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# Quantification of the need to retrofit freight wagon fleets in Germany and member states of the European Union in light of the differing legal frameworks

Working Paper



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# Quantification of the need to retrofit freight wagon fleets in Germany and member states of the European Union in light of the differing legal frameworks

Working Paper

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# 1 Introduction

Aiming to ban “noisy” freight wagons and against the backdrop of noise pollution by freight wagons equipped with cast iron brake blocks a revision of the Technical Specification for Interoperability (TSI) Noise is currently underway.

Parallel to these efforts, some European states plan to introduce more severe noise limits. Besides the Netherlands and Switzerland, this is also the case for Germany. As the national Railway Noise Mitigation Act has been adopted by the German parliament, all “noisy” freight wagons are prohibited from operations from December 2021 onwards.

This working paper discusses the arising liabilities for the affected parties due to the prohibition. They include costs for retrofitting and organizational difficulties. The analysis is done under the assumption that new and retrofitted freight wagons are deployed to maximize their benefits. Meaning that “silent” wagons are used for traffic in countries with laws prohibiting „noisy” wagons, and „noisy” wagons in countries where this is not the case.

Both the Railway Noise Mitigation Act and the revised TSI Noise foresee exceptions from the ban. §§ 4 and 5 of the Railway Noise Mitigation Act exempt freight wagons with brake equipment that cannot be retrofitted based on the (current) state of technology or that operate on lines with steep gradients, the latter applying as long as there is no suitable and approved low-noise brake equipment. Furthermore, „noisy” wagons can operate if a reduced operation speed of the trainset or track layout result in meeting the emission and immission limits<sup>1</sup>.

The purpose of this working paper is to identify the necessary extent to retrofit freight wagons. It includes an analysis of the associated costs for the different scenarios as well as the accruing liabilities due to the planned ban of „noisy” freight wagons for the affected wagon keepers and railway undertakings. Therefore, the one-off costs of retrofitting and the annual costs, which are higher in comparison to cast iron brake blocks, of operating „silent” wagons with composite brake blocks are estimated and considered as part of the analysis. The examined scenarios differ with regard to the countries where a ban of „noisy” freight wagon is implemented (Germany, Netherlands-Switzerland-Germany, Netherland-Switzerland-Austria-Germany) and the time frame (coming into effect in December 2020 or December 2029).

The pilot and innovation program “Leiser Güterverkehr”<sup>2</sup> assumes that foreign freight wagons perform 25% of the German rail freight transport. Hence, it is mandatory to not only consider that freight wagons registered in Germany needs to be retrofitted but also those abroad.

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<sup>1</sup> With reference to the sixteenth Regulation to Enact the Federal Immission Protection Law (cf. Traffic Noise Ordinance (2014))

<sup>2</sup> Cf. Leister Güterverkehr (2011)

## 2 Data Analysis Procedure

To quantify the need to retrofit freight wagon fleets based on the varying legal scenarios, an overview of the number of wagons in Germany, the member states of the European Union, Norway and Switzerland is given. In order to do so, data from the National Vehicle Register Germany (NVR), European Centralized Virtual Vehicle Register (ECVVR), the German Umrüstungsregister (URR, Registry of Retrofitted Wagons), Silent Wagon Database (SWDB) and the General Contract of Use for Wagons (GCU) is sourced. In a first step, the freight wagons from the data sources are assigned to the respective country according to their registration and evaluated based on their wagon keeper. To determine the need to retrofit, the proportion of “silent” freight wagons is identified with the help of the available information in the data sources and an overview of their distribution for each of the European states is given.

Finally, the costs to retrofit and the operating costs for a freight wagon retrofitted with “silent” brake blocks are applied on the estimated numbers of freight wagons for the years 2020/21 and 2029/30. Additionally, the cost of disposition that are possibly incurred due to sole use of „silent” wagons in European countries where „noisy” wagons are banned is also determined. The analysis of costs is applied for the varying legal scenarios, meaning countries or country groupings with their distinct timeframe of introducing a ban on “noisy” wagons as it is planned in Germany, Switzerland, the Netherlands and Austria.

## 3 Evaluation of the data sources

Based on the data sources an evaluation of the wagon keepers, the fitted brake systems and the number of wagons was undertaken.

