UITP ADVANCING PUBLIC TRANSPORT

ACTION POINTS

HOW SHOULD THE PUBLIC TRANSPORT SECTOR TRANSITION TO RENEWABLE ENERGY

APRIL | 2023

INTRODUCTION

For many years, a significant proportion of public transport operations have relied on polluting fossil fuels. However, public transport is an energy-efficient mode of travel and is already partially powered by electricity, positioning the sector as a leading provider of sustainable transport. In order to maintain this leadership role and take its share of the burden of reducing emissions, the sector is currently decarbonising its activities by transitioning to renewable energy sources. This includes the electrification of vehicle fleets (including buses, boats, shared cars and trains) and investing in fleets powered by other alternative energy sources, such as hydrogen or biofuels.

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For the sector to achieve this transformation and meet its decarbonisation objectives, it must invest both in new green fleets to ensure that they have access to green and renewable sources of energy; the energy supply for existing fleets and all assets managed by public transport undertakings must not be ignored in striving for CO_2 benefits throughout an organisation.

For cities in search of achieving their climate objectives and Sustainable Development Goals (SDGs), deploying clean public transport fleets supplied with renewables and encouraging a modal shift towards public transport is the key. This deployment can be leveraged for other city services and to support the local economy and energy market while improving health of citizens.

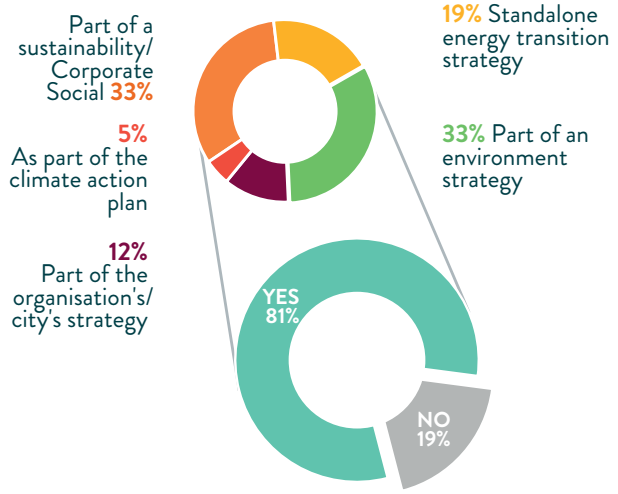
These Action Points offers guidance on how public transport undertakings can achieve a successful energy transition to their decarbonisation goals while unlocking other benefits arising from this energy transition.

1 United Nations Department of Economic and Social Affairs, 2023. The 17 Goals.

DECARBONISATION OF PUBLIC TRANSPORT

According to a survey completed by 71 UITP members, **72% already have a carbon neutrality target or strategy.** In order to reach those targets, the majority of public transport undertakings are working on reducing their operational emissions. Some **81% of public transport operators (PTOs) and authorities (PTAs) responding already have an energy transition strategy.** Those strategies cover more often look more at the procurement of clean vehicles than at the provision of renewable energies. However from a lifecycle perspective, a combination of both is vital to ensuring the true decarbonisation benefits and will be central to reaching carbon neutrality objectives. Additionally, energy consumption of other assets managed by public transport undertakings, such as stations or depots, should not be disregarded.

Share of PTOs and PTAs that cover energy transition in their strategy



It is also important to notice that decarbonisation of public transport goes beyond energy consumption itself, it is a matter to be considered by the whole supply chain. In this regard, requirements to reduce carbon emissions from manufacturing or construction processes for instance are also being requested by authorities when tendering vehicles or commissioning infrastructure works.

TENDER REQUIREMENTS FOR ELECTRIC BUSES

Sustainability criteria play increasingly an important role in the design of electric buses. Life Cycle Assessment (LCA) is a valuable tool to evaluate the environmental impact of buses throughout their life cycle, from cradle to grave, focusing on the reduction of energy consumption and emissions associated with the extraction, processing, and transportation of raw materials, as well as with the manufacturing, operation, and end-of-life disposal.

In this light, some criteria that can be considered in bus design include the use of lightweight materials to reduce energy consumption, the use of recycled materials to reduce waste, and the use of energy-efficient components to reduce energy consumption and subsequent emissions.

Specifically on e-bus design, criteria related to the choice of the battery technology and the decommissioning process should be considered, as well as vehicle interior design choices for the driver cabin and the passengers area that guarantee thermal comfort and minimise energy losses.

