RCH data provision

I1.2. additional service fees: station usage fee, vehicle storage fee, weighing fee, value provided by RCH from its own records

I1.3. additional network access charges: any type of network access charge that has not been considered elsewhere but is an expense with the railway undertaking

I2. cost of terminal track use: average container handling cost per transport capacity unit based on the revenue of the annual own network usage fee of Rail Cargo Terminal - BILK based on the data of the contracted railway company

I3. cost of operating the railway network for own use: average cost of operating the infrastructure based on the data provided by the infrastructure manager

Costs to be calculated:

A. Company level prime cost = T1 + I1

B. Sector-level prime cost = (A. Contractor railway company cost) + T2 + T3 + T4 + I2 + I3

C. Transport sector level prime cost = (B. Railway sector cost) + T5

D. Infrastructure usage cost = I1 + I2 + I3

The goodness of the data received as part of the corporate data, treated as a business secret, was verified on the basis of the publicly available annual report information, and adjusted if necessary according to the aspects of the unified methodology. Costs weighted by corporate transportation performance for domestic traffic type is summarised in Table 6, and export/import traffic type in Table 7.

Table 6: Prime cost of single wagonload transport per transport capacity unit compared to road transport - domestic traffic [HUF/net tonkm]
(source: own editing based on contractor railway company data)

Types of costs	**Unit costs of single wagon load services**		**Reference costs of road transport services**
T1. Operating costs of private operator	32,36		25,17
I1. Costs of access to network/use of railway	5,02		3,75
A. Unit costs of the company (T1+I1)	*37,38*		*28,92*
T2. Private wagon costs	1,63		-
T3. Costs of operations carried out on the terminal*	-		-
T4. Costs of shunting/traction services on private siding	2,35		
I2. Costs of using terminal tracks*	-		-
I3. Operating costs of private siding	2,31		-
B. Sectoral costs (A+T2+T3+T4+I2+I3)	*43,67*		
T5. Costs of loading/unloadin	25,17		-
C. Unit costs of road freight transport sector (B+T5)	**68,84**		**28,92**
ebből: **D. Infrastructure costs** *(I1+I2+I3)*	**7,33**		**3,75**

*in the single wagon load train, the volume of consignments unloaded and sent at the terminals was of negligible magnitude, therefore we waived its cost calculation

It is clear in Table 6 that in domestic traffic, although the company-level cost values of rail and road do not differ much, but the additional costs associated with rail transport in the rail sector and the costs of road loading and / or hauling significantly increase both the sectoral costs of rail transport and the overall infrastructure usage cost.

Table 7: Prime cost of single wagonload transport per transport capacity unit compared to road transport - export-import traffic [HUF/net tonkm]
(source: own editing based on contractor railway company data)

Types of costs	**Unit costs of single wagon load services**		**Reference costs of road transport services**
T1. Operating costs of private operator	23,03		22,64
I1. Costs of access to network/use of railway	3,70		3,75
A. Unit costs of the company (T1+I1)	*26,73*		*26,39*
T2. Private wagon costs	2,31		-
T3. Costs of operations carried out on the terminal*	-		-
T4. Costs of shunting/traction services on private siding	1,54		
I2. Costs of using terminal tracks*	-		-
I3. Operating costs of private siding	0,20		-
B. Sectoral costs (A+T2+T3+T4+I2+I3)	*32,93*		
T5. Costs of loading/unloadin	25,17		-
C. Unit costs of road freight transport sector (B+T5)	**58,10**		**26,39**
ebből: **D. Infrastructure costs** *(I1+I2+I3)*	**3,90**		**3,75**

*in the single wagon load train, the volume of consignments unloaded and sent at the terminals was of negligible magnitude, therefore we waived its cost calculation

It can be established on the basis of Table 7, that in the export/import product group category the unit costs of both sub-sectors are lower compared to the domestic, given the increase in the average transport distance per transport task and thus the overweighting of variable costs, but the absolute difference between rail and road transport costs remains.
The production cost of road transport and the infrastructure usage cost are lower than similar cost values of rail transport, the difference is larger for domestic traffic (product group category) than for export/import traffic (product group category).
Higher rail costs are likely to significantly reduce the room for manoeuvre of single wagon company in terms of freight rates offered to customers, thus, it is at a competitive disadvantage compared to full truck load (FTL) road haulage, which handles similar traffic.

2.3 Determining the maximum possible amount of aid - by mode of transport and production, based on the infrastructure usage cost

The area to be examined under the Commission's Guidelines on State aid for railway undertakings is therefore the comparison of infrastructure costs in two transport sub-sectors. For this, we use the methodological bases and the results of the previous chapters. In essence, therefore, we need to compare the cost of using the railway infrastructure and the cost of using the infrastructure related to the same transport capacity of the road (expressway toll, motorway toll, HU-GO system in Hungary).

2.3.1 Comparison of infrastructure usage costs (single wagon load train - road)

In order to determine the maximum possible amount of aid, the transport capacity of all railway companies operating in Hungary in this segment must be taken into account. Based on the data provided by the infrastructure managers, 28 contracted railway companies performed single wagonload transport in Hungary in 2018[8]. Examining the composition of the market, we conclude that RCH's market share in 2018 (measured in net tonkm) in the single wagonload transport segment is approximately 87% based on the data provided by the infrastructure manager. The net tonkm performance (2018) and distribution of the single wagonload transport by traffic type (product group category) is presented in Table 8.

