

## LIFE REBREATH

### DELIVERABLE 5.1

#### *Exploitation and After -LIFE conservation Plan*

#### *Project Information*

<b>Project Acronym</b>	RE - BREATH
<b>Project Full Title</b>	REduction of Brake weaR Emissions in the Transport sector "RE-BREATH"
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## 1. Introduction

ARRIVA is one of the largest operators in the mobility industry and it operates in nine European countries and the United Kingdom, as shown in the following map:



34.600 colleagues



1.5bn Passenger journeys



10 countries



13.000 buses



500 trains

UK	Poland
Italy	Croatia
Spain	Slovakia
Netherlands	Slovenia
Czech Republic	Hungary

ARRIVA operates a wide range of services: local urban and intercity public transport, regional and national rail services, streetcars, maritime connections, on-call services, and services for the disabled.

Employing about 35.000 people and with a fleet of around 13.000 buses and 500 trains, ARRIVA transporting 1.5 billion passengers annually.

The Re-BREATH project, acronym for reduction of brake wear emissions in the transport sector, aims to design and develop an innovative and more environmentally friendly bus braking system as well as to intervene with green mitigation works.

It is a research project coordinated by Brembo, a world leader in the development and production of braking systems, which sees ARRIVA Italia and ARRIVA Slovakia as ones of its official partners.

The project involves testing activities on Crossway LE 12m euro 6 model buses aimed at measuring the emissions of non-exhaust micro particles generated by Local Public Transport mobility braking systems.

The cities where the demonstrations are conducted are Bergamo for ARRIVA Italy and Bratislava for ARRIVA Slovakia.



This deliverable presents in more detail the partner countries and their local units, but also the potential other fleets that will be considered for the installation of the innovative RE-Breath solution.

The choice is always based on the availability of Crossway LE 12m euro 6 model buses, and sees, as potential units, the cities of Turin and Cremona in Italy and the cities of Nové Zámky and Trnava in Slovakia.

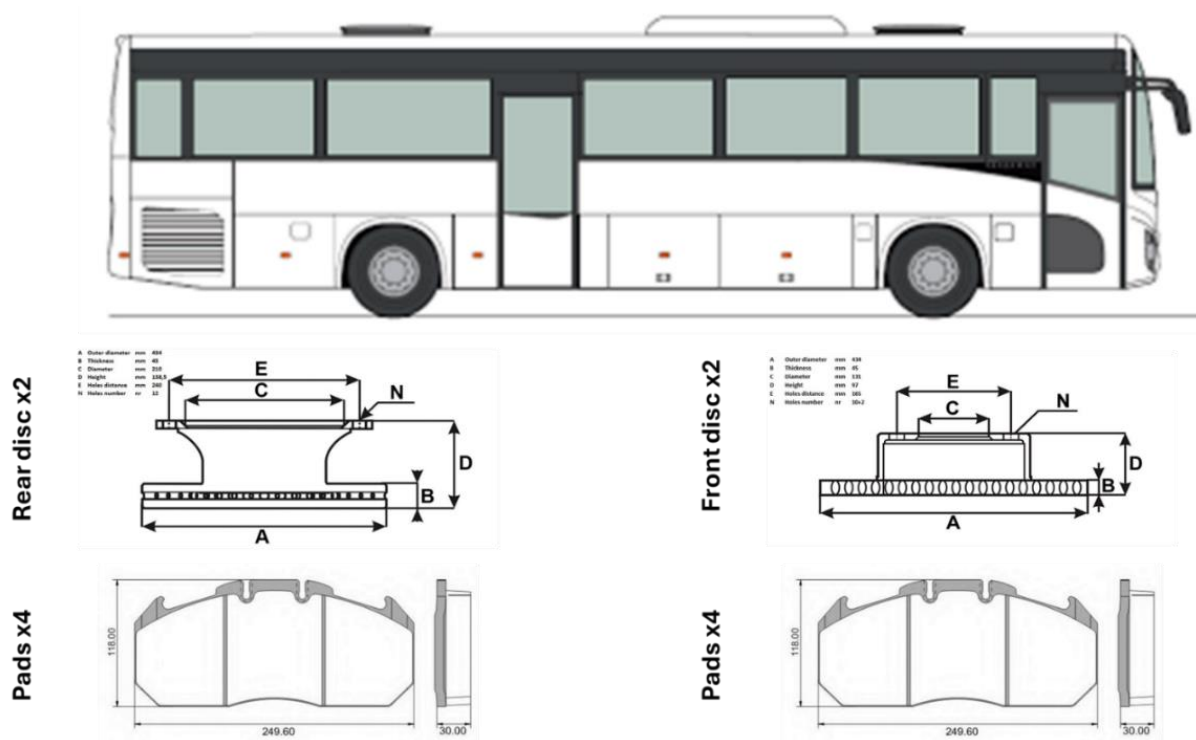
Additionally, Spain and the Czech Republic have been identified as potential countries in Europe.