As the primary source for the evaluation data from the ECVVR was used as this registry has the highest degree of totality. Information from the URR and NVR (Germany), as for example the fitted brake systems are added to the findings from the ECVVR dataset. Additionally, information from the GCU database, the SWDB and the Impact Assessment<sup>3</sup> were added to it. This approach, which consolidates data from different sources helps to obtain the best possible overview of the freight wagon fleet in Europe.

### 3.1 Overview of wagon keepers

This chapter provides an overview of active wagon keepers that are registered in Europe. Based upon the Vehicle Keeper Marking (VKM) registry of the ERA, dated 02.05.2018, there are 3,551 codes for active vehicle keepers from 63 countries. The registry contains besides the keepers of freight wagons also keepers for locomotives, power cars, passenger coaches and other railway vehicles as well as former vehicle keepers that currently do not vehicles at their disposal.<sup>4</sup>

The number of wagon keepers that actually own and operate wagons was determined through comparing all provided data sources and registries. Table 1 provides an overview of the number of active wagon

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<sup>3</sup> Cf. ERA (2018b).

<sup>4</sup> Cf. ERA (2018a).

keepers and freight wagon keepers organized by countries. Overall, there are 994 registered and active wagon keepers in Europe. As there were no entries in the ECVVR with regard to Estonia, Ireland and Hungary, the number of registered keepers was determined based upon the GCU database.

Table 1: Number of VKM for member states of the European Union, Switzerland and Norway

Country	Number of wagon keepers according to VKM registry	Number of wagon keepers with freight wagons
Belgium	26	15
Bulgaria	84	32
Denmark	27	11
Germany	1042	245
Estonia	4	0*
Finland	40	8
France	125	49
Greece	3	0
Ireland	3	0*
Italy	121	22
Croatia	19	6
Luxembourg	14	6
Netherlands	51	18
Norway	33	14
Austria	125	34
Poland	282	104
Portugal	12	10
Romania	233	53
Sweden	179	74
Switzerland	229	81
Slovakia	165	53
Slovenia	10	6
Spain	113	35
Czech Republic	215	87
Hungary	57	18*
United Kingdom	47	13
<b>Total</b>	<b>3,259</b>	<b>994</b>

(\* = missing data added based upon GCU database entries)

Based upon Table 1 Germany has the highest number of active wagon keepers, both over all vehicle categories and in particular for freight wagons. Approx. 25% of all active freight wagon keepers in the EU (including Switzerland and Norway) are registered in Germany.

As a rule, it is to assert that the major vehicle keepers are regional entities, that are among other wagon keepers and have multiple but country specific VKMs. To determine the fleet size in Europe of such vehicle keepers, their national vehicle keepers are grouped into so-called vehicle keeper groups. Table 2 illustrates the major vehicle keeper groups with their associated VKMs and the number of their freight wagons in Europe. To verify the stated number of freight wagons which is based upon the ECVVR entries, the number of freight wagons from the UCG database is listed in brackets.

It is to assert, that the seven biggest vehicle keeper groups – based upon the ECVVR – have registered a total of 299,647 active freight wagons, which is approx. 44 % of all active freight wagons in the EU including Switzerland and Norway.

Table 2: The biggest vehicle keeper groups in Europe

Vehicle keeper group	VKM	Number of active freight wagons (UCG)	Headquartered in
DB	<b>ATG, BTKS, DB, DBFZI, DBSBG, DBSNI, DBSR, DBSRP, DBSRS, DBSUK</b>	<b>80,667 (74,942)</b>	<b>Germany</b>
PKP	<b>PKPLS, PKPC, PKPCS, PKPE</b>	<b>60,439 (60,305)</b>	<b>Poland</b>
VTG	<b>AAE, AAEC, VTG, VTGCH, VTGA, VTGB, VTGE, VTGF, VTGD, VTGI, VTGUK</b>	<b>52,878 (47,724)</b>	<b>Germany</b>
Ermewa	<b>ERMD, ERMW, ERSA</b>	<b>43,647 (43,398)</b>	<b>France</b>
ČD Cargo	<b>CDC, CDCR</b>	<b>24,301 (23,854)</b>	<b>Czech Republic</b>
GATX	<b>GATXA, GATXD, GATXP</b>	<b>23,399 (22,881)</b>	<b>Austria</b>
Rail cargo	<b>RCCF, RCH, RCW</b>	<b>14,316 (23,803)</b>	<b>Austria</b>

Based upon Table 2, “DB” is the largest vehicle keeper group in Europe running a fleet of more than 80,000 active freight wagons. Not to neglect is that VTG AG is with more than 80,000 registered freight wagons<sup>5</sup> the largest freight wagon keeper that is based in Europe, yet with two subsidiaries that do operating outside Europe their domestic European fleet is significantly smaller.