Table 8: Railway single wagonload transport per traffic type, net tonkm performance, distribution, 2018 (source: own compilation based on data provided by the infrastructure manager)

Traffic type	Capacity (million net tonkm)	Distribution (%)
Domestic	450.1	30%
Export/import	1 050.1	70%

In the calculations, we examined (Chapter 2.2.) what would be the cost of using the infrastructure in addition to what is provided for in the Commission's Community guidelines on State aid for railway undertakings in the case of the road transport sub-sector (including the use of heavy goods vehicles) which is able to provide an alternative to rail at national level[9] and the same for rail for the same transport capacity. The calculation result is presented in Table 9.

Based on the calculation results, we can see that there is a large cost difference between product

[8] "*Consignments dispatched in a wagon are considered as being transported by single wagonload transport if they run in more than one train paths during their transportation in a way that the distance covered by the route in the first and/or the last train path does not exceed 80 km and the normal hauled load of the train does not exceed 2,000 tons. The first or last train path shall be considered the train path prior to / after running on which the loaded/unloaded status of the wagon (also including loaded loading) or the harmonised commodity code (NHM) has changed. Additional conditions include that*

- *the composition of trains running on all train paths concerned shall not be the same,*
- *there is no interruption between the detachment/marshalling stations of the train paths concerned,*
- *no more than 10 train paths are involved,*

the consignment is not transit (the point reached in the first and last train path can not be a border in both cases – allowing import or export relations)."

[9] Communication from the Commission, Community guidelines on State aid for railway undertakings (2008/C 184/07), 22.07.2008

group categories when comparing infrastructure usage costs (IUC): while in export + import traffic the cost difference is only 0.15 HUF for single wagons, in domestic traffic it is a multiple of 3.58 HUF per tonne of freight per kilometre. The reason for this is that in domestic traffic, both the dispatch and the destination stations of the carriage are single wagonload transport, thus, more costly service processes appear twice, while in international traffic, these wagons leave the country as a direct train (or arrive as such), so the more costly processes occur only once, as one of the service endpoints is abroad and the Hungarian section is burdened by the costs of only one of the service processes.

Table 9: Based on the difference in the cost of using infrastructure, the possible amount of aid for single wagonload transport by product group category (2018, source: production cost calculation, data provision by MÁV Zrt and GYSEV Zrt)

Product group category	Forwarding capacity, million net tonkm	Railway production cost (PC), HUF/ net tonkm	Railway production cost, HUF mln	30% of railway production cost, HUF mln (PC30)	Infrastructure use cost difference, HUF/ net tonkm	Infrastructure use cost difference, HUF mln (IUC100)	Amount eligible for aid (the smaller of PC30 and IUC100), HUF mln
Domestic;	450.1	50.94	22 926.3	6 877.9	3.58	1 611.2	1 611.2
Export+ import	1 050.1	34.36	36 083.1	10 824.9	0.15	157.5	157.5
Total	1 500.2		59 009.4	17 702.8		1 768.8	**1 768.8**

2.3.2 The amount of aid that can be determined on the basis of a comparison of infrastructure usage costs

Based on Chapter 2.2, which determines the production cost (cost level at the transport sector level), the production cost per the same freight transport capacity is HUF 59 billion, 30% of which is HUF 17.7 billion. According to the Commission's guidelines:
"The Commission considers that there is a presumption of necessity and proportionality of the aid when the intensity of the aid stays below the following values: a) for aid for rail infrastructure usage, 30 % of the total cost of rail transport, up to 100 % of the eligible costs […]"
Eligible costs are 100% of the difference between the cost of using the rail and road infrastructure defined above. From the difference between 30% of the production cost and the infrastructure usage costs, we choose the lower values per product group category in order not to exceed the allowable aid rate. According to the methodology presented in Chapter 2.1., in our case, in both examined product group categories (domestic and export+import turnover), and thus also in aggregate value, the smaller difference between the costs of using railway and road infrastructure, i.e., the theoretical maximum state aid that can be used (i.e. the maximum possible aid amount) is HUF 1,768.8 mln for single wagonload transport, as a product group in total.

2.4 Calculation of the eligible costs for the single wagon load train - Establishing the range of external costs, developing a cost calculation methodology for domestic road-rail traffic

In this chapter, we review those external cost items for which adequate data and research results are available. Given that these costs are eligible (and eligible for general social benefit), it is important to quantify them. It should also be taken into account that these effects and costs - due to their nature - cannot be detected in an exact way, so the choice of methodology also affects the final result. Consequently, it is appropriate to choose a sufficiently robust, tested and accepted evaluation methodology, which at the same time provides a good basis for the amount of aid that can be provided by the aid system (based on the assessment of road-rail external costs).
The EU Commission published a Handbook[10] to define the external costs of transport [5]. The cost components identified in this can be considered as a guideline for external cost calculations related to transport systems. According to the statement of the objective of the document: *"The objective of this Handbook is to provide information on how to generate state-of-the art estimates for all main external costs of transport."* In the Final Report, we use the Commission's Handbook [5] to take stock of external cost items and express them in value. The reasons for this are:

- A comprehensive document containing the most recent data available for the 2018 and 2019 values, respectively;
- The work of scientific research workshops refining the methodology adopted by the EU Commission over the years;
- Includes detail data needed to make comparisons;
- Guideline, summary work on which the calculations to be adopted by the Commission are based.