The last section of the deliverable reports the assumptions necessary to develop the analysis of the cost feasibility of the project.

The conclusions summarized the potential location identified for the replacement of the RE-Breath product and the presentation of the updated exploitation plan.

## 2. Requirements

The project foresees the assembly of Brembo discs and pads on 5 buses Crossway LE 12m euro 6 model, as shown in the following image:



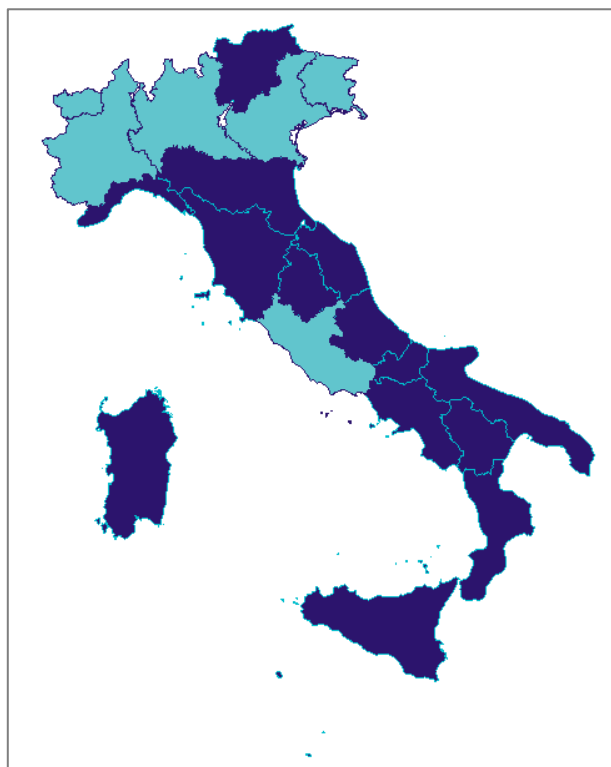
Pad e discs Iveco Crossway

The table below shows the codes of the standard discs and pads Brembo installed:

	Front axle discs	Front axle pads	Rear axle discs	Rear axle pads
Iveco catalogue substitution number	500055596	500086357	500043169	500086357
Aftermarket number Bratislava	2087434001	2129131604	K184836N50	2129131604
Aftermarket number Bergamo	MBR5056	42583125	K184836N50	42583125

### 3. Arriva Italy Exploitation Plan

#### 3.1 Arriva Italia: general description



Arriva has been present in Italy since 2002, where it operates local public transport services mainly in northern Italy, as well as airport connections, rental and granturismo services, and mobility for large events.

Arriva Italia operates local public transport services in the Aosta Valley and in the provinces of Turin, Brescia, Bergamo, Lecco, and Cremona, as well as providing airport connections and transportation services for disabled students and those with reduced mobility in the Rome Capital Municipality.

As a holding company, Arriva Italia owns majority stakes in Arriva Udine and Arriva Veneto and minority stakes in ASF Autolinee and Trieste Trasporti.

Overall, the Arriva Group in Italy operates public transport services for about 90 million bus/km annually, with 2,400 vehicles and 3,500 total employees.