## 3.2 Brake equipment

The entries in the ECVVR do not provide information with regard to the fitted brake equipment of each individual wagon. Nevertheless, to be able to estimate the fitted brake equipment based upon the ECCVR entries year of putting into service is taken as a reference. With the enactment of the TSI Noise in 2006 no more freight wagons with cast iron brake blocks, given minor exceptions, were granted a permission to be brought into service and therewith did not receive a registration. Considering the granted transition period of 3 years, an identification of the brake equipment based upon the construction year<sup>6</sup> can be done for wagons from 2009 onwards.

Building upon all provided data sources<sup>7</sup> it is possible to estimate the distribution between “silent” and “noisy” freight wagons in Europe. Figure 1 shows the distribution for each EU member state as well as Switzerland and Norway. It is to conclude that the overall share of “silent” wagons in the EU, including Switzerland and Norway, is 26 % if the findings from the Impact Assessment are taken into account. Figure 1 shows the distribution between “noisy” and “silent” freight wagons based upon the provided data sources and the data from the Impact Assessment. Data from the Impact Assessment with refer-

<sup>5</sup> Cf. VTG (2017)

<sup>6</sup> It is assumed that the construction year corresponds with the date of putting into service.

<sup>7</sup> NVR (Germany), URR, ECVVR und SWDB

ence to “silent” wagons was only made use of if the provided data sources did not allow to identify the amount of “silent” wagons, or the shares determined from data sources is below the values from the Impact Assessment. In Germany, e.g. the share that is determined with the help of the data sources is higher than what is stated in the Impact Assessment, therefore this working paper used the figure based upon the data sources<sup>8</sup>.