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PROVIDING DECARBONISED ENERGY: OPPORTUNITIES FOR THE PUBLIC TRANSPORT SECTOR

On one side, alternative fuel technologies such as electromobility, hydrogen and biofuels have considerable potential to decarbonise operations; on the other side, supplying renewable energies for existing and new fleets is also essential to unlock true carbon benefits. Selecting the appropriate solution and schemes should be considered according to the local context and other organisational factors.

According to the local legislation, low carbon fuel standards differ from a country to another. When initiating the energy transition of vehicles and of energy supplies, this should be well assessed and taken into account to support the achievement of strategic and decarbonisation objectives.

The deployed solution should also be sustainable not only environmentally speaking but also financially and in terms of stability of supply. As energy represents one of the largest operating costs for any public transport undertakings, there is an increasing business case for sourcing cheaper, cleaner and locally produced energy options.

Public transport undertakings should investigate in the wide range of schemes available (such as "Power Purchase Agreement") to deploy renewable assets, either:

- On-site: Renewable plant located on the customer's property, such as roof of depots or stations.
- Off-site: Contract associated with a utility-scale wind farm or photovoltaic plant connected to the network of the country's electricity system.

Public transport operations requires a large amount of electricity to power its assets. Transport for London (UK) consumes 1.6TWh per annum, which is equivalent to the electricity consumed by over 437,000 homes (12% of homes in London) and is currently seeking to enter into a PPA. The Société des Transports Intercommunaux de Bruxelles (Belgium) is the seventh largest electricity consumer in the country and has recently signed a contract to supply 20% of its electricity with wind power. As a large consumer, decarbonisation of electricity supply has a great impact on reaching the organisation's climate objectives and on the deployment of renewable energy assets in the country. With the introduction of solar panels both on-site and off-site, Delhi Metro Railways Corporation (DMRC) estimated that they saved 30,743 Tonnes of CO_2 emission in the year 2020–21 and enabled financial savings thanks to a reduced energy bill and earned carbon credits. The city of Brookville in the US

TRAINS AND STATIONS POWERED WITH A COMBINATION OF WIND TURBINES AND SOLAR PANELS: NEDERLANDSE SPOORWEGEN, NETHERLANDS

Since 2017, trains in the Netherlands have been 100% run using energy from wind power. Energy consumed by the operator is equivalent to the total electricity consumption of all households of Amsterdam (1% of the electricity consumed in the country). Even for the Dutch renewable energy market, NS' electricity consumption represents 85% of the entire renewable energy market of the country. Half the electricity consumed originates from wind farms in the Netherlands, while the remained originates from wind farms located in Sweden, Finland and Belgium.

This 100% wind energy provision does not, however, cover the entire actual energy consumption of the organisation, as it is currently still technically and meteorologically impossible. Nederlandse Spoorwegen (NS) is currently working to improve the situation, to match the production of renewable electricity to its consumption. Together with knowledge institutes and energy providers, the organisation has the ambition to make sure that the energy NS uses each hour (opposed to the total energy consumption) is actually delivered from a renewable asset. One promising approach is to work on more-efficient energy storage for wind and solar energies. Another potential improvement being studied is to develop ways to combine different renewable energy production methods (solar, wind and hydro power), find ways to spread the generation of renewable energy over time and reduce energy consumption at peak hours (particularly in winter).

is currently electrifying its bus fleet by integrating a renewable energy production to charge the vehicles. It is expected to enable a 62% carbon emissions reduction[2].

For other fuels, undertakings can support the deployment of renewable-fuel power plants according to their context, such as public-private agreement for production and use of a fuel with other partners. With the 'H2iseO Hydrogen Valley', the FNM Group has signed a Memoranda of Understanding with some players of the energy and hydrogen sector to build partnerships and identify best applications for green hydrogen[3].

In addition to the decarbonisation benefits, energy transition can have a significant impact on the organisation, the public transport system and even on society in general:

The energy system and grid: While public transport cannot alone influence the national energy mix, its large purchasing power does mean that it can leverage this influence to increase the level of local renewable power generation. As an important land and building owner, renewable energy assets can be deployed on the properties and support the deployment of further assets into other transport modes or for residential and commercial building.

Financial stability: Procuring renewable electricity with an energy provider allows to lock-in prices and offers a better financial visibility of energy prices for the duration of the contract. Benefits defer according to the type of model selected according to the objective an organisation is seeking to achieve; for example, greater stability but with higher prices, or lower prices at a greater risk.

