Factsheet

Electric Three Wheelers

Wuppertal Institut

UN HABITAT
FOR A BETTER URBAN FUTURE

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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.

Future Radar

Future Research, Advanced Development and Implementation Activities for Road Transport (FUTURE-RADAR) project will support the European Technology Platform ERTRAC (the European Road Transport Research Advisory Council) and the European Green Vehicle Initiative PPP to create and implement the needed research and innovation strategies for a sustainable and competitive European road transport system. Linking all relevant stakeholders FUTURE-RADAR will provide the consensus-based plans and roadmaps addressing the key societal, environmental, economic and technological challenges in areas such as road transport safety, urban mobility, long distance freight transport, automated road transport, global competitiveness and all issues related to energy and environment.

FUTURE-RADAR will also facilitate exchange between cities in Europa, Asia and Latin America on urban electric mobility solutions. The FUTURE-RADAR activities include project monitoring, strategic research agendas, international assessments and recommendations for innovation deployment as well as twinning of international projects and comprehensive dissemination and awareness activities. Overall it can be stated that FUTURE-RADAR provides the best opportunity to maintain, strengthen and widen the activities to further develop the multi-stakeholder road transport research area, for the high-quality research of societal and industrial relevance in Europe.

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In brief

Electric three-wheelers, also known as E tuk-tuks or E-rickshaws, are an environmentally-friendly and economical means of urban transport that have been in use for a decade in many developing countries around the globe, including those in Asia, Central and South America, and Africa. E tuk-tuks are replacing fossil-fuelled auto-rickshaws in some countries. This also has the added benefits of directly enhancing urban air quality, contributing to a reduction of carbon emissions, as well as urban noise pollution with similar or better services. They are good at serving first/last mile connectivity, covering the distance between a station and a traveller's final destination, and usually offering cheap and fast transport services.

Examples

E tuk-tuks are powered by battery that takes energy from sustainable renewable energy sources, and can be found with various designs and functions. They can be widely used as a means of public transportation and as taxi services. E tuk-tuks used for public transportation have six to eight seats, as in Kathmandu (Nepal) and two to three seats in taxi E tuk-tuks, as in Chang Mai (Thailand), Jabalpur (India) and Stockholm (Sweden). In Amsterdam (Netherlands), E tuk-tuks are used for 'last mile solution' for tourists, serving city tours and shuttle transfer .

Results

Low emission:
Beside benefits such as last-mile connectivity, easy access to narrow roads and cost effectiveness, E tuk-tuks also potentially result in significant reductions in CO2 emissions, provided that the electricity grid is low carbon intensity. Estimates show that E tuk-tuks have lower specific energy consumption compared to LPG and diesel-fed rickshaws, as in West Bengal (India) (Majumdar & Jash, 2015). Likewise, an emission test in Rajshahi (Bangladesh) shows that the grams of CO2 emitted per kilometre of electric rickshaws is around a fourth of spark-ignition and compression-ignition auto-rickshaws.

Air quality:
E tuk-tuks help improve the air quality in cities. The emission calculation on fossil-fuelled tuk-tuks in Asian cities (for example, in Thailand) show that they produce 4 tons of CO2 per year. Thailand has 20,000 running tuk-tuks, which totals emission of 100,000 tons of CO2 per year just from the fossil fuelled tuk-tuks (Frangoul, 2018). E tuk-tuks have huge potential to reduce carbon emission.

Technical & financial considerations

Technological requirements
The use of battery technology determines the efficiency and performance of E tuk-tuks. For example, lead-acid batteries, although a cheaper option compared to lithium-ion, can potentially result in lead leakages, if improperly handled and disposed of. Taxi E tuk-tuks with lithium-ion batteries take up to 5 hours to recharge and provide up to 120-150 km of travel range, while lead-acid batteries take up to 12 hours recharge time and have an 80 km travel range (CNBC, 2018).

Charging/recharging batteries in E tuk-tuks is a major issue in many cities. Different recharging models are available, such as at-home charging, charging in stations, or battery swapping, depending on charging infrastructure in the city. E tuk-tuk charging at home models require special attention, as the existing charging infrastructure for peak load in residential areas may not be suitable or enough (Park & Kwon, 2016). In cities found in low-income countries, it may be expensive to plug batteries for recharging into the utility grid. The source of electricity in the grid for charging also determines the overall emission reduction potential of E tuk-tuks; for example, low potential from carbon-emitting energy source like coal and high potential from renewable sources. Jabalpur (India) is a good example to initiate solar powered charging stations for taxi E tuk-tuks (ABB, 2017). An adequate number of charging stations and charging infrastructure standards need to be in place in many cities in order to pursue scaling E tuk-tuks.

Considering vehicle safety for citizens, the design and dimension of E tuk-tuks need to be suited to the configurations of the roads where they are to be deployed, and to the type of operations where they will be allowed to perform. For example, setting maximum vehicle speeds and motor capacity should be considered together with questions regarding where they would be allowed to operate (e.g. will they slow down main stream traffic if the speed and motor capacities are restricted?).

The production of E tuk-tuks is feasible in many countries, as in India. The electric motors and batteries might be imported and the chassis are made within the country, as with E tuk-tuks in Nepal.