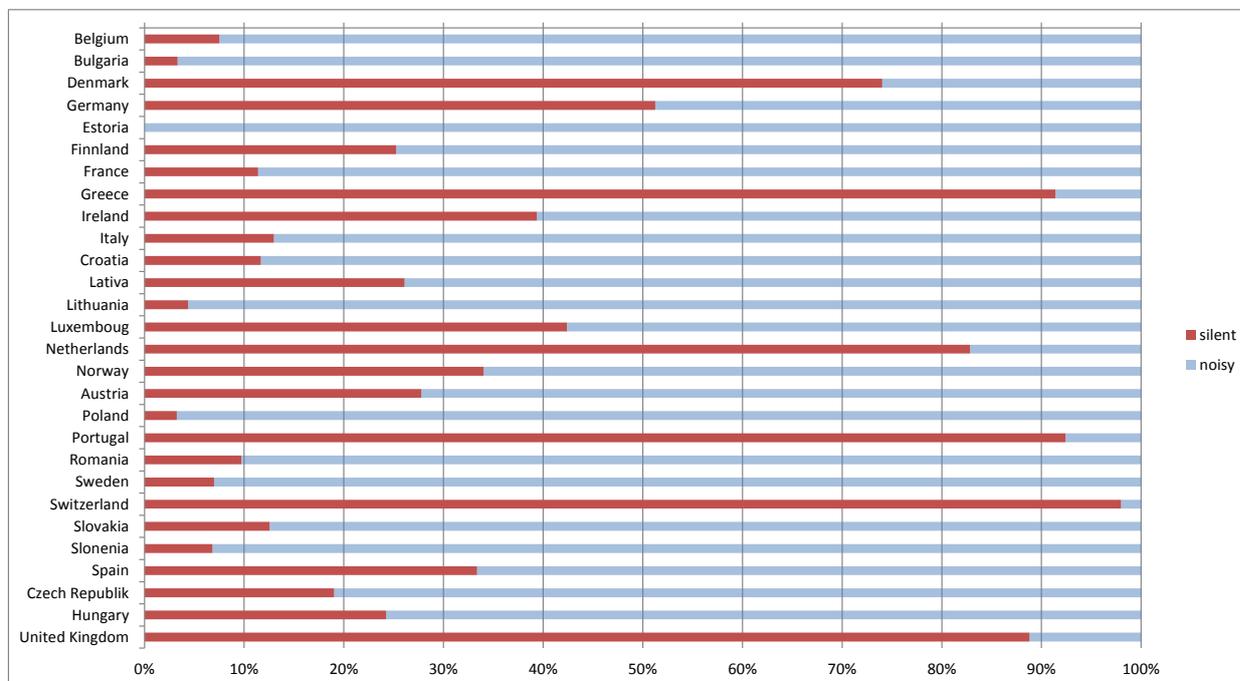


Figure 1: Distribution of “silent“ and “noisy“ wagons in European countries with additional information from the Impact Assessment

### 3.3 Amount of freight wagons of EU countries, including Switzerland and Norway

This chapter provides a summary of all active and registered freight wagons in Europe as they are listed in the ECVVR<sup>9</sup>. Additionally, missing information with regard to the number of wagons were added from the Impact Assessment. Table 3 shows the number of freight wagons according to their place of registration for each EU member state, including Switzerland and Norway.

The total amount of active freight wagons in the EU (including Switzerland and Norway); with additional information if necessary added from the Impact Assessment, is approx. 712,000 wagons. It is to observe that almost one quarter of all European freight wagons are registered in the German NVR.

<sup>8</sup> The reason for the difference is that the data sources are prevailing over the Impact Assessment.

<sup>9</sup> Freight wagons that have been inactive at the time of data retrieval could not be taken into account as part of the study as these wagons are not listed in the ECVVR.

Table 3: Number of active freight wagons according to their country of registration

Country	Number of freight wagons according to ECVVR
Belgium	35,439
Bulgaria	17,147
Denmark	304
Germany	166,239
Estonia	20,849*
Finland	13,160
France	75,068
Greece	3,209
Ireland	254*
Italy	21,443
Croatia	3,277
Latvia	9,827
Lithuania	13,584
Luxembourg	3,327
Netherlands	23,301
Norway	1,516
Austria	23,435
Poland	91,018
Portugal	3,379
Romania	37,122
Sweden	13,328
Switzerland	20,716
Slovakia	28,498
Slovenia	3,314
Spain	20,319
Czech Republic	42,022
Hungary	3,755*
United Kingdom	17,415
<b>Total EU Member States (including Norway and Switzerland)</b>	<b>712,265</b>

(\* = based upon Impact Assessment<sup>10</sup>)

Among the EU member states of Estonia, Finland, Latvia and Lithuania the prevailing track gauge is 1,500 mm (broad gauge). The rest of Europe, with the exception of Spain and Portugal<sup>11</sup>, operate standard gauge railway networks. Some freight wagons can be operated on standard and other track gauges. Therefore, the freight wagons have to undergo gauge conversion<sup>12</sup>. As a result, the total number of active freight wagons that can be operated on standard gauge is 642,287.

<sup>10</sup> Cf. ERA (2018b).

<sup>11</sup> The track gauge in Spain is 1.674 mm and in Portugal 1.668 mm.

<sup>12</sup> Through gauge conversion a freight wagon is construed to operate on both broad and standard gauge. To do so the bogies need to be exchanged. As the number of such freight wagons is very low they will not be taken into consideration.

## 4 Incurred cost to retrofit a freight wagon

To retrofit a freight wagon additional costs occur that go beyond the “normal” cost rates. On the one hand, these are costs to procure the composite brake blocks and on the other hand, there are the costs for retrofitting. In most cases, the retrofit takes place during revision or if an unscheduled maintenance visit at the workshop has to take place, this allows to minimize the additional time and expenses. Additional costs occur during operation of retrofitted wagons as composite brake blocks have an increased wear of the wheels.<sup>13</sup>

The following chapter draws from various sources on the costs of retrofitting and operations that are incurred by retrofitting a freight wagon from cast iron brake blocks to composite brake blocks.

Based upon the identified costs for the retrofit and operations of retrofitted freight wagons Chapter 6 will give a projection of the incurred costs.