In Chapters 2.4, 2.5 and 2.6 of the Final Report, we review the identified external cost items and the methodology for determining them on the basis of that Handbook. Based on this, we determine the maximum possible amount of aid.

2.4.1 External cost items and their content elements

2.4.1.1 Accident costs

Accident costs can be divided into two main groups in terms of quantification: material costs (typically damage or destruction of vehicles, infrastructure and other built environmental elements, billable costs of medical treatment, rehabilitation) and non-material costs (shorter life cycle, suffering, pain). A special feature of accident costs is that some of them are internalized through insurance and the associated risk premiums (it becomes a demonstrable internal cost).

[10] Handbook on the external costs of transport, Version 2019, ISBN: 978-92-79-96917-1; Delft, CE Delft, January 2019

The following components are taken into account when assessing accident costs:

- Human costs: The quantified value of the pain and suffering that can be identified as a result of the accidents and, in the event of a fatal accident, the average economic loss resulting from the loss of production involved.
- Medical costs: The cost of institutional, personnel and equipment related to the medical care involved in the accident, including medicines and non-medical costs.
- Administrative costs: accident costs of non-medical organisations subject to public charges, costs of police, fire brigade and other public administration bodies.
- Production losses: An outage due to the (average) loss of working time due to the accident, in extreme cases a loss of production for the rest of his life, or a decrease in production depending on the extent and type of injury.
- Material damages: The part of the recovery value of assets damaged as a result of an accident that has not previously been internalized through insurance (i.e. that is not included in an insurance).
- Other costs: Congestion caused by accidents caused to another party, e.g. loss of production due to congestion and other consequential costs.

Accident prevention costs are not included in external costs. It further reduces external costs through insurance, with a calculated risk premium. These are borne by the insured entities appearing in the risk community as an internal cost.

An important circumstance for the goods carried in single wagons is that we have to deal with increased accident exposure in both road and rail cases. In the case of both transport sub-sectors, due to the nature of the goods and the specifics of the means of transport, a unique loading-securing technology must be used, which means an additional risk compared to more standardisable (e.g. container) transport. In the case of railways, this is accompanied by a typically greater (e.g. compared to directional trains) need for shunting, coupling, train composition for single wagons, through this the appearance of possible shunting accidents.

2.4.1.2 Costs related to air pollution

The examination of external costs related to air pollution has received the most emphasis in recent years. This includes direct damage to health due to various air pollutants, but also harmful factors that do not directly affect humans: damage to buildings, declining yields and loss of biodiversity. The air pollution costs discussed in the Final Report include:

- Health effects: factor affecting respiration (nitrogen oxides, suspended particles make breathing difficult or lead to circulatory problems. In connection with this, we take into account the loss of production due to emerging health reasons (medical treatment, lost working hours, etc.).
- Crop losses: ozone depletion (mainly due to emissions of nitrogen oxides) and other air pollutants that cause acid rain (sulphur-containing oxides) result in agricultural yield losses and thus lower incomes compared to the state without pollution.
- Material and building damage: dusting and oxidation of the facade of buildings, deterioration, faster corrosion of structural elements due to acidic components.

- Biodiversity loss: as part of the damage to the ecosystem, the acidification of the soil and natural waters, the eutrophication of wetlands (the undesirable proliferation of certain plants and algae) appear here. All this leads to a loss of species richness in flora and fauna.

Single wagonload transport has a relatively higher traction demand due to the dispersity of serving at smaller stations. The total weight of the trains are also smaller in proportion (they may consist of only 1-2 wagons). Traction type (in the absence of electrification of the extensions to be serviced) means a higher proportion of diesel than electric traction. The road alternative (assuming that similar quantities are moved as in railcars, i.e. transporting at least 20-40 tonnes of goods) requires the use of heavy goods vehicles, which, overall, has more favourable characteristics per unit of mass of goods transported within truck traffic.

2.4.1.3 Climate change costs

The costs of climate change are long-term, global. These are mainly affected by warming caused by greenhouse gases (CO_2, N_2O and CH_4). This means almost exclusively irreversible processes through the weather characteristics that fundamentally determine terrestrial life, altitude, biodiversity loss and habitat loss. Within the effects of climate change, the following groups have been taken into account:

- Sea level rise: an increase in average temperature affects the melting of Arctic ice caps and the melting and release of other ice masses in glaciers and other ice stocks into the oceans. As a result, coastal areas are submerged, and increased efforts are needed to protect the coasts and make new areas liveable.
- Yield decline: rising average temperatures in several agricultural areas make it impossible to grow traditional varieties. All this can indirectly lead to famine and intensified migration processes.
- Health costs: Heat-related illnesses and blood pressure problems may appear at a higher rate. Some insects that were previously thought to be tropical only (e.g., malaria mosquitoes) can spread over a much larger area. As a result, health care spending is expected to increase.
- Damage to buildings and structural materials: the frequency of extreme weather events (hurricanes) and their individual intensification cause the destruction or damage of buildings. Similarly, the affected infrastructure is damaged.
- Water management issues: in addition to dehydration and desertification in some areas, excess water may appear in other areas. In both cases, this is accompanied by water management difficulties.
- Effects on the ecosystem and biodiversity: the fauna and flora have limited adaptability to a rapidly changing climate. Species extinction and habitat loss and migration are expected.