#### 3.2 Bergamo Area

##### Geographical Context

Bergamo region has an area of 2 722,86 km<sup>2</sup>, with a population density of 408,38/km<sup>2</sup> meanwhile the city itself has a population of around 120,000, which makes Bergamo is the fourth-largest city in Lombardy. The Highest place in the region is at 3050 m above the sea level, the lowest is at 82: indeed, the region is composed by 64% of mountain morphology (Valli Bergamasche), 12% by an illy territory and the 24% of valley. Due to these differences in altitude, the climatic condition change from the area, which is considered, varying from a warm weather in the valley becoming colder towards the mountains. The old town of Bergamo, called **Città Alta**, is known for being an UNESCO World Heritage Site since 2017, in addition to this the city is also served by **Il Caravaggio International Airport**, the third-busiest airport in Italy with 16.9 million passengers in 2023 and it is very well connected with important cities like Milan (45 km), Brescia (50km), Lake of Como (35 km), Lake of Garda (80 km).



It appears clear that having a good public transportation system is fundamental to supply the population a service to reach the job locations and schools/universities and to allow the tourism industry to grow; indeed, the routes chosen for the project begin in the city center and end in a hilly or mountainous area.

#### Summary table

Number of buses	365
Number of IVECO CROSSWAY (June 2024)	141
Total km (per year) 2022	10.449.179
Total km travelled by IVECO CROSSWAY (per year) 2022	1.893.675
Total km (per year) 2023	10.922.757
Total km travelled by IVECO CROSSWAY (per year) 2023	4.383.681

### 3.3 Other locations

#### **Turin**

##### Geographical Context

Turin is a city and an important business and cultural centre in Northern Italy. It is the capital city of Piedmont and of the Metropolitan City of Turin, and was the first Italian capital from 1861 to 1865. The city is mainly on the western bank of the Po River, below its Susa Valley, and is surrounded by the western Alpine arch and Superga hill. The population of the city proper is 843,514 (31 October 2023), while the population of the urban area is estimated by Eurostat to be 1.7 million inhabitants. The Turin metropolitan area is estimated to have a population of 2.2 million. Located in northwestern Italy at the foot of the Alps, Turin features a mid-latitude, four seasons humid subtropical climate, located not far away in the French Alps although Turin's average annual rainfall is lower. Winters are moderately cold and dry, summers are mild in the hills and quite hot in the plains. Rain falls mostly during spring and autumn; during the hottest months, otherwise, rains are less frequent but heavier.

Arriva Italia connects the city of Turin with its province, also making direct connections to the airports of Caselle and Malpensa. To offer a punctual and efficient service to passengers every day, enhancing comfort and safety: this is the goal that Arriva Italia aims to achieve day after day, investing in quality and without neglecting respect for the environment.

#### Summary table

Number of buses	195
Number of IVECO CROSSWAY	120
Total km (per year) 2023	9.281.179
Total km travelled by IVECO CROSSWAY (per year) 2023	6.330.593

#### **Cremona**

##### Geographical Context

Cremona is a city in northern Italy, situated in Lombardy, on the left bank of the Po River in the middle of the Po Valley. It is the capital of the province of Cremona and the seat of the local city and province governments. The city of Cremona is especially noted for its musical history and traditions, including some of the earliest and most renowned luthiers.

The population of the city is around 71.223 and the city is 69.7 km<sup>2</sup>, meanwhile the province is around 360.000 and the area is around 1.771 km<sup>2</sup>. The weather is very particular because the area has a full humidity which implies a very hot temperature in summer and a very cold weather in the winter. Cremona is very important from an economical point of view; indeed, it is one of the richest areas in Lombardy due to its farm and industries helped by the good infrastructure.

