urban mobility solutions

Urban, Electric Mobility Initiative

# Factsheet

## Metro Systems

Wuppertal Institut

UN HABITAT
FOR A BETTER URBAN FUTURE

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Solutions project

UEMI SOLUTIONS

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## UEMI

***Urban Electric Mobility Initiative (UEMI)*** was initiated by UN-Habitat and the SOLUTIONS project and launched at the UN Climate Summit in September 2014 in New York.
UEMI aims to help phasing out conventionally fueled vehicles and increase the share of electric vehicles (2-,3- and 4-wheelers) in the total volume of individual motorized transport in cities to at least 30% by 2030. The UEMI is an active partnership that aims to track international action in the area of electric mobility and initiates local actions. The UEMI delivers tools and guidelines, generates synergies between e-mobility programmes and supports local implementation actions in Africa, Asia, Europe and Latin America.

## Solutions

***SOLUTIONS aims to support the exchange*** on innovative and green urban mobility solutions between cities from Europe, Africa, Asia and Latin America. The network builds on the SOLUTIONS project and brings together a wealth of experience and technical knowledge from international organisations, consultants, cities, and experts involved in transport issues and solutions.

***The overall objective*** is to make a substantial contribution to the uptake of innovative and green urban mobility solutions across the world by facilitating dialogue and exchange, promoting successful policy, providing guidance and tailored advice to city officials, fostering future cooperation on research, development and innovation.

## Aims

***SOLUTIONS_UEMI supports urban mobility*** implementation actions that contribute to the Paris Agreement and the New Urban Agenda.
***Sustainable energy and mobility*** can make positive contributions to a number of policy objectives, nationally and locally. In particular in cities there is a great potential to create synergies between for example safety, air quality, productivity, access and climate change mitigation.  A UEMI resource centre will provide opportunities for direct collaboration on projects focusing on sustainable urban mobility and the role e-mobility can play in it. The UEMI will pool expertise, facilitate exchange and initiate implementation oriented actions.
***UN-Habitat, the Wuppertal Institute & Climate Action Implementation Facility*** jointly host the resource centre for the Urban Electric Mobility Initiative, aiming to bridge the gap between urban energy and transport and boosting sustainable transport and urban e-mobility.

## In brief

The term “metro” is a common international term that refers to subways and heavy rail transit. Metros are the most expensive form of mass rapid transit per kilometre, but have the highest theoretical capacity. Because metros have an exclusive right-of-way infrastructure and perform mass and high-speed transit within urban areas and with neighbouring urban areas, they could reduce road congestion and travel time, especially with more frequent service and when accompanied by pedestrian-friendly and cycling access and by public feeder systems.

## Examples

There are many metro systems around the world. The most well-known are in London (which began operation in 1890, and which now has a 402 km network, 270 stations, and an annual ridership of 1.34 billion journeys a year), Paris (est. 1900; 214 km; 302 stations; 1.52 bn), New York (est. 1904; 375 km; 422 stations; 1.76 bn); Tokyo (est. 1927; 195 km; 179 stations; and Singapore (est. 1987; 170 km; 121 stations; 1 bn).

Metro systems generally operate separately from road traffic below-grade, on elevated structure, or at-grade level that run along exclusive rights of way. As metros generally run along major thoroughfares, they are supported by other smaller modes of public transport like buses that serve as feeder systems and by efficient public transport interchange terminals with connections to various public transport services. Integrated or single ticketing contributes to smoother transfers. Apart from physical infrastructure, successful metros are backed by a back-end operational support or an information and communication technology to facilitate service delivery in line with the agreed timetable.

## Results

The International Association of Public Transport estimates that metros carried 155 million passengers a day in 2006 and are by far the fastest mode of mass rapid transit. They travel at an average speed of 40-50 km/hour, while Light Rail Transit, and Bus Rapid Transit systems typically operate between 20-30 km/hour.

Metro systems can transport many people and use space more efficiently than buses or cars, thereby saving emissions. They also consume less energy than buses and cars; a 1-kilogram equivalent of petrol

will allow a single person to travel more than 48 kilometres by metro, compared to 38 kilometres by bus, and no more than 19 kilometres by car. Constructing, operating and maintaining metro systems also creates jobs.

## Technical and financial considerations

**Technical and financial considerations**
Metro systems are most applicable in areas with more than 5 million inhabitants, in corridors with a trip volume of more than 700,000 trips per day, and with at least $18,000 (€16,000) per capita annual income at the city level, given its high cost of construction and operation.

Other pre-requisites include competitive fares, a steady and growing prosperous population, and integrating metro systems with other modes. Bus systems can handle moving 30,000 passengers an hour in one direction, but only metro systems can transport over 35 000 people. Rail transport costs $15 million to $30 million (€13.5 million – €27 million) per kilometre and elevated rail transport $30 million to $75 million (€27 million- €67.6 million) per kilometre. However, underground rail transport is estimated to be six times more expensive, reaching $60 million to $180 million (€54 million- €16 million) per kilometre. However, despite the higher costs, they improve the overall mobility of the population.