Considering that the mechanisms of action related to climate change can be traced back to approximately the same causes as in the case of air pollution, thus, the findings for the single wagonload transport can be considered the same as those made there.

2.4.1.4 Costs due to noise pollution

Noise means an undesirable sound effect of varying frequency and duration. As a result of urbanisation, noise pollution is affecting more and more people. The density of moving vehicles also increases, so the noise effect increases. So more and more people are exposed to more (denser) noise effects. This predicts that noise pollution and exposure to noise will increase in the future despite the use of noise abatement technologies. In many cases, noise is accompanied by vibration and shock. Noise pollution has the following negative effects:

- Annoyance, discomfort: loss of comfort, possibly without health symptoms.
- Exhaustion
- Sleep disturbance
- Hypertension
- Loss of concentration, productivity losses

Rail transport is classically associated with noise pollution in public opinion, despite the fact that in many cases it is less common overall (trains are relatively less frequent than on-going road traffic) and does not necessarily lead to higher noise pressure. This is because the encounter of metals sounds at a more sensitive frequency to the human ear, so it sounds louder even at the same noise pressure. Another reason is that the perception of a temporary noise effect is sharper than that of a disturbance that is constantly present in the background.

In addition to the general patterns typical of railways, single wagonload transport has two characteristics:

- Due to the need for extra shunting, the noise generated by the shunting locomotives (especially during the night hours of deep sleep) has a serious disturbing effect locally. Especially in cases where wagon stations have, over time, been surrounded by areas which would serve for relaxation (residential areas).
- The specialties of the loading activity include the activity carried out in terms of small quantities and locations. In this respect, loading noise is also more perceptible: while in the case of directional trains loading takes place in parts of industrial parks, freight terminals, ports or industrial facilities isolated from human settlements, in the case of single wagonload transport the use of public loaders close to settlements occurs several times.

2.4.1.5 Congestion costs

Congestion costs typically result from delays *caused* by vehicles to *each other*. As soon as one more vehicle appears in the orderly saturated transport system, all other transport times will be extended, which is an additional delay compared to the undisturbed state. Considering that all other modes of transport, albeit with a saturated timetable or capacity allocation, operate with the use (allocation) of pre-planned capacity, the phenomenon of congestion cannot be interpreted in these, so not at the railway either. Rail (or flight, sea or river) delays are of a disruptive nature, which are of course not independent of the number of trains (vehicles) running, but do not automatically cause each other delays.
In the road sub-sector, there are two different, coexisting versions of the definition of delay

costs:

- Dead load loss due to congestion: a value that can be determined by function analysis, the area of the triangular plane (intersecting the individual), the average cost (increasing with the delay), the social marginal cost and the intersections of the demand, unit of measure (HUF/vehicle) * hour
- Delay costs: the total of the delays caused by an additional vehicle entering the system together with all the others

The non-road congestion costs not quantified in this Final Report can be divided into the following groups on the basis of theoretical considerations:

- Delay costs: A delay is when scheduled (or pre-scheduled in capacity allocation) services cause delays to each other. This should not, in principle, occur, but there are (secondary) delays, when disruption to a particular service affects the next one(s).
- Bottleneck costs: The cost of using bottlenecks or sections on the network and through this the vehicles cause each other delays.

There are elements in the Hungarian railway system (mainly due to technological and passenger transport reasons) that can be considered as bottlenecks, however, they do not play a significant role in single wagonload transport in the event of delays or congestion in train movements. In the case of single wagonload transport, however, in many cases the availability of loading areas, capacity and the way of using the allocated capacity arise. All three can cause bottleneck costs:

- A common problem is the occupancy of loading areas with other materials (e.g. track construction materials) or their inadequate condition (lack of road accessibility, inadequate pavement or axle load);
- In several cases, the capacity is inadequate, typically the loading area is too short for the wagons to be loaded could be set in one unit;
- Another recurring problem is the irresponsible booking system: loading areas are reserved by several railway companies even in the absence of transport tasks, thus, it can no longer be issued to another company even if there is no real use.

2.4.1.6 Energy production costs

If we consider the transport system as a whole, then not only the daily operation, but also the production and post-processing of vehicles, equipment, infrastructure elements entails external costs. These are also called costs of ‘preventive and follow-up processes’. In the case of equipment with longer life cycle (both in terms of infrastructure and rolling stock, the life cycle is close to or less than 40 years), their quantification is more uncertain than in other external cost elements due to changing specifications and the time value of the currency.

The largest and at the same time the best can be expressed among the costs of preventive-follow-up processes, the costs of energy production, which is also referred to in the English literature as ‘well to tank’ costs. Other life cycle costs are not discussed in our Final Report.

The cost of energy production in single wagonload transport is basically based on the traction type, i.e., it appears through traction energy. There are external costs to the production of electricity and diesel, their weighted average appears in the traffic studied, similar to the effects

of air pollution or climate change.