Security of supply and job creation: The energy transition can also be an opportunity to re-localise energy provision and to become less dependent on fluctuating energy market (such as diesel or gas markets). In addition, it has the potential to create new jobs with the deployment of power plants and renewable assets.

Health benefits: For some technologies, there are clear health benefits associated to operations in cities, from the improved air quality and reduction of street noise with zero emission vehicles[4].

The reputation of public transport:

- For customers, improved comfort in-vehicle through certain technologies and a clearer indication of the environmental benefits of using public transport powered by renewable energy.
- Consolidated leadership on sustainable mobility, as a more energy-efficient transport mode (energy consumed to move a certain amount of people); action on energy provision and vehicle transition through public transport provide greater benefits than individual transport modes. It is an opportunity for public transport show leadership on the decarbonisation agenda of transportation.

2 Schneider electric, 2023. *Brookeville Smart Energy Bus Depot, Maryland.*
3 FNM Group, 2022. *H2iseO Hydrogen Valley.*
4 University of Gothenburg, 2022. *Better residents' health after switch to electric buses.*

AN OVERVIEW OF THE BENEFITS OF RENEWABLE ENERGY VS. NON-RENEWABLE ENERGY PROVISION

Procuring renewable energy for power public transport assets can deliver a range of benefits to an organisation compared to one that does not focus on its energy supply. The table below lists, for electricity, hydrogen and biofuels, the benefits for public transport of providing a renewable source compared to its non-renewable counterpart.

Type of renewable energies Benefits	Renewable electricity	Hydrogen synthesised from renewable sources	Biofuels converted from waste and low Indirect Land-Use Change (ILUC) risk
Decarbonisation	Stronger if developing a new asset.	Stronger if developing a new asset.	Stronger benefits if biofuel originating from waste material.
Contribution of public transport to improving the renewable energy sector	Power Purchase Agreement: Deployment of new assets, either on or off site. Renewable energy certificates: Incentive to deploy new infrastructure, but less strong than PPAs.	If new renewable assets deployed. If not, potential risk of drawing renewable electricity produced to hydrogen production instead of grid supply.	Potential in the installation of biomethane production infrastructures in agricultural or waste collection sites.
Price stability	The greater the level of renewable in the mix, the more stable the price. Stable if a long-term contract (PPA).	Stable provision if produced locally and according to renewable electricity prices.	Depends on the origin (for example risks in case of food crisis for crop-based fuels). Generally tracks the price of fossil equivalent. Availability of biofuels is finite (land-use).
Financial	Stable price if long-term contract (PPA). Carbon offsetting potential for on-site assets.	Cost currently high, but expected to decrease with more investment in hydrogen economy.	Varies according to market and legal framework but generally similar price structure to fossil equivalent. Carbon offsetting potential for some biofuels.
Reputation of public transport	If certified and advertised.	If certified and advertised.	If certified and advertised.

SETTING UP THE ENERGY TRANSITION TOWARDS RENEWABLE ENERGIES

The strategic approach of the organisation is central to achieving the energy transition strategy, by setting up the scope, objectives and alignments with other strategic objectives of the city and organisation.

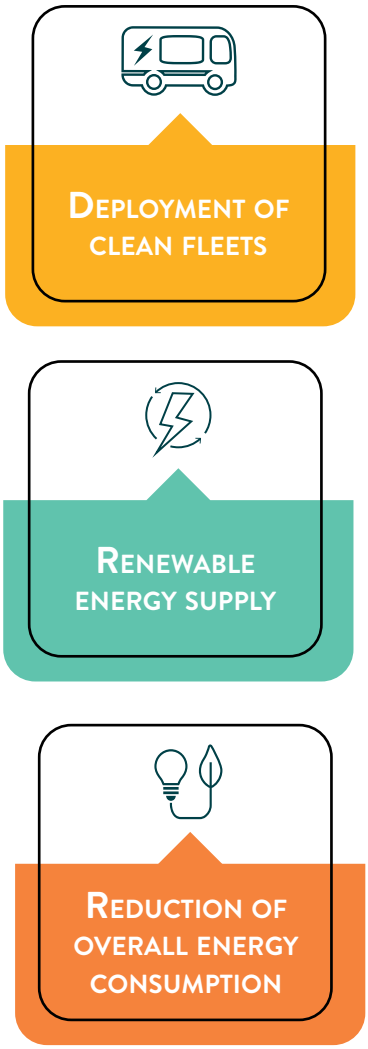
The deployment of the energy transition is a major undertaking process, which often involves decades of investments. Blending financial schemes and public-private investments can be an opportunity for public transport undertakings to finance the energy transition. According to the technology, application and context, investment opportunities will differ. In the EU, the EU Taxonomy is a classification system establishing a list of environmentally sustainable economic activities and should be essential in directing investments towards sustainable projects and activities. As of 2026, it will only recognise transport activities where direct (tailpipe) CO_2 emissions are zero[5]. Only under certain technical criteria biogas and biofuels can be considered as sustainable, which should have a significant impact on the deployment on the technology. However with this regulation, public transport is identified as a sustainable activity and it should represent an new opportunity for the sector in the EU and beyond to attract private funds which were traditionally not invested in public transport systems.

