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## BUS SYSTEMS IN EUROPE : TOWARDS A HIGHER QUALITY OF URBAN LIFE AND A REDUCTION OF POLLUTANTS AND CO<sub>2</sub> EMISSIONS

*The International Association of Public Transport (UITP) is the advocate of sustainable urban mobility and the only worldwide network to bring together all public transport stakeholders and all sustainable transport modes. We have 1,300 member companies from 92 countries. Our members are public transport authorities and operators, research institutes and the public transport supply and service industry. In Europe, UITP brings together more than 400 urban, suburban and regional public transport operators and authorities from all EU member states.*

### **Key facts for public transport in the EU 28**

*Passenger journeys: 57 billion/year, more or less equally shared between road modes (mainly bus) and rail modes (urban, suburban and regional rail).*

*Economic value of public transport services: € 130 - 150 billion/year or 1 – 1.2% of GDP.*

*Employment: direct employment 1.2 million and indirect employment 2 - 2.5 indirect jobs for each direct job on average.*



## Executive summary

Public transport – incl. bus services – contributes to cleaner air and quality of life in cities and reduces green house gas (GHG) emissions in the EU, as it uses up fewer resources and emits less CO<sub>2</sub> per passenger than other modes of transport. In light of the EU's objective to decarbonise transport by 2050, efforts should continue to be made towards technological innovation and to support new technologies to reach maturity and be deployed across the EU. At the same time, a retrofitting or replacement of the oldest diesel buses in the most cost-efficient way today – i.e. in a first step by existing, reliable technologies and in a second step by new experimental technologies – can make an immediate contribution towards the EU's strategic aims.

However, technological solutions alone are not enough. In order to be most effective in lowering CO<sub>2</sub> emissions, they should be accompanied by the creation of the right framework conditions for public transport undertakings to form the backbone of urban mobility. Sustainable mobility relies on a strong and attractive public transport system, which is to be integrated with other sustainable modes of transport, such as car- and bike-sharing schemes. Improvement in services and customer satisfaction can be ensured via continuous support for research projects in the field of buses based on a long-term strategic research strategy. Strong and qualitative modal shift targets in favour of public transport would reduce CO<sub>2</sub> emissions and significantly improve the quality of life in European cities.

## Recommendations to the European Union

- Include the promotion of public transport as part of any European CO<sub>2</sub> reduction strategy and a strategy on clean air. Support local authorities in developing sustainable mobility plans on the basis of an efficient public transport system as the backbone, which is complemented by other sustainable modes of transport.
- Expand public transport systems by investing into more priority bus lanes, BRT and BHLS systems that are resource-efficient and contribute to the mobility and quality of life in the region.
- Encourage cities to set ambitious quantitative modal share targets to attain balanced sustainable local mobility: e.g. 50% of local mobility should be done via public transport and soft modes such as biking and walking. Such targets could be fixed within the Sustainable Urban Mobility Plans (SUMPS).
- Continue to provide R&I funding earmarked for public transport development within the European research framework programmes. Engage into a long-term research strategy instead of multiple "pilot projects" in the field of bus passenger transport.
- The EU, Member States and local transport authorities should consider that a "clean fleet" can be composed of hybrid, electric and alternatively fuelled as well as modern Euro VI buses. It is the task of local authorities to determine the right mix, taking into account the feasibility in the local context.
- Besides developing further Euro standards for diesel buses, support modal shift to public transport.
- Together with the European Investment Bank (EIB), provide funding for an accelerated renewal of the oldest parts of bus fleets, leading to an immediate improvement in CO<sub>2</sub> emissions and pollutants.
- Sufficient resources should be made available for the development of sustainable technologies, the further testing and market uptake of electric and alternatively-fuelled buses and their infrastructure.
- Encourage Member States to invest in green public transport and develop future-oriented SUMPS, and support efforts through the European Structural and Investment Funds.
- Put forward the announced new legislation with the aim to reduce CO<sub>2</sub> emissions of heavy duty vehicles. The new legislation shall establish a mandatory certification system of CO<sub>2</sub> emission values for all delivered vehicles. As a second step, continue with emission standards.

## Introduction

In its 2011 Transport White Paper, the European Commission put forward the concepts of decarbonisation and resource-efficiency in transport. Low-carbon and resource-efficient mobility is essential for a sustainable future and helps build competitive cities where people, businesses and culture can thrive. Public transport plays a major role in helping to achieve the EU's economic and climate targets. Bus operators and the bus industry are key players in this regard, considering that they are part of the public transport systems of every European city, and that public transport in most small and middle-sized towns is based entirely on buses.