2.4.1.7 Costs of habitat damage

Due to the large dimension of the transport system, including the transport infrastructure, it takes a lot of habitats from both the flora and fauna and the human habitat. At the same time, this not only means a loss measured on the surface, but also fragmenting the habitat, inhibiting the movement of animal populations, thereby reducing their chances of survival and genetic diversity. Habitat damage (according to some translations: environmental occupation or environmental destruction) consists of the following items:

- Habitat loss: environmental loss due to transport infrastructure space requirements. This value is particularly high in the case of infrastructure construction, which involves many times the size of the area that has been breached / disturbed and temporarily or permanently inaccessible to the ecosystem during construction.
- Fragmentation effect: for migratory or migrating animals in particular, the fragmentation of their former habitat is a loss, even a fatal one, which creates impenetrable barriers for them and which condemns these species to an island-like life.
- Habitat degradation due to emissions: an effect on biodiversity that affects an area larger than a direct occupation and that adversely affects biodiversity, resulting from transport infrastructure or its use (e.g. lead pollution, salt pollution along public roads).

The natural environment suffers a significant loss of area both during the establishment and during the operation and use of the road and railway infrastructure. With millions of square metres of loading space nationwide, their residual contaminants further reduce wildlife, including human habitat. There are additional external costs associated with associated light pollution (even unnecessary lighting of loading areas), snow removal, weeding and other artificial interventions caused by changes in the natural climate.

2.4.1.8 Numerical values for each external cost

The Commission's Handbook [5] includes the external cost items presented in average units, i.e. expressed in Euro per tonne-kilometre of goods (abbreviated as tkm in the table) and per vehicle-kilometre, with the intention of allowing subsequent calculations, this is contained in Table 10.

An important circumstance is that the EU cannot be considered as a homogeneous unit in terms of external costs: the economic and social composition of each country and the typical transport systems represent different external costs. The average of the 28 EU Member States gives a good general picture of the level of costs, however, it is expedient to examine the special data of the given country (in our case Hungary). This is made possible by the annex with tables to the Handbook, which also contains country-specific data.

Table 10: Average values of external costs, EUR

External cost types	Road EUR/tkm (EU28)	Road EUR/tkm (HU)	Road EUR/vehicle km (EU28)	Road EUR/vehicle km (HU)	Rail, electric EUR/tkm (EU28)	Rail, electric EUR/tkm (HU)	Rail, electric EUR/vehicle km (EU28)	Rail, electric EUR/vehicle km (HU)	Rail, diesel EUR/tkm (EU28)	Rail, diesel EUR/tkm (HU)	Rail, diesel EUR/vehicle km (EU28)	Rail, diesel EUR/vehicle km (HU)
Accidents	0.01300	0.01100	0.15500	0.13200	0.00070	0.00150	0.34100	1.06000	0.00070	0.00150	0.34100	1.06000
Air pollution	0.00760	0.00886	0.09380	0.10739	0.00004	0.00001	0.02140	0.00900	0.00680	0.00640	3.05390	2.91000
Environmental change	0.00525	0.00571	0.06478	0.06921	0.00000	0.00000	0.00000	0.00000	0.00250	0.00245	1.12436	1.12436
Noise	0.00400	0.00460	0.07200	0.08000	0.00650	0.00150	3.59000	1.17000	0.00450	0.00260	2.01000	1.17000
Congestion (extra time)	0.00220	0.00220	0.03020	0.03140	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Energy production	0.00200	0.00208	0.02500	0.02523	0.00160	0.00098	0.86500	0.78190	0.00140	0.00265	0.61300	1.21572
Habitat damage	0.00190	0.00300	0.02400	0.03500	0.00240	0.00200	1.34000	1.40000	0.00250	0.00300	1.11000	1.40000
Total	**0.03595**	**0.03745**	**0.46478**	**0.48023**	**0.01124**	**0.00599**	**6.15740**	**4.42090**	**0.01840**	**0.01860**	**8.25226**	**8.88008**

Projected to freight tonne-kilometre of goods, there are 3.6 Eurocents for roads, 1.1 Eurocents for electric rail traction and 1.8 Eurocents for diesel traction. This means that the total external cost of a road is more than twice the external cost of a railway.

2.4.2 Methodological considerations for determining external costs

The comprehensive Handbook covering all sub-sectors of public transport allows a number of alternatives to be presented, in many cases more detailed data (e.g. differentiation of Euro 0… 6 engines in road transport) leave enough room for precise definition of external costs. In order to delimit the task and to clearly interpret the results, we make the following considerations regarding the possibilities, alternatives, analysis and methodological directions offered by the Handbook:

Analysis of road as an alternative. According to the guidance of the Handbook already quoted, *"rail transport and alternatives based on other modes of transport should be compared"*. The sub-sectoral alternative of goods transported by rail in single wagonload transport in Hungary is exclusively road transport. In essence, neither water nor air transport can be considered in this respect, so our external costs can be ignored.

Application of capacity values by mass of goods. The external cost can also be expressed in terms of mass of goods (EUR/net tonkm) and vehicle (EUR/vehicle km). The Handbook calculates a payload of 11-12 tonnes per vehicle for road and 350-550 tonnes per train for rail, which is a value corresponding to the domestic traffic of single wagonload transport and its road alternative. At the same time, it is advisable to deduct the external cost from the movement of specific vehicles, so the value of EUR/ net tonkm is taken into account. This also allows for a more illustrative comparison (while comparing road and rail vehicles would be more difficult due to their completely different nature).