5 For more information: *www.ec.europa.eu/sustainable-finance-taxonomy/sectors/sector/6/view*

Considering this, a strong **strategy** should be put in place. It should:

- Have a well-defined aim and clear objectives to be achieved by the strategy
- Take a holistic approach across assets to ensure cooperation between assets
- Include the three following levers:
  - A shift of the vehicles' fuel demand towards renewable sources of energy
  - A supply of renewable energy to cover energy consumption
  - A reduction of overall energy consumption
- Be sufficiently flexible to be able to deal with technological uncertainties and aligned with original objectives
- Be linked with other strategic frameworks and objectives in order to understand the role it has to play for the organisation.

Three levers to reduce emissions from energy consumption



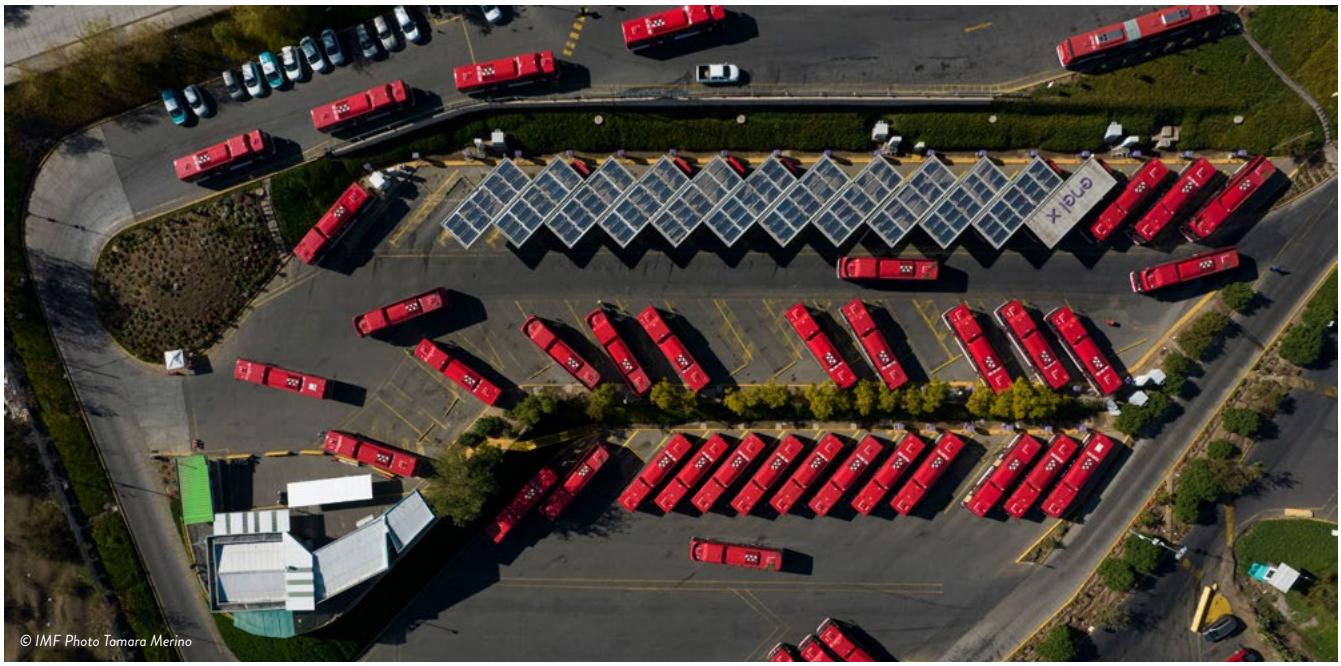
A TRANSITION TOWARDS E-BUSES IN SWEDEN

Västtrafik, the public transport authority in Västra Götaland Region, has switched to ebuses running on renewable electricity. This is based on their organisation's requirements to reach the climate goals. All city traffic needs to be electrified by 2030. The shift started with testing new technology in a mutual learning process:

The first pilot started in 2011 with the testing of plug-in hybrids on an existing route in the central part of Gothenburg. The pilot involved 3 plug-in hybrids used outside of the ordinary timetable with two charging stations, one at each end of the route.