In view of the announced mid-term review of the Transport White Paper, UITP stresses that the European Union needs a comprehensive approach towards a more sustainable mobility in Europe. In order to reach the EU's GHG emission reduction objectives, technological efforts need to be combined with a strong shift towards collective modes of transport. Cities such as Vienna can serve as an example, where the use of alternatively-fuelled buses in combination with policies encouraging the use of public transport raised the modal share of public transport to 39%, while it causes only 6% of the city's transport-related CO<sub>2</sub> emissions.

Concerning the announced EU policy initiatives towards cleaner air and a further reduction of CO<sub>2</sub> emissions of heavy duty vehicles (HDVs), the European bus sector welcomes these initiatives and underlines the contribution which buses and public transport in general already make towards these aims.

This policy paper demonstrates the contribution from the bus sector towards a higher quality of urban life and a low-carbon economy, and gives recommendations how this contribution can be strengthened.

## Resource efficiency & quality of life

Compared to private motorised mobility, public transport (including by bus) makes the most efficient and equitable use of scarce resources, such as fuel and public space. By occupying less space and generating fewer emissions per passenger, public transport enhances the quality of life in cities. In other words: While all traffic contributes to the problems of air pollution and congestion, public transport is part of the solution! The following table compares what resources are needed to transport 10.000 persons across 1 km.

	# of passengers	# of vehicles	Space (m <sup>2</sup> )	Fuel (liters)
 passenger car	5	2,000	24,000	200
 8 m (midi)	25	400	8,500	120
 12 m (standard)	100	100	3,200	50
 18 m (articulated)	160	63	3,000	35
 23 m (bus-train)	185	54	3,200	35
 24 m (double-articulated)	200	50	3,000	26

Source: Volvo Bus Corporation, MAN Truck & Bus AG, and UITP Bus Committee © 2015

The full potential can only be exploited in the right conditions, i.e. when buses operate on reserved priority lanes, with priority traffic lights, or benefit of other prioritization measures. Thanks to a higher and more regular commercial speed, buses on separate lanes save fuel and produce even fewer emissions per passenger. Several European cities have priority bus lanes, whereas in South America more and more Bus Rapid Transit (BRT) and Bus on High Level of Service (BHLS) systems are being established due to their relatively low infrastructure costs, flexibility and scalability, compared to rail-based systems.



BRT system in Bogotá, Columbia

#### UITP Recommendations to the EU:

- Include the promotion of public transport as part of any European CO<sub>2</sub> reduction strategy and a strategy on clean air. Support local authorities in developing sustainable mobility plans on the basis of an efficient public transport system as the backbone, which is complemented by other sustainable modes of transport.
- Public transport systems should be expanded by investing into more dedicated bus lanes, BRT and BHLS systems that are resource-efficient and contribute to the mobility and quality of life in the region. The European institutions, including the European Investment Bank, should support this by providing funding opportunities for such systems.

### **Attractiveness & stronger shift towards a use of public transport**

The attractiveness of public transport systems depends on various factors, such as reliability and punctuality, value-for-money, level of service, easiness to access and to use, intermodal consistency, comfort and cleanliness, etc. The bus industry and operators work jointly towards a higher attractiveness through various measures impacting all elements of the bus system (vehicle, infrastructure and operations), such as:

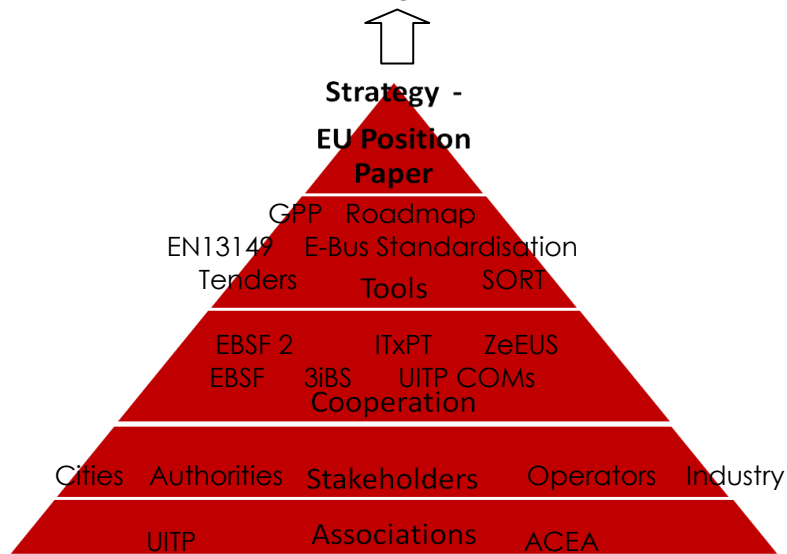
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| <ul style="list-style-type: none"> <li>✓ Installing special bus lanes and favourable traffic management systems, which increase the buses' speed and punctuality;</li> <li>✓ New and modern fleets;</li> <li>✓ Efficient planning of the network and ensuring a high level of service, especially at peak times;</li> <li>✓ Easy access to ticketing and information systems;</li> </ul> | <ul style="list-style-type: none"> <li>✓ Accessible design of the vehicles and the physical environment (bus stops, stations and intermodal hubs);</li> <li>✓ Internal layout enabling comfortable standing and moving for passengers whatever the bus load;</li> <li>✓ Further deployment and interaction with soft modes complementary to bus systems;</li> <li>✓ Etc.</li> </ul> |
|--|---|

In June 2009, UITP set out the ambitious aim for its sector to double the market share of public transport worldwide by 2025.<sup>1</sup> Transport operators and the industry, who are working towards this goal, would like to see this ambition shared by European policy-makers. By ensuring sufficient investments into a high-quality public transport system and promoting modal shift towards public transport, this could substantially contribute to reducing CO<sub>2</sub> emissions, clean air and quality of life, in particular in urban areas.

In order to render public transport more attractive to passengers, UITP and its members engaged in various research projects which delivered successful outputs, such as new layout concepts for improved boarding / alighting operations and increased capacity and comfort; an IT architecture enabling interoperability between IT systems to provide integrated mobility services to customers; recommendations for customer-

friendly signals at urban interchanges; a new functional design of bus stops featuring new services and new facilities; etc. Further resources for R&I and a long-term strategy to identify strategic projects in the field of bus passenger transport are needed to continue these efforts in the future. It is essential that local transport authorities, bus manufactures and bus operators engage jointly in such projects.

**Vision: Improved urban mobility of people, less air quality and CO2 emissions, leading to more quality of life**



UITP Recommendations to the EU:

- Encourage cities to set ambitious quantitative modal share targets to attain balanced sustainable local mobility: e.g. 50% of local mobility should be done via public transport and soft modes such as biking and walking. Such targets could be fixed within the Sustainable Urban Mobility Plans (SUMPS).
- Continue to provide R&I funding earmarked for public transport development within the European research framework programmes, and engage into a long-term research strategy in the field of bus passenger transport. The Roadmapii developed and supported by many bus stakeholders already indicates areas for innovation and priorities for research.

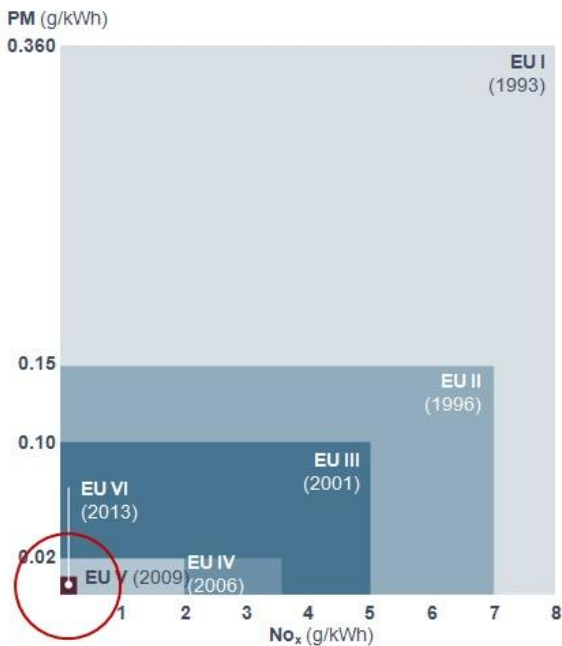
**Modern propulsion technologies**

Today the propulsion technologies used in the bus sector are much diversified. UITP and its members have contributed to the development and testing of alternatively-fuelled and electric buses and continue to test them in a real environment. For the time being, diesel and biodiesel buses constitute by far the largest part of the bus fleet (90% of the bus fleets in Europe, according to the results of the 3iBS survey representing 70,000 buses operated in 63 European cities and regions).