### 4.1 Cost for retrofitting and operations

The main obstacle to retrofit freight wagons to “silent” brake block are the incurred cost and the fact that the role of the owner and operator differ. The first decides to undertake the retrofit and has to bear the costs whereas the latter benefits from the bonus granted by the infrastructure provider. The retrofitting costs vary based upon the type of brake block and wagon. Aside from the one-off retrofitting costs, further costs are to be considered as “silent” wagons have higher operational costs per kilometer in comparison to wagons fitted with cast iron brake blocks.

The determined costs to retrofit a 4-axle freight wagon to composite (K) brake blocks are EUR 7,500 (EUR 1,900 per axle). For retrofitting a 4-axle wagon with composite (LL) brake blocks, the costs for retrofitting were determined at EUR 2,500 (EUR 625 per axle).

As previously mentioned in addition to the costs to retrofit the operational costs are higher for a retrofitted wagon in comparison to one equipped with cast iron brake blocks. In the Impact Assessment<sup>14</sup> it is stated that for the operational costs per wagon kilometer is EUR 0.0215. This cost rate applies for both K and LL composite brake blocks as it is assumed that their operational costs are comparable.

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<sup>13</sup> Cf. ERA (2018c); Table 5 portrays the difference in operational performance (distance) of worn wheels according to the brake system.

<sup>14</sup> Cf. ERA (2018b)

## 5 Development of the number of freight wagons for 2020/21 and 2029/30 in Germany, Switzerland, the Netherlands' and Austria

This chapter develops a forecast of the number of freight wagons and the number of required freight wagons in Europe for the years 2021 and 2030. On the one hand the number of freight wagons will be determined based upon the expected life cycle of a freight wagon and on the other hand based upon the development of the operational performance and hauling capacity of rail freight transport.

### 5.1 Projection for the number of freight wagons in Europe based upon their expected life cycle

Based upon a life cycle for a freight wagon of 45 years a forecast for the number of registered and active wagons in 2020/21 and 2029/30 in the EU including Switzerland and Norway is undertaken. With a reference to the construction year, it is possible to deduce the average annual number of registration of new wagons. Based upon the ECVVR, the average number of new registrations in the period 2009-2018 was approx. 7,800 freight wagons per year. Considering freight wagons that are older than 45 years, wagons with no information about their construction year and the average number of new registrations, it is possible to forecast the number of freight wagons until 2030. The development of the number of freight wagons in Europe is depicted in Figure 2.

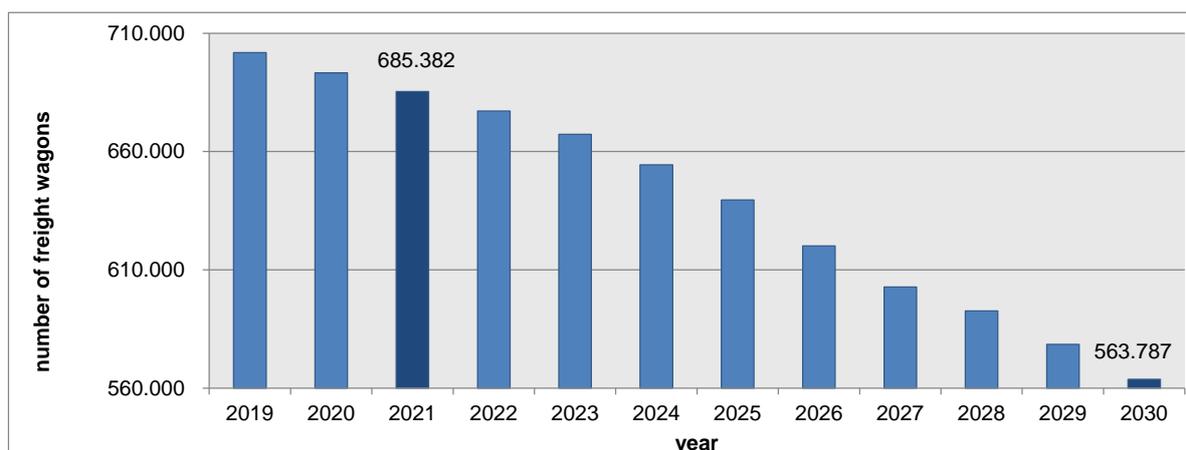


Figure 2: Forecast of the number of freight wagons in Europe based upon the construction year of currently operating freight wagons

## 5.2 Estimation of the required numbers of freight wagons to provide the forecasted operational performance and hauling capacity

To identify the number of required freight wagons two methods are applied to undertake the projection for the years 2020/21 and 2029/30. On the one hand the number of freight wagons is determined based upon the operational performance (track and wagon kilometers) and on the other hand based upon the hauling capacity of the respective country. The average of both figures is calculated and verified against other sources. Supported by operation and transport statistics for each country and the Eurostat database the average rate of change of rail freight transport for the years 2012 – 2016 is determined. Finally, a projection is undertaken by adjusting the historical average of the operational performance and hauling capacity to the years 2021 and 2030.