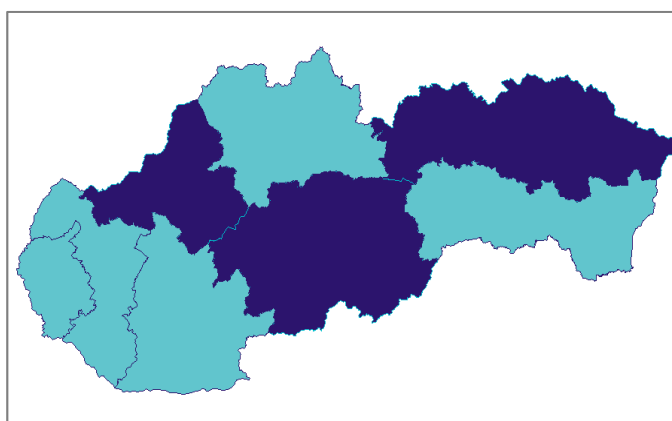
Arriva Cremona is the only responsible of the public transportation, covering the urban area with a project to be the first reality with a complete electric fleet, and the province area: the consequence is that the fleet is covering a very high mileage during its service.

#### Summary table

Number of buses	103
Number of IVECO CROSSWAY	37
Total km (per year) 2023	3.393.385
Total km travelled by IVECO CROSSWAY (per year) 2023	1.248.926

## 4. Arriva Slovakia Exploitation Plan

### 4.1 Arriva Slovakia: general description



ARRIVA entered the bus market in 2008 and have become the largest private bus operator in Slovakia. It provides urban, suburban, contract and commercial bus transport in 5 regions and 16 cities, employs more than 2,500 employees in Slovakia and operates more than 1,500 buses. It consists of six transport companies, a service company and a headquarters.

### 4.2 Bratislava Region

#### Geographical Context

Bratislava region with an area of 2 052.6 km<sup>2</sup>, is the smallest within the Slovak Republic. It is located in the south-western part of Slovakia. The region has a common border with the Republic of Austria and the Republic of Hungary. There is the westernmost point in the Slovak Republic on the western border with Austria, in Záhorská Ves municipality in Malacky district. The highest place in the region is Vysoká hill (759 m above sea level), the lowest water area of the gravel pit in Hrubá Borša municipality (118 m above sea level). The territory of the region is formed in the western part by Záhorská nížina lowland, from the southwest to the northeast there is the mountain range Malé Karpaty, the eastern and south-eastern part is occupied by Podunajská nížina lowland. Climatically, the region belongs to a moderately warm area, while in the southern part contacts the warm area.

### Summary table

Number of buses	223
Number of IVECO CROSSWAY	110
Total km (per year) 2022	15.437.104
Total km travelled by IVECO CROSSWAY (per year) 2022	7.614.715
Total km (per year) 2023	16.077.955
Total km travelled by IVECO CROSSWAY (per year) 2023	7.930.830

## 4.3 Other locations

### Nové Zámky

#### Geographical Context

Arriva Nové Zámky is operating in the southern part of Nitra region. Nitra region with area of 6 343.7 km<sup>2</sup> occupies 12.9% of the territory of Slovak Republic. It is located in the south-western part of the Slovak Republic, bordering the Republic of Hungary in the south.

The relief of the region has mostly a flat and lowland character interrupted by hills. Almost the entire region is located on the Podunajská pahorkatina hills and Podunajská rovina plain, which are the units of Podunajská nížina lowland. The highest place in the region is Panská Javorina hill with a height of 942 m above sea level. The lowest point is the outflow of the river Dunaj (Danube) from the region at the state border with Hungary (101 m above sea level). The region is one of the warmest areas in Slovakia.

#### Summary table

Number of buses	276
Number of IVECO CROSSWAY	80
Total km (per year) 2023	14.921.704
Total km travelled by IVECO CROSSWAY (per year) 2023	2.363.260

### Trnava

#### Geographical Context

With an area of 4 146.3 km<sup>2</sup>, the Trnava region occupies 8.5% of Slovakia's area. It is located in the western part of the Slovak Republic, where it forms a common border with the Czech Republic and the Republic of Austria in the north and with the Republic of Hungary in the south.

From a geographical point of view, the largest area is occupied by the lowlands Podunajská nížina in the south and by Záhorská nížina in the north. They are divided by the mountain range Malé Karpaty. The highest peak of this mountain is Záruby hill (766 meter above sea level), which is also the highest place in the region. The lowest place is the water area in the cadastral district of Okoč municipality (105 m above sea level).