In order to assess the environmental impact and contribution of each conventional and alternative fuel, including electricity, to the EU's climate goals, UITP recommends to assess them "from well to wheel", i.e. to consider also how climate-friendly the fuel is generated and transported. In the case of electric vehicles, the electricity mix determines the amount of CO<sub>2</sub> generated per electric vehicles. Taking a "well to wheel" approach is particularly important as CO<sub>2</sub> is not a local pollutant, but a global one.

## Euro VI diesel buses

Since the 1990's, every few years a new "Euro" standard set new mandatory emission limits for certain pollutants, amongst which NO<sub>x</sub> and PM. Euro I standards were introduced in 1992, followed by the Euro II regulation in 1996. In 1999, Directive 1999/96/EC introduced Euro III (2000) as well as Euro IV & V standards (2005 & 2008). Most recently, Euro VI emission standards became effective from 2014.



Pollutants by Euro VI standards in comparison with previous Euro norms.

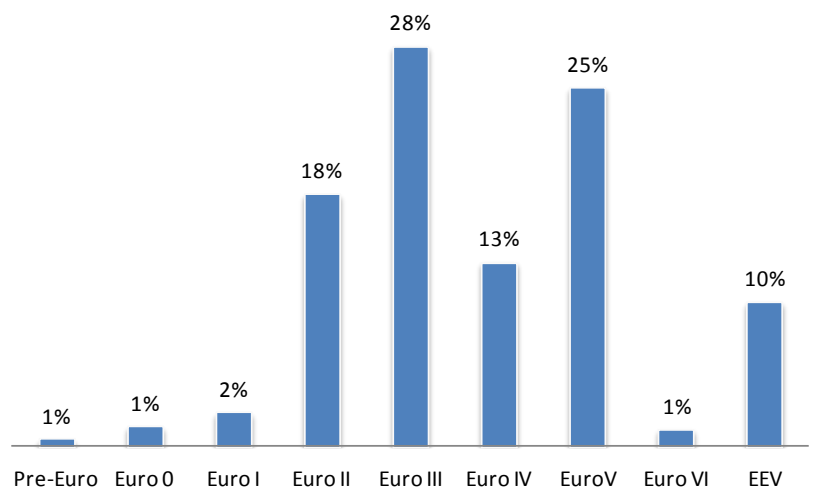
European bus manufacturers have invested heavily in new engine development in order to comply with these standards: the development of Euro IV, V and VI engines required up to 50% of their total product development investment resources. These costly investments have led to a significant reduction in local pollutants, close to the limit of the ability to detect them (see graph on the left). Therefore UITP considers that the focus should no longer be just on developing further Euro standards, but rather on investing into bus systems as a whole, leading to more modal shift (see previous chapter).

Despite the outstanding results achieved so far, diesel buses still suffer of a negative reputation and politicians start to call for a "clean fleet" composed only of electric and alternatively-fuelled buses. This negative perception of diesel buses may be due to the fact that almost 50% of buses used across the EU are still Euro III and older (see graph below).

Whilst a regular percentage (ca. 8%) of the bus fleet is renewed every year, the renewal of an entire fleet is achieved over a full bus lifecycle, i.e. ca. 12 years, sometimes longer. An accelerated renewal of the oldest parts of a fleet and substitution by modern Euro VI buses and (partly) electric or alternatively-fuelled buses would trigger an immediate reduction of particles and GHG emissions in the respective city or region.