Table 4 summarizes the result from the projection for the number of freight wagons in Germany.

Table 4: Projection of the required freight wagons for Germany in 2021 and 2030

Year	Amount based on operational performance	Amount based on hauling capacity	Average
2021	<b>172,143</b>	<b>209,727</b>	<b>190,935</b>
2030	<b>144,240</b>	<b>178,720</b>	<b>161,480</b>

## Development of the number of freight wagons for 2020/21 and 2029/30 in Germany, Switzerland, the Netherlands' and Austria

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Due to the expected changes over the course of time and interviews conducted with wagon keepers and RUs this study assumes that 70 % of the rail freight transport in Germany will be performed by locally registered wagons. Based upon this assumption, the number of freight wagons registered in Germany will be 133,655 for 2021 and 113,036 for 2030.

Table 5 summarizes the projection for the number of freight wagons in Germany as well as the Netherlands and Switzerland.

Table 5: Projection for the number of freight wagons required in Germany, the Netherlands and Switzerland for 2021 and 2030

Year	Amount based on operational performance	Amount based on hauling capacity	Average
2021	<b>198,558</b>	<b>250,850</b>	<b>224,704</b>
2030	<b>168,781</b>	<b>228,334</b>	<b>198,558</b>

Based upon the projected operational performance and hauling capacity for 2021 and 2030 the average of the required freight wagons for Germany, the Netherlands and Switzerland in 2021 is 224,704 and in 2030 is 198,558 wagons.

Table 6 summarizes the projection for the number of freight wagons in Germany as well as the Netherlands, Switzerland and Austria.

Table 6: Projection for the number of freight wagons required in Germany, the Netherlands, Switzerland and Austria for 2021 and 2030

Year	Amount based on operational performance	Amount based on hauling capacity	Average
2021	<b>225,905</b>	<b>298,141</b>	<b>262,023</b>
2030	<b>191,412</b>	<b>291,478</b>	<b>241,445</b>

The average projection of operational performance and hauling capacity for 2021 and 2030 indicates that in 2021 262,023 freight wagons and in 2030 241,445 freight are required in Germany, the Netherlands, Switzerland and Austria.

## 6 Determination of costs based upon the projected number of freight wagons

With regard to various legal scenarios that prohibit the operation of “noisy” freight wagons in Germany, Switzerland, the Netherlands and Austria by December 2021, this chapter estimates the need to retrofit and the incurred costs based on the forecasted number of freight wagons by 2021.

Based on the ban of „noisy“ freight wagons in Germany from December 2021 onwards the incurring costs have been calculated. The analysis builds upon the number of projected freight wagons according to chapter 5.2 and the retrofitting and operational costs according to chapter 4.1. The results are summarized in Table 7 and categorized by LL and K brake blocks.

Table 7: Incurring cost due to the ban of “noisy” freight wagons in Germany

YEAR	NUMBER OF “SILENT” FREIGHT WAGONS	COMPOSITE (LL) BRAKE BLOCKS		COMPOSITE (K) BRAKE BLOCKS	TOTAL
		Costs to retrofit	Operational costs	Operational costs	
<b>2018</b>	98,068	€ 57,500,000	€ 63,847,671	€ 31,032,873	<b>€ 152,380,543</b>
<b>2019</b>	124,808	€ 57,500,000	€ 86,100,171	€ 34,651,323	<b>€ 178,251,493</b>
<b>2020</b>	151,548	€ 57,500,000	€ 108,352,671	€ 38,269,773	<b>€ 204,122,443</b>
<b>2021</b>	178,288	€ 57,500,000	€ 130,605,171	€ 41,888,223	<b>€ 229,993,393</b>

According to Table 7 the costs incurred by a ban for “noisy” freight wagons amount to approx. EUR 765 million by 2021. Of this amount around EUR 179 million have to be spent on freight wagons not registered in Germany but operating on the German railway network.