## Policy/Legislation

**Policy/legistion**
The emission savings from metros are greater with higher ridership in terms of CO2emission/passenger/kilometre. Therefore, the frameworks for metros should promote its use together with other public transport modes and should attract demand to ensure high ridership. Among the fundamental requisite for metros are clearly articulated roles of parties involved, especially in public-private partnership (PPP) arrangements. Metros require large funding and resources for construction, operation and maintenance.

Thus, the generated revenue should be able to cover operating costs or the infrastructure could deteriorate. Secondly, metros should be integrated with other public transport modes and with key origins and destinations. This indicates a need for land-use planning and long-term transit-oriented development to also ensure mixed-use and walkable development and high-density population along its route that are within walking distance of the stations, as well as travel demand management to ease the crowding situations during peak hours.

**Institutions**

The lead agency for metros is usually the transport ministry but because operational subsidies are usually still required for metros, the private sector is involved by way of PPP. The transport and planning ministries should lead in oversight and in identifying station locations aligned with the country's sustainable transport masterplan and the city's long- term urban plan. Planning for such a large-scale solution involves di erent national and local government agencies to model and forecast demand growth, draw up land-use and transport plans, provide information and communication technology (ICT), among others, to develop and maintain metros cost e ectively. The government should likewise help ensure the participation of the key stakeholders like residents and retailers in the community to consider the diverse viewpoints and priorities.

**Transferability**

Integrated public transport planning would ultimately be an enabler for encouraging shifts towards public transport. Successful metros are generally viewed to be convenient, comfortable, attractive, a ordable, e cient and reliable, thus the integration is not only by physical infrastructure with easy interchanges but also through ticketing system integration for seamless transfers between various transport modes. A thorough understanding of cost requirements for metros would allow planners to anticipate operating and maintenance expenses.

Another approach is land value capture which is a funding instrument used to recover land value increments (i.e. unearned income of the private land owner) generated from publicly created value generated by public infrastructure investments. Land-value capture is used for  nancing public transport systems that have intensive capital and operation and maintenance costs like metros, or for furthering transport-oriented developments. Transport agencies and developers could agree to have the latter contribute to the construction of transport infrastructure including public transport services, walkable districts and public spaces (e.g. parks, bicycle lanes, sidewalks) as their property value would increase.

**Case Study: Singapore's MRT**

# Case Study: Singapore´s MRT

## Context

The idea for the Singapore metro system, known as the Mass Rapid Transit (MRT) network, came about in 1967 when urban experts predicted that, as the population and the number of motor vehicles in Singapore grew over the next 20 years, traffic conditions would worsen. The MRT went into operation in 1987, and today it is one of the most extensive and efficient rail systems in the world, covering almost every heavy transport corridor of the country.

A comprehensive tra c study in 1981 concluded that a mass transit rail system would be more favourable and practical for Singapore instead of a public transport system an all-bus public transport one. The Mass Rapid Transit Corporation (MRTC) was officially set up in 1993 to oversee the network and would later be combined with the Registry of Vehicles and Roads and Transport Division to form the Land Transport Authority.

## In action

The MRT runs on four main lines: North South Line, east West Line, Circle Line (which runs along the perimeter of the country's central business district), and the North east Line. While the Land Transport Authority owns the MRT system, private companies operate it. The bus and LRT systems serve as feeder modes to connect residential areas and other light corridors to MRT stations.

The MRT operates daily from 5:30am until midnight, though it extends during special holidays. Between 7 amand 9 am, trains run every 2-3 minutes, and the average interval for the rest of the time is 3-7 minutes. Passengers can use ticket smartcards to travel on the MRT and the LRT and bus system. Students, senior citizens, and children enjoy special rates.

To ease the pressure on the MRT during peak hours, commuters are given incentives when they travel during o -peak hours through an awards scheme. With a registered smartcard, travellers can automatically earn one point for every kilometre they travel before 6:30 am and after 9:30 am from Monday to Friday, with additional points available if travelling during the designated "decongesting" hours (6:30–7:30 am and 8:30–9:30 am.)

**Results**

Estimates say that the average annual MRT ridership could grow from the current 688 million to 1.3 billion by 2030. According to Singapore's Land Transport Masterplan (2008), the government is increasing the rail transit system density from 31 kilometre per million population to 51 kilometres per million population by 2020. It also sets out three challenges: increasing travel demand and limited land; declining public transport mode share; and changing demographics and expectations.

The Land Transport Authority is also committed to removing physical barriers and ensuring clear passageways, and installing tactile guidance systems and wheelchair-accessible toilets to meet the needs of the elderly and less mobile MRT users.

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## More Information

## Implementing Partners

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