With the gathered knowledge from the first pilot, Västtrafik continued with the project ElectriCity. The ElectriCity project provided an arena for Västtrafik and partners to test different solutions connected to the Public Transport system. The customers have been satisfied with the reduction of noise, and the fact that the buses are electric, and the drivers experienced a better working environment in terms of noise reduction and vibrations.

Västtrafik continued implementing electric buses into some existing contracts together with the contracted partners in 2019. The contracts were selected according to different operational conditions and geographical situations.



The **local specificities** should also be factored into the energy transition, and public transport undertakings should:

- Assess the different available technology options
- Understand their local energy market
- Understand their legal context
- Confirm the potential the potential of the technology in operational conditions.

PUBLIC TRANSPORT AND OTHER ENERGY CONSUMERS:

With growing electricity applications in cities (phasing out from natural gas consumption in heating and cooking) and in transportation (shift of private and public vehicles towards electric technologies), new considerations arise on the management of the city's electricity grid in order to cover all consumption needs. Risk allocation on electricity or hydrogen sourcing between operators and authorities can be addressed in contracting. Authorities can bring support in defining the transportation and cities' energy strategies and in finding synergies with other energy consumers in close cooperation with public transport operators (e.g. optimise electricity distribution and consumption peaks between transport modes like in Singapore or sharing hydrogen refuelling infrastructures for different applications as explored by some European cities deploying stations for both buses and garbage trucks).

A successful energy transition is based on:

- The political commitment of the region, metropolis and cities in the operational area.
- The involvement of different stakeholders, including local municipalities for locating charging/fuelling infrastructures, energy providers for the provision of renewable energy, other local energy consumers to unlock synergies.
- The adaptation of operational processes to a data-driven daily operations, which requires new skills and knowledge to acquire (e.g. data scientists, battery specialists...).
- The acceptance of the energy transition amongst the organisation, from the management board, financial and legal departments, to asset managers when conducting a renewable electricity contract and appropriate training of the operational staff for the deployment of new technologies.
- The acceptance of the public (including obstacles to the deployment of renewable energy production assets).

Rolling out the energy transition is not simply about the deployment of vehicles, it is about the deployment of a whole system; from the vehicles, to the charging infrastructures, adaptation of existing infrastructure, adaptation of operations and deployment of renewable energy assets.

AN OVERVIEW OF THE BENEFITS OF CLEAN VEHICLE TECHNOLOGIES

Each vehicle technology brings potential benefits and impacts at different levels, according to its own specific characteristics. While clearly reliant on the local context, this assessment is meant to offer a global perspective on the potential of each technology to achieve a given benefit.

Benefits	Type of technology	Diesel	CNG	Biofuels	Biogas	BEV	FCEV
Environmental	Decarbonisation (whole life cycle)	🔴	🔴	🟡	🟡	🟡	🟡
	Local air quality (tailpipe emissions)	🔴	🔴	🟡	🟡	🟢	🟢
	Noise reduction	🔴	🔴	🔴	🟡	🟢	🟢
Economic	CAPEX	🟢	🟢	🟢	🟢	🔴	🔴
	OPEX	🟡	🟡	🟡	🟡	🟢	🔴
	Price-shock risk	🔴	🔴	🟡	🟡	🟡	🟡
Operational	Energy efficiency	🔴	🔴	🟡	🟡	🟢	🟡
	Operational flexibility (fuelling)	🟢	🟢	🟢	🟡	🟡	🟢
	Technological risk	🟢	🟢	🟢	🟢	🟢	🟡
Energy Management	Security of supply	🟡	🔴	🟡	🟡	🟢	🟢
	Transition risk	🔴	🔴	🟡	🟡	🟡	🟡
City and public transport	City infrastructures	🔴	🔴	🟢	🟢	🟢	🟢
	Job creation	🔴	🔴	🟢	🟢	🟢	🟢
	Modernising customer offers	🔴	🔴	🟡	🟡	🟢	🟢

🟢 **High:** Strong potential of achieving this benefit

🟡 **Medium:** Possibility of achieving this benefit, according to local context, operational conditions and limits of the energy source

🔴 **Low:** The benefit is not applicable or does not work well for this technology.