Additional costs beyond the retrofitting and operational costs can occur for a targeted disposition of “silent” non-German freight wagons on the German network. Wagon keepers and RUs indicated during interviews that the costs per freight wagon and disposition are approx. EUR 40. This being the case, the additional disposition costs would amount to approx. EUR 5.4 million under the assumption that the freight wagon is used only once per year.<sup>15</sup>

If „noisy“ freight wagons are banned in Germany, the Netherlands and Switzerland from December 2021 onwards the incurring retrofitting and operational costs are calculated based on the input factors outlined in chapter 4.1 and the number of projected freight wagons according to chapter 5.2.

<sup>15</sup> For 2018 the disposition costs would amount to approx. EUR 929,000, for 2019 to approx. EUR 1.2 million, for 2020 to approx. EUR 1.5 million and for 2021 to approx. EUR 1.7 million, assuming a single usage of a freight wagon.

## Determination of costs based upon the projected number of freight wagons

Based on the calculations of the need to retrofit, Table 8 shows the costs incurred for the traffic of “silent” freight wagons in Germany, the Netherlands and Switzerland, building upon the previously outlined assumptions. Overall, taking into account the made assumptions, approx. 96.7% of freight wagons operating in Germany, the Netherlands and Switzerland in 2021 will be equipped with a “silent” brake system. The number of foreign “silent” freight wagons is approx. 44,000.

Table 8: Incurring costs for a ban of “noisy” freight wagons in Germany, the Netherlands and Switzerland

YEAR	NUMBER OF “SILENT” FREIGHT WAG- ONS	COMPOSITE (LL) BRAKE BLOCKS		COMPOSITE (K) BRAKE BLOCKS	TOTAL
		Costs to retrofit	Operational costs	Operational costs	
2018	130,631	€ 60,000,000	€ 65,874,662	€ 60,510,628	€ 186,385,289
2019	159,641	€ 60,000,000	€ 89,094,662	€ 65,357,803	€ 214,452,464
2020	188,651	€ 60,000,000	€ 112,314,662	€ 70,204,978	€ 242,519,639
2021	217,661	€ 60,000,000	€ 135,534,662	€ 75,052,153	€ 270,586,814

Until 2021 the total costs for “silent” rail freight transport in Germany, the Netherlands and Switzerland will amount to approx. EUR 914 million. Approx. EUR 189 million would have to be spent on foreign freight wagons operating on the German, Swiss and Dutch rail networks. The disposition costs for a targeted use of “silent” foreign freight wagons amount to approx. EUR 5.5 million by 2021.<sup>16</sup>

In addition to the countries that have been examined previously the incurring costs arising from a ban on “noisy” freight cars in Austria are added.

Table 9 summarizes the incurring cost for the scenario that “noisy” freight wagons are banned for rail freight transport in Germany, the Netherlands, Switzerland and Austria.

Table 9: Incurring costs for the ban of “noisy” freight wagons in Germany, the Netherlands, Switzerland and Austria

YEAR	NUMBER OF “SILENT” FREIGHT WAG- ONS	COMPOSITE (LL) BRAKE BLOCKS		COMPOSITE (K) BRAKE BLOCKS	TOTAL
		Cost to retrofit	Operational costs	Operational costs	
2018	142,687	€ 71,250,000	€ 74,862,422	€ 63,187,719	€ 209,300,141
2019	176,706	€ 71,250,000	€ 102,436,172	€ 68,527,351	€ 242,213,523
2020	210,725	€ 71,250,000	€ 130,009,922	€ 73,866,984	€ 275,126,906
2021	244,744	€ 71,250,000	€ 157,583,672	€ 79,206,616	€ 308,040,288

<sup>16</sup> For 2018 the disposition costs would amount to approx. EUR 936,000, for 2019 to approx. EUR 1.2 million, for 2020 to approx. EUR 1.5 million and for 2021 to approx. EUR 1.8 million, assuming a single usage of a freight wagon.