The territory of the region is spread over two climatic zones - warm and moderately warm. The driest and the warmest are the southern areas of Podunajská Nížina and the coldest area is the area of Malé Karpaty Mountain. Average annual temperature is around 10 °C.



## Summary table

Number of buses	262
Number of IVECO CROSSWAY	72
Total km (per year) 2023	13.388.918
Total km travelled by IVECO CROSSWAY (per year) 2023	2.777.571

## 5. Potential Countries

### 5.1 Arriva Spain: general description



Arriva is in the top 10 private operators in Spain, providing services for scholars, private companies and public transport services both in Madrid and Galicia.

In Madrid we connect some of the most important municipalities in the south with the capital city. In Galicia we operate scholar, business and public transport lines providing essential services to connect rural and urban contexts. Our team of close to 1.000 people provides high quality services to more than 40 million passengers each year, delivering close to 1,5 M trips annually.

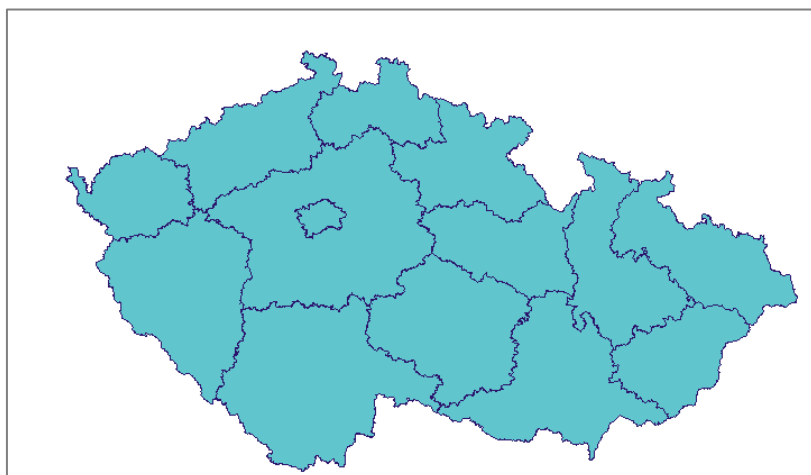
Five years ago, we launched our electrification plan and are committed to contributing to Arriva's pan European decarbonization and sustainability objectives.

In the first phase of our sustainability project, in 2021 we inaugurated our new headquarters in Alcorcón (which combines corporate and operations depot in the same premises). The office building is built following the prestigious Passivhaus Institute criteria for energy efficiency. In 2022 we integrated 15 ZEV to our fleet to service passengers in Alcorcón, one of the largest municipalities in Spain. By the end of 2024 we will be fully executing phase II of our plan, with the electrification of our urban operations in Mostoles and the connection between Alcorcón and Móstoles, servicing more than 400.000 passengers in these municipalities. The completion of this electrification project will have a strong impact in our business. We expect to be much better positioned as a lead competitor to maintain and increase our presence in our current markets and for new tenders.

## Summary table

Number of buses	400
Number of IVECO CROSSWAY	77
Total km (million per year)	33
Total passengers (million per year)	40

## 5.2 Arriva Czech Republic: general description



Arriva CZ operates 2000 buses, more than 100 trains and employs 3500 people. The total annual turnover of the company exceeds seven billion CZK. Arriva CZ's main activity is the provision of regular bus transport, with over 15,000 daily services and more than 115 million passengers per year. Arriva CZ is the market leader in regular passenger bus transport and hold 7% of the rail market in the Czech Republic.

Arriva CZ is constantly evolving. They are taking all steps to be a leader in sustainable travel in Czech Republic. They have got the biggest fleet of electric buses. As they started to operate modern electric trains in Plzensky region, they see electrifying the railways as an essential part of the future. They have got over a hundred CNG buses in our fleet too. Plus, they are constantly expanding the numbers of low-emission buses and trains.