RECOMMENDATIONS

Energy transition strategy and net-zero emissions target:

- **Energy transition and net zero emissions strategies and targets for all stakeholders:** Such strategies and commitments should be considered by all stakeholders in the public transport sector. The energy transition and sourcing of green energy will be central for operators of all transport modes in achieving carbon neutrality. The political commitment of region, metropolis and cities is crucial in achieving the energy transition and decarbonisation targets.
- **An energy transition strategy should:**
  - Have a well-defined aim and objectives
  - Take a holistic approach to assets managed by the undertakings to identify potential synergies and achieve greater results.
  - Be sufficiently flexible to be able to deal with technological uncertainties
  - Be aligned with the local Sustainable Urban Mobility Plans (SUMPs) and Sustainable Energy and Climate Action Plans (SECAPs).

Fleet renewal:

- **Performing an assessment of available options:** When transitioning fleets to alternative fuels, undertakings should assess different technologies. The technology should be selected according to local operating conditions, the local energy market and should reflect the strategic objectives of the organisation.
- **Confirming the potential of a technology with pilots:** Similar vehicles deliver differing results depending on operational conditions. Pilots should be performed that monitor performances during operation; to ensure that strategic objectives are met and expectations are managed for the large-scale implementation of the solution and to build the business case for the energy transition. Operators are encouraged to share results of their pilot with other cities in search of deploying their energy transition.
- **From traditional to data-driven operations:** The deployment of new technologies require new skills (such as real-time data analysis or knowledge of battery technology) and the implementation of new processes to set up a good and efficient operation. Adaptation of the organisation at all levels should be performed to reflect the operational changes from the energy transition.

Renewable energy supplies:

- **Understand the legal context:** Depending on the location, different regulations may apply for the supply of renewable energy. It is important to understand this legal context, as it can favour some fuel options and restrain the use of others.
- **Understand the local energy market:** The carbon intensity of energy differs significantly between geographical locations. Before commencing the energy transition, there should be an assessment to understand the potential carbon emissions reduction and other impacts on the environment or human activities from a selected energy option. It is also important to consider that a public transport undertaking decarbonising its energy supply can contribute to accelerate the deployment of renewable energy assets in its local context.
- **Work in cooperation with an energy provider/ developer:** A partnership created through contracts such as Power Purchase Agreements (PPAs) favours transparency of energy provision and carbon emissions of energy generation. It allows prices to be locked in, providing greater cost visibility of electricity consumption.

Accounting, financing and acceptance of the energy transition:

- **Finance the energy transition:** To cover the important investments often needed to implement the energy transition, public transport undertakings should consider blending different financial schemes and public-private investments. The energy transition represents a good opportunity to attract private investments in public transport.
- **Acceptance of the energy transition:** Measures taken for the energy transition should be embraced by both the staff of the organisation and the general public. Energy transition has the potential to modernise the offering to the customer and to bring new users to the network.
- **Avoid risks of double counting of emissions:** When purchasing certificates or signing a PPA, criteria should be included to avoid the risk of double-counting emissions. Situations varies between regions and countries; therefore assessments and monitoring should be considered when purchasing certificates to claim their benefits.

CONCLUSION

The transition of public transport to renewable energies is an opportunity for the sector to secure its place as a leader of sustainable mobility and be a significant piece in achieving urgent climate objectives. In the midst of the current energy crisis and economic downturn, a transition to renewable sources can both contribute to decarbonisation objectives and bring about greater financial stability, improve security of supply and modernise the customer offering. Decarbonisation measures should be perceived as an opportunity to improve public transport and enhance its benefits on the society. Building a strong business case for the energy transition will attract the required investments and with the blending of different financial schemes accelerate the deployment of the energy transition in public transport.

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This is an official Action Point of UITP, the International Association of Public Transport. UITP represents the interests of key players in the public transport sector. Its membership includes transport authorities, operators, both private and public, in all modes of collective passenger transport, and the industry. UITP addresses the economic, technical, organisation and management aspects of passenger transport, as well as the development of policy for mobility and public transport worldwide.

These Action Points was prepared on the basis of a Report from the UITP Sustainable Development Committee and Renewable energy and energy transition in public transport Working Group.
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APRIL | 2023

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