Use of average costs. The Handbook contains values for both marginal costs (additional costs per unit) and average costs (EUR/tonne-kilometre). Given that the external costs of total traffic have to be shown when comparing transport sub-sectors, we use average costs in our calculations. The average costs are multiplied by the total output to obtain the value of the total costs for a given external item in the relevant sub-sector (marginal cost, however, can illustrate the effect of changing an existing situation with different measures to show the appearance or disappearance of unit surplus output).

Application of country-specific specific values. In the annex to the Handbook, road and rail specific values are included for all 28 EU countries (indicating, of course, countries without railways). We use the special values applied to Hungary, taking into account the extent of the deviation from the EU values.

Consideration of heavy goods vehicles on the road. When calculating external costs, a distinction can be made between light commercial vehicles (LCV) and heavy goods vehicles (HGV). In our statements, the latter are taken into account when calculating the road alternative. This is due to the fact that tractors and heavy goods vehicles with trailers are almost exclusively suitable for the road transport of the amount of goods transported in single wagonload transport (20-60 tons per wagon). If road haulage precedes or follows rail freight, such vehicles typically perform the task. Light trucks of a few tonnes do not perform such transportation.

Unweighted application of traction type. The traction type significantly affects railway externalities. Diesel traction (mainly due to emission factors) is significantly less favourable. Domestic practice shows that a significant part of service trains are diesel-towed, and diesel locomotives also typically serve on industrial tracks. At the same time, due to their significantly more economically advantageous properties, railway companies try to use electric traction as much as possible. It can be said that the goods transported in the single wagonload transport also typically make the majority of their route by electric traction, after they are enlisted in the collection services and before they are enlisted in the distribution services. The value of the traction mix is applied according to the data source of the most important railway company in the single wagonload transport, RCH Zrt. Based on this, the rate of electric traction is 89% and that of diesel traction is 11%. The specific values by traction type are weighted with the corresponding values.

Consideration of delay costs in case of road congestion. Congestion costs can be identified using both delays (extra time usage) and deadweight losses (EUR*vehicle/hour). In our calculations we use the former, i.e. the cost of time loss due to vehicle delays due to its more practical orientation, formulaic interpretability (deadweight loss can only be determined by function analysis, as a difference between the integrins of demand and marginal cost functions - this is more suitable for theoretical economic considerations).

2.5 Determination of external costs for domestic road-rail single wagon load train

In our calculation, we determine the external costs of road and rail for the transport capacity corresponding to the single wagonload transport, and then we determine the maximum subsidy rate by taking 50% of the difference between them. The calculation therefore models the external cost savings of the transport capacity of single wagonload transport during the period under review (business year 2018) by carrying out this transport performance not by road but by rail. Road external costs are thus not generated for an existing, real traffic, but for a fictitious traffic that shows how much this value would have been if the rail traffic had been transmitted by the road sub-sector.

The transport capacity of the 2018 business year, on which the external effect of single wagonload transport is to be calculated on the sum of domestic and export+import turnover. According to the data provided by MÁV Zrt. And GYSEV Zrt., This is 1,500,213,254 net tonkm (transport capacity of single wagonload transport on the open access railway network of MÁV and GySEV).

The weighted railway unit cost, which includes 89% electric traction and 11% diesel traction, can be formed with the electric vs diesel traction ratio defined in the methodological chapter. For railway external costs, we therefore form the specific value per net tonkm projected on the basis of the traction mix.

The examination was performed for separate product group categories, i.e. for domestic and for single wagonload transport combined for export+import traffic. According to the data of MÁV Zrt. and GYSEV Zrt

- transport capacity of domestic single wagonload transport: 450,063,976 net tonkm
- total transport capacity of export+import single wagonload transport: 1,050,149,278 net tonkm

Multiplying the external cost items by this value by item (see Table 10) gives the total external cost value of the examined sub-sectors (calculated by the average exchange rates of the Magyar Nemzeti Bank for banking days in 2018 [318.87 HUF / EUR]) in the domestic traffic according to Table 11, and in export-import traffic according to Table 12.

Table 11: Road and rail external costs in case of freight performance corresponding to the domestic single wagonload transport, in domestic traffic (2018, HUF million)

Domestic traffic	Road (HUF mln)	Rail (HUF mln)	Difference (road-rail, HUF mln)
Accidents	1 578.6	215.3	1 363.4
Air pollution	1 271.5	102.5	1 169.0
Habitat change	819.5	38.7	780.8
Noise	660.2	232.6	427.5
Congestion (extra time)	315.7	0	315.7
Energy production	298.5	167.0	131.5

Habitat damage	430.5	302.8	127.7
Total	**5 374.5**	**1 058.9**	**4 315.6**

Table 12: Road and rail external costs in case of freight performance corresponding to the domestic single wagonload transport, in export and import traffic (2018, HUF million)

Export+Import traffic	Road (HUF mln)	Rail (HUF mln)	Difference (road-rail, HUF mln)
Accidents	3 683.5	502.3	3 181.2
Air pollution	2 966.9	239.3	2 727.6
Habitat change	1 912.1	90.2	1 821.8
Noise	1 540.4	542.8	997.5
Congestion (extra time)	736.7	0	736.7
Energy production	696.5	389.7	306.8
Habitat damage	1 004.6	706.6	298.0
Total	**12 540.5**	**2 470.8**	**10 069.7**

Road transport has a higher external impact, accounting for approximately five times the external costs of rail.