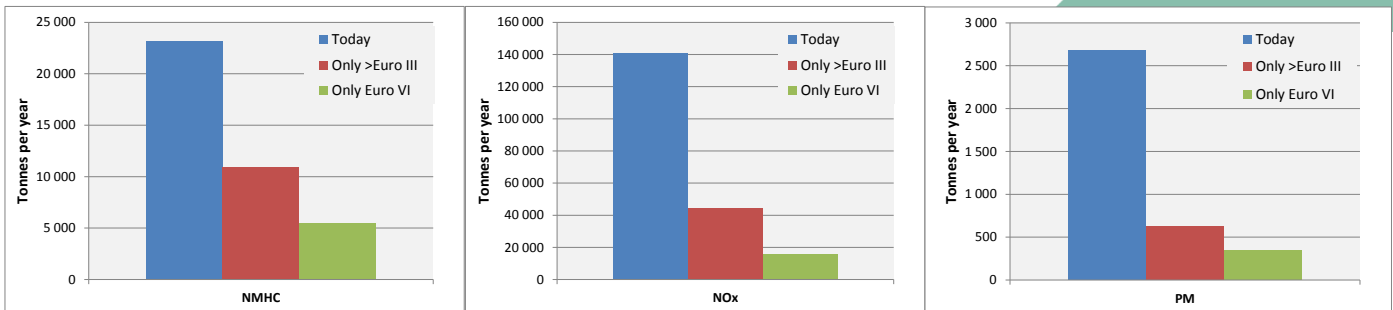
The graph on the next page demonstrates the various possible scenarios:

- Emissions by a bus fleet as we find it today (blue);
- Fleet of buses newer than Euro III (red); and
- only Euro VI buses or fully emission-free buses (green).



Bus fleet breakdown by Euro standards, 2015. (Source: 3iBS project elaboration based on city and regional bus services in operation in France, Italy, the Netherlands, Poland, Sweden and United Kingdom).





Estimated reduction in local pollutants with new buses. (Source: VOLVO Bus Corporation, based on data from the 3iBS project, 2015).

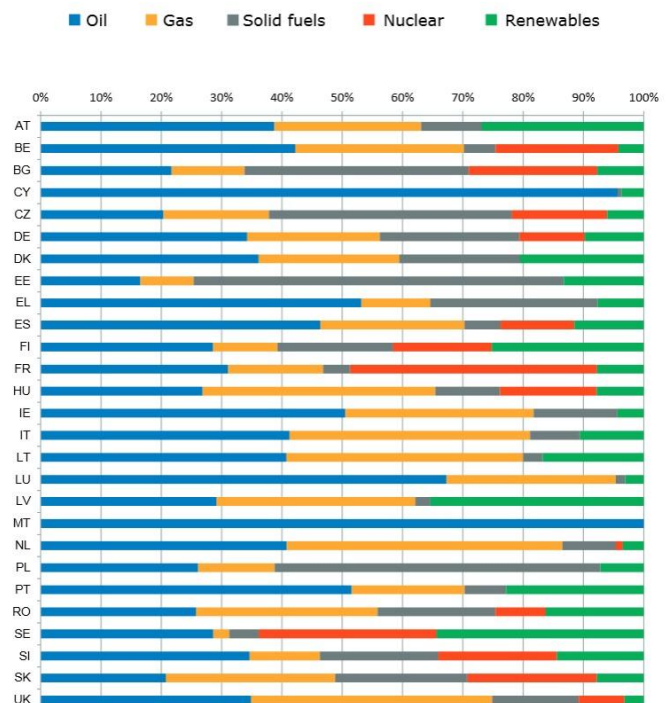
### Alternatively fuelled buses

Buses powered by alternative fuels have been available for more than ten years and have gained popularity in recent times due to their advantageous CO<sub>2</sub> balance. From the start, UITP members have supported the development and testing of such alternative technologies. On the one hand, there are proven and reliable technologies, such as bio fuels (i.e. bio diesel, bio gas and bio ethanol) and natural gas (CNG); on the other hand, new experimental technologies, such as hydrogen, new generation bio fuels, bio waste, etc. are emerging.

### Electric buses

Electric buses have been used by public transport operators since the 1930's, when trolley bus systems were established in some EU Member States. Besides trolley buses, solutions vary from mature and reliable technologies to new and experimental ones. All electric vehicles have in common that they do not produce local emissions and hence contribute to clean air and quality of life in cities. They also produce less noise than conventional buses, which makes them very popular in urban environments.

When considering the environmental impact and CO<sub>2</sub> balance of electric buses, this should include its components such as the battery (its origin, production and disposal), but also the origin of the electricity mix, which varies strongly amongst EU Member States and can in fact lead to an unfavourable CO<sub>2</sub> balance of electric vehicles and a shift of emissions from the cities to the rural areas where power stations are located. Zero emissions can only be claimed if electric vehicles are powered by green energy.