Number of buses	2000
Number of IVECO CROSSWAY (+ another 36 from Jan 24)	548
Total km (million per year)	110
Total passengers (million per year)	115

## 6. Cost feasibility

The analysis of the cost feasibility of the project is based on the evaluation of some important technical and safety conditions to be ensured, reported in the following table from the operational, safety and economical point of view:

<b>Operational</b>	<ul style="list-style-type: none"> <li>- Original discs and pads replaced only when it is reached the minimum thickness defined by the manufacturer.</li> <li>- Similar replacement times of the original disc and pads.</li> <li>- At least the same durability of the original disc and pads.</li> <li>- Easy assembly/disassembly.</li> <li>- Delivery time in line with the maintenance requirements.</li> </ul>
<b>Safety</b>	<ul style="list-style-type: none"> <li>- At least safety level offered from then manufacturer of the original discs and pads.</li> <li>- Equal environmental impact in terms of disposal.</li> </ul>
<b>Economical</b>	<ul style="list-style-type: none"> <li>- An economic impact comparable with respect to the manufacturer, in terms of initial purchase of discs ad pads and future labor and maintenance costs.</li> </ul>

A detailed business case is reported in the deliverable 5.2 developed by Brembo.

## 7. Conclusions

The following table reports the number of buses, and specifically the number of Iveco Crossway, per each local units of the partner countries, and also for the potential local units and countries individuated for the exploitation plan:

	Area	Notes	Number of buses	Number of IVECO CROSSWAY
ARRIVA Italy	Bergamo	Re-Breath demonstration	365	141
	Turin	Potential local unit	195	120
	Cremona	Potential local unit	103	37
ARRIVA Slovakia	Bratislava	Re-Breath demonstration	223	110
	Nové Zámky	Potential local unit	276	80
	Trnava	Potential local unit	262	72
ARRIVA Spain		Potential country	400	77
ARRIVA Czech Republic		Potential country	2000	548

In conclusion, it is reported a summarize of the proposals declared at the beginning of the project from each partner, that will be achieved with respect to the expected timelines:

#	Asset	Owner	Description	Exploitation path	Comment
1	Brake	BREMBO	At least 40 brakes will be produced	1) Patent creation on production methods 2) Commercial path: communication of the results to new and existing customers so to increase potential market	<ul style="list-style-type: none"> <li>• Second optimization loop could be released on the market by the end of the project.</li> <li>• Replication activities planned in Slovenia (new potential customer) and in Italy (other locations).</li> </ul>
2	Dataset on emission factors and air quality	CNR	Data from two measurement campaigns in Bergamo and Bratislava	1) Knowledge transfer in National and International committee 2) Publication of scientific papers	<ul style="list-style-type: none"> <li>• Publication of 1 scientific papers</li> <li>• Participation in 2 conferences/workshop/webinars</li> </ul>
3	Vehicle demonstrators	ARRIVA IT	Several buses will be used as demonstrators	1) Commercial path: marketing campaigns to increase commercial potential of the new buses in Bergamo	<ul style="list-style-type: none"> <li>• During the demonstration 5 buses were equipped with REBREATH braking system.</li> <li>• A replication plan is in place to test the second optimization loop and the Greenance product.</li> <li>• An event in Bergamo will be organized by the end of the project.</li> <li>• A total of 298 IVECO CROSSWAY are available for the replication activities in Bergamo, Turin and Cremona.</li> </ul>

4	Vehicle demonstrators	ARRIVA SK	Several buses will be used as demonstrators	1) Commercial path: marketing campaigns to increase commercial potential of the new buses in Bratislava	<ul style="list-style-type: none"> <li>• During the demonstration 5 buses were equipped with REBREATH braking system.</li> <li>• Two public events organized in Bratislava - at the beginning of the demonstration period and in March 2025.</li> <li>• A total of 262 IVECO CROSSWAY are available for the replication activities in Bratislava, Nové Zámky and Trnava.</li> </ul>
5	Green areas	MoBER	Green areas will be installed along the bus routes	1) Awareness towards public	<ul style="list-style-type: none"> <li>• Within the awareness campaign conducted by ATB we distributed a survey on citizens' perception regarding the pilot use case in Bergamo with a focus on green areas.</li> <li>• The green areas chosen for the RE-BREATH pilot host a info board on the project.</li> </ul>