## Determination of costs based upon the projected number of freight wagons

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In total approx. EUR 1,035 million would have to be spent by 2021 to operate “silent” rail freight transport in Germany, the Netherlands, Switzerland and Austria with a share of 93.2% “silent” freight wagons. For holders of foreign freight wagons operating on the German, Swiss, Dutch and Austrian rail network, approximately EUR 282 million would have to be raised. For a targeted use of the “silent” foreign freight wagons, the additional costs amount to approx. EUR 8.1 million by 2021 assuming a single use of the freight wagon.<sup>17</sup>

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<sup>17</sup> For 2018 the disposition costs would amount to approx. EUR 1.4 million, for 2019 to approx. EUR 1.8 million, for 2020 to approx. EUR 2.2 million and for 2021 to approx. EUR 2.6 million, assuming a single usage of a freight wagon.

## 7 Summary

Rail freight transport accounted for approx. 12% of total freight transport in Europe in 2015. Due to the increase in transport services in rail freight transport the burden through rail freight transport noise pollution increased significantly in Germany and other European countries in recent decades. To ensure that rail freight transport continues to be one of the most environmentally friendly modes of transport, traffic with “noisy” freight wagons has been banned on the German rail network from December 2020 onwards.

This working paper quantified the need to retrofit the freight wagon fleets in Germany and other European countries. Applying different legal scenarios that are based on the ban of “noisy” freight wagons in Germany, Switzerland, the Netherlands and Austria. The analysis focuses on different data sources (e.g. ECVRR, URR and NVR) and interviews with wagon keepers and RUs.

The analyzed data reveals that 712,000 freight wagons are registered as active in Europe, with 642,287 of them capable to operate on standard gauge (1,435 mm). 28 % of the European rail freight transport is undertaken on the German rail network. This figure reveals how important the German freight rail transport is in the European context. Germany has with approx. 166,000 freight wagons by far the biggest fleet of active wagons. Overall there are approx. 1,000 freight wagon keepers and among them 247 are registered in Germany. The largest wagon keeper group in Europe, with approx. 80,000 active freight wagons, is DB.

The data base did not allow to exactly identify the brake systems off of all freight wagons, as this information was not existent in all data sources. Therefore, an estimation with regard to equipped brake system based on the construction year was carried out. According to the TSI Noise all freight wagons that have been built or registered after 2009 are equipped with a “silent” brake system (either composite brake blocks or disc brakes). Based upon this estimate and the few information available in the data sources it was possible to determine that 27 % of active freight wagons in Europe are fitted with a “silent” brake system. In Germany, approx. 44 % of the active freight wagons are equipped with “silent” brake systems. In addition, information from the SWDB registry and the Impact Assessment were used to analyze the brake systems.

Based upon the average life cycle of a freight wagon of 45 years it was forecasted that the number of freight wagons for 2021 will be 685,382 wagons and for 2030, it will be 563,787 wagons. Furthermore, the required number of freight wagons was determined based upon the projected operational performance and hauling capacity. According to this approach, the number of required freight wagons for the German rail freight transport in 2021 are 190,935 wagons and for 2030 are 161,480 wagons. The demand for rail freight transport in Germany, Switzerland and the Netherlands resulted in a total of 224,704 freight wagons for 2021 and 198,558 freight wagons for the year 2030. In the final step, rail freight transport traffic in Austria was also considered for the forecast. This resulted in a demand for freight wagons of 262,023 in 2021 and 241,445 in 2030 for Germany, Switzerland, the Netherlands and Austria.

Given the projected number of freight wagons and the determined number of “silent” freight wagons, it was possible to estimate the arising costs to retrofit and for operations differentiated by the different legal scenarios. For the rail freight transport in Germany, the accounting costs for retrofitting and operations during the year 2018 to 2021 will be approx. EUR 765 million. Adding Switzerland and the Netherlands the incurring costs until 2021 will sum up to approx. EUR 913 million. If rail freight transport in Austria is also considered the incurred costs are approx. EUR 1,034 million. The additional costs that occur for the targeted use of “silent” freight wagons in countries where a ban of “noisy” wagons is

## Summary

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planned was also identified. To pool foreign freight wagons for traffic in Germany until 2021 approx. EUR 5.4 million would have to be spend. The ban of “noisy” freight wagons in Germany, Switzerland and the Netherland incurs costs of approx. EUR 5.5 million for wagon pooling. Approx. EUR 8.1 million would be necessary for pooling freight wagons if, in addition, Austria plans to ban “noisy” freight wagons.

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