Energy mix of EU Member States. (Source: European Commission, 2013)

In summary, today, standard diesel buses still form the backbone of most public transport networks and already deliver relatively low-emission trips per passenger. A "clean" bus fleet should be defined as one causing "near-to-zero emissions", i.e. a fleet composed of Euro VI, electric and alternatively fuelled buses. Some of the electric and alternatively-fuelled buses are currently still significantly more expensive than diesel buses. However, it is important to look at the life-cycle costs of these vehicles, which must take into

account the cost of fuel or energy consumption, as well as positive externalities such as a reduction in emission and low noise levels. Some new technologies require the installation of local charging infrastructure. Independently of the technology, public transport operators together with the industry are already engaged in various projects with the aim to steadily reduce the fleet's consumption of fuels and energy.

For bus operators, the main question when starting to use alternatively-fuelled and electric buses is how to integrate them into the network and timetable without causing delays or interruptions of service. In terms of human resources, the introduction of new technologies into a bus fleet requires the development of the appropriate skills in the employees. Both drivers and the maintenance and repair staff need to get familiar with the new technologies prior to their introduction.

UITP considers that new propulsion technologies need to be further developed and tested in order to increase their availability and reliability. The purchase of more alternatively-fuelled or electric buses should however not lead to a reduction of overall service due to budgetary restraints. Instead, the key strategy to reduce CO<sub>2</sub> emissions in cities should be to make more people shift from individual to public transport.

#### UITP Recommendations to the EU:

- The EU, Member States and local transport authorities should consider that a “clean fleet” can be composed of hybrid, electric and alternatively fuelled as well as modern Euro VI buses. It is the task of local authorities to determine the right mix, taking into account the feasibility in the local context.
- Besides developing further Euro standards for diesel buses, support modal shift to public transport.
- Together with the European Investment Bank (EIB), provide funding for an accelerated renewal of the oldest parts of bus fleets, leading to an immediate improvement in CO<sub>2</sub> emissions and pollutants.
- Sufficient resources should be made available for the development of sustainable technologies, the further testing and market uptake of electric and alternatively-fuelled buses and their infrastructure.
- Encourage Member States to invest in green public transport and develop future-oriented SUMPS, and support efforts through the European Structural and Investment Funds.

## **Transparency and public procurement**

Public transport authorities and operators are committed to enhance the quality of life in their city and contribute to the preservation of the planet. The “Green Public Procurement Directive” 2009/33/EC is already a good step into this direction. Following the publication of the European Commission's strategy for CO<sub>2</sub> emissions from heavy duty vehicles (HDV), UITP and its members welcome the Commission's initiative to bring full transparency on fuel efficiency and CO<sub>2</sub> emissions to the sector.

As demonstrated in the previous chapter, the various types of new technology applied in buses contribute to a global CO<sub>2</sub> reduction; now the operators and industry requires a system to compare the CO<sub>2</sub> emissions of vehicles. For the sake of making an effective contribution to the EU's overall strategic aim of decarbonising the transport sector, it would be important to consider CO<sub>2</sub> emissions not only locally, but globally (“well-to-wheel”), and to include all alternative fuels and electric vehicles as well as hybrids.

#### UITP Recommendations to the EU:

- Put forward the announced new legislation with the aim to reduce CO<sub>2</sub> emissions of heavy duty vehicles. The new legislation shall establish a mandatory certification system of CO<sub>2</sub> emission values for all delivered vehicles. As a second step, continue with emission standards.



## Conclusion

European bus systems have improved a lot in recent years and continue to enhance daily the quality of life of EU citizens, contribute to air quality in cities and to the global reduction of GHG emissions. The European bus sector has done its homework and invested heavily in the development of new technologies and other “soft” improvements of bus systems. UITP and its members now ask the European institutions to create the right framework conditions that will allow these efforts to be put to best use.

This includes:

1. Agreement on strong modal shift targets.
2. Contributing to improving the image of bus systems across Europe.
3. Supporting the accelerated renewal of the oldest parts of the bus fleets by modern buses.
4. Supporting the further development of new propulsion technologies.
5. Providing the funding for R&I projects based on a long-term strategy for the bus sector.

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<sup>i</sup> [www.uitp.org/strategy-public-transport](http://www.uitp.org/strategy-public-transport)

<sup>ii</sup> [www.ertrac.org/uploads/documents\\_publications/Roadmap/European%20Bus%20System%20of%20the%20Future.pdf](http://www.ertrac.org/uploads/documents_publications/Roadmap/European%20Bus%20System%20of%20the%20Future.pdf)