2.6 Determining the maximum possible amount of aid - by mode of transport and production, based on external costs

According to the Commission guidelines on State aid for railway undertakings [1], the external costs of the more favourable and alternative but less favourable transport sub-sectors should be compared. The comparison should also take into account the transport sector level costs (production costs), broken down by product group category. For this, we use the methodological bases (Chapter 2.1) and the results of the external cost calculations (Chapter 2.5).

2.6.1 Comparison of external costs (rail single wagon load train - road)

In the calculations, we examined (Chapter 2.5), that in the case of the road transport sub-sector (including the use of heavy goods vehicles) which is able to provide an alternative to rail at national level what would be the external cost in addition to what is provided for in the Commission's communication on Community guidelines on State aid for railway undertakings and the same for rail for the same transport capacity. Summarising the results of the calculation, the values expressed in HUF can be calculated at the exchange rate of HUF 318.87/EUR, based on the base year 2018, for single wagonload transport (average of MNB medium rates calculated on banking days in 2018. Source: mnb.hu). The calculation result is presented in Table 13.

Table 13: Based on the difference in external costs, the possible amount of aid for single wagonload transport by product group category (2018), source: external cost calculation, data provision by MÁV Zrt and GYSEV Zrt)

Product group category	Forwarding capacity, million net tonkm	Railway production cost (PC), HUF/ net tonkm	Railway production cost, HUF mln	30% of railway production cost, HUF mln (PC30)	External cost difference, EUR/ net tonkm	External cost difference, HUF/ net tonkm	External cost difference, HUF mln	50% of external cost difference, HUF mln (EXT 50)	Amount eligible for aid (the smaller of PC30 and EXT50), HUF mln
Domestic;	450.1	50.94	22 926.3	6 877.9	0.03007	9.59	4 315.6	2 157.8	2 157.8
Export + import	1 050.1	34.36	36 083.1	10 824.9	0.03007	9.59	10 069.7	5 034.9	5 034.9
Total	1 500.2		59 009.4	17 702.8			14 385.3	7 192.6	7 192.6

While the cost of production paid by rail carriers differs in comparison between domestic and export and import, the specific proportion of external costs is the same.
Primarily due to high accident costs, and secondly due to high air pollution and climate change costs, the railway alternative causes less external costs with a total social burden of HUF 14.39 bln. With the support of this segment of railway transport, taking over half of the external costs at the social level (internalised from taxpayers' money), rail freight still represents a social benefit (cost savings) of almost HUF 7.19 bln.

2.6.2 The amount of aid that can be determined on the basis of a comparison of external costs

Similar to the analysis of infrastructure usage costs, we compare the difference in external costs to 30% of production costs in our chapter provided that, according to the Commission's guidelines, only 50% of this difference can be taken into account.
Based on Chapter **Hiba! A hivatkozási forrás nem található.**, which determines the production cost, the production cost per the same transport capacity as the total value of the product group categories is HUF 59 billion, 30% of which is HUF 17.7 bln. According to the European Commission's[11] Guidelines:

"The Commission considers that there is a presumption of necessity and proportionality of the aid when the intensity of the aid stays below the following values: […] for aid for reducing external costs, 30% of the total cost of rail transport, up to 50 % of the eligible costs."

Eligible costs are therefore 50% of the difference between external road and rail costs defined above. 50% of the production cost and the eligible costs (half of the difference between road and rail external costs) is half of the difference between road and rail external costs, thus, the

[11] Communication from the Commission, Community guidelines on State aid for railway undertakings (2008/C 184/07), 22.07.2008

maximum possible amount of aid provided for the reduction of external costs for the entire product group is HUF 7.1926 bln.
When comparing infrastructure usage costs, we saw that production costs for railways are so high that the difference in infrastructure usage costs is the determining factor in determining the upper limit for aid costs. In this chapter, the situation is similar when comparing half of the external cost difference between road and rail: due to the high production costs, 50% of the external cost difference between road and rail gives the upper limit of eligibility, which is HUF 7.1926 mln.

3 Summary: aids in accordance with the guidelines of the European Council.

Section 1 of the introduction to Community guidelines on State aid for railway undertakings 2008/C 184/07 states that rail has unique advantages: it is a reliable mode of transport and does not pollute the environment. Rail transport therefore has great potential for contributing to the development of sustainable transport in Europe. Pursuant to Section 14, the granting of State aid to the railway industry can be authorised only where it contributes to the completion of an integrated European market, open to competition and interoperable and to Community objectives of sustainable mobility. In the case of such aid, the Commission will examine whether the financial aid from public funds does not distort competition beyond what is justified. It is essential to consider that the European rail freight market is in a special situation which makes it compatible with the common market, subject to certain conditions and in the general interest, to compensate railway undertakings for difficulties in carrying out freight transport activities. For the purposes of Section 98 (b), the following shall be considered as aid to meet the needs of transport coordination: aid for reducing external costs, designed to encourage a modal shift to rail because it generates lower external costs than other modes.

Eligible costs may include aid for the use of railway infrastructure and aid to reduce external costs. Pursuant to Section 105, both for aid for rail infrastructure usage and for aid for reducing external costs, a transparent, reasoned and quantified comparative cost analysis between rail transport and the alternative options based on other modes of transport has to be provided. These calculations must be made publicly available.

In view of the necessity and proportionality of the aid, the values described in Section 107 have been taken into account in this Aid Programme:

- for aid for rail infrastructure usage, 30% of the total cost of rail transport, up to 100% of the eligible costs;
- for aid for reducing external costs, 30% of the total cost of rail transport, up to 50 % of the eligible costs;
- for interoperability aid, 50% of the eligible costs.

Based on the findings of the Final Report, the presented support complies with the European Union guidelines both in terms of its objectives and in terms of its size.

3.1 Calculation methodology

Thus, when setting the top limit of the aid, we need to identify three different cost groups. These are:

- 30% of production costs (carrier prime cost), abbreviated as PC30;
- 100% of the difference in the cost of using the infrastructure (the difference between the cost of using the road and the railway infrastructure), abbreviated as IUC100
- 50% of the difference between the external cost (50% of the difference between the road external cost and the railway external cost), abbreviated as EXT50

According to Section 107 of the Commission Guidelines, railway aid may be granted under two independent aid headings:

a) PC30, but up to IUC100 for grants for the use of infrastructure, and
b) PC30, but not more than EXT50 for aid to reduce external costs,

thus, if the state intends to support both (infrastructure usage and external cost reduction), the sum of the above two lines, but not more than IUC100+EXT50, is the theoretical maximum eligibility.

3.2 Eligibility of rail single wagon load train

Based on the results of the calculation, it can be stated that the single wagonload transport can be supported both in terms of infrastructure usage and reduction of external costs.
According to the methodology presented in Chapter **Hiba! A hivatkozási forrás nem található.**, a comparison of 30% of the cost of production of railways with the difference between the cost of using rail and road infrastructure, that in both categories of the examined product groups, and thus also in the total value, the difference between the infrastructure usage costs is smaller, so the maximum amount of state resources that can be used in the case of subsidies for infrastructure usage is HUF 1.77 bln for single wagonload transport as a product group in total (see in Table **Hiba! A hivatkozási forrás nem található.**, 'Infrastructure usage cost difference (IUC100)' column, summary cell).
While the cost of production paid by rail carriers differs in comparison between domestic and export and import, the specific proportion of external costs is the same. This is because the social burden of rail transport is lower in terms of accident, air pollution and climate change costs. Primarily due to high accident costs, and secondly due to high air pollution and climate change costs, the railway alternative causes less external costs with a total social burden of HUF 14.39 bln. With the support of the single wagonload transport segment, taking over half of the external costs at the social level, rail freight still represents a social benefit (cost savings) of almost HUF 7.19 bln [see Table 14, "50% of the difference of external costs (EXT50)" column, summary cell].

Table 14: The relevant possible subsidy amount is for single wagonload transport, by product group category in Hungary

Single wagon load train	Forwarding capacity (million net tonkm)	Railway production cost, HUF mln	30% of railway production cost, HUF mln (PC30)	Infrastructure usage cost difference, HUF mln (IUC100)	External cost difference, HUF mln	50% of external cost difference, HUF mln (EXT 50)	Standard aid according to Chapter 2.1, HUF mln
Domestic ;	450.1	22 926.3	6 877.9	1 611.2	4 315.6	2 157.8	3 769.0
Export+ import	1 050.1	36 083.1	10 824.9	157.5	10 069.7	5 034.9	5 192.4
Total	**1 500.2**	**59 009.4**	**17 702.8**	**1 768.8**	**14 385.3**	**7 192.6**	**8 961.4**

Aid may also be granted for certain categories of domestic and export-import product groups in single wagon load train (domestic traffic: HUF 3.769 bln, export+import traffic: HUF 5.192 bln).

In total, an application for the approval of a maximum of HUF 8.96 bln per year can be submitted to the Commission for the targeted support of single wagonload transport.

Literature

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List of tables

List of abbreviations

TFEU	Treaty on the Functioning of the European Union
RCH	Rail Cargo Hungaria Zártkörűen Működő Részvénytársaság
PC	Production cost
IUC	Infrastructure usage cost difference
EXT	External cost difference
FTL	Full truck load
OBU	(truck) on-board unit
NÚSZ Zrt.	Nemzeti Útdíjfizetési Szolgáltató Zártkörűen Működő Részvénytársaság
TEU	Twenty-foot equivalent unit - 20 feet long metal container
HU-GO	Hungarian electronic toll collection system
NHM	Harmonised Commodity Code
MÁV Zrt.	Magyar Államvasutak Zártkörűen Működő Részvénytársaság
GYSEV Zrt.	Győr-Sopron-Ebenfurti Vasút Zártkörűen Működő Részvénytársaság
EUR	Euro
HU	Hungary
LCV	Light commercial vehicle
HGV	Heavy goods vehicle
HUF	Hungarian forints
net tonkm	Freight tonne kilometre
vehicle km	Vehicle kilometre
gtkm	Gross tonne kilometre
train km	Train kilometre