Finance requirements
E tuk-tuks are cost-effective compared to gasoline tuk-tuks in terms of travel per km and maintenance cost, as in Chang Mai (Thailand) (CNBC, 2018). The

vehicle cost is also generally lower for E tuk-tuks than conventional auto-rickshaws, as seen in Jabalpur (India) and Chang Mai (Thailand). This proves beneficial for both riders and drivers (vehicle owners). Increasing the mass market adoption of E tuk-tuks, which is still low in many cities, requires a good business model and technological improvement. A study by Bloomberg NEF shows that technological improvement, for example in batteries, can reduce the cost of E tuk-tuks by 7-8% a year. As in Figure 1, this will eventually reduce the total cost of ownership of E tuk-tuks in India depicting their opportunity (See figure 1) (Field, 2018). The provision of loans to E tuk-tuk drivers also incentivises the market uptake; for example, loan offers by Loxley and Government Saving Bank (in Thailand) (The Nation, 2018).

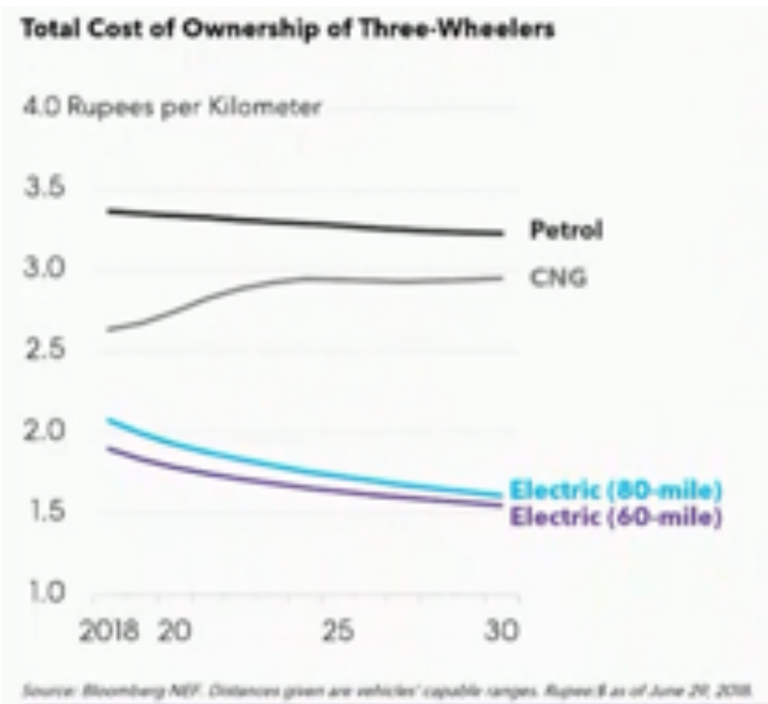

Figure 1: E Tuk-tuk opportunities in India (Source: Bloomberg NEF in Field, 2018).

Policy/legislation

Considering environmental and socio-economic benefits, the number of E tuk-tuks on the road are growing in cites but the rate is still low. Introducing E tuk-tuks entails a process of involving government agencies that are responsible for regulating such a mode, particularly if they are replacing existing auto-rickshaws. In some cases, such E tuk-tuks have not been recognised as legal public modes of transport (Majumdar & Jash, 2015). National, state, and local transportation agencies must be involved. In a broader context, cities need national regulations regarding the use of electric vehicles, including technical standards related to vehicle design and performance, as well as safety. Thus, government agencies that are responsible for overseeing the development of such standards must be on board. For example, the Indian government is proposing to amend building by-laws to make it mandatory to set up EV charging stations in residential and commercial buildings and parking lots (Singh, 2018). Likewise, the involvement of environmental agencies ensures the confirmation of environmental standards. Agencies, as well as relevant private entities, which are responsible for the generation, transmission and distribution of electricity, should also be involved in the process, so as to ensure that the system can adequately meet charging requirements. Most importantly, organisations representing the existing drivers and operators of three-wheelers should be involved, as they will directly be impacted by the measure. Involving them in the process from the start and raising awareness would be beneficial in terms of avoiding unnecessary negative perceptions, as well as in terms of collecting on-the-ground feedback regarding the initiative.

Institutions/ Stakeholders

Involving governmental and other relevant parties such as academic, non-government organisations, citizens and media organisations, would also be beneficial for the policy formation and concept dissemination. During the pilot phase, implementing (transport) agencies may need to seek support from national and international funding organisations for research and development (R&D) and demonstration.

Transferability

E tuk-tuks are highly replicable to other cities and countries, but the type and design depends on the infrastructure and citizens' needs.

Case study: Taxi E tuk-tuks in Jabalpur, India

Jabalpur is a central Indian city with nearly 1.6 million people. Taxi auto-rickshaws, run with fossil fuels, are a typical means of transport in the city for the last mile gap, covering shorter to medium distance travel. Auto-rickshaws have contributed to air pollution as well as Greenhouse gas (GHG) emissions. Although E tuk-tuks were introduced in India in 2008, adoption of their use is still low. The case is similar in Jabalpur. Partly due to the lack of affordable and accessible public charging stations, as it is expensive for low-income people to charge batteries at home. Jabalpur is trying to tackle environmental and socio-economic hurdles by initiating E tuk-tuks in the city, along with charging stations powered by renewable energy.This has been supported by the smart-cities effort, in which the Indian government has set the goal of replacing all modes of transport in the country with electric vehicles by 2030 (ABB, 2017).

In action

Identified as a 'smart city' by the national government, Jabalpur is committed to encouraging the country's economic development and provide affordable access to the citizens reducing carbon emission. Therefore, transportation officials in Jabalpur have initiated the adoption of zero emission E tuk-tuks and have created a network of solar-powered charging stations. As a pilot project in Jabalpur, local authorities plan to set up nine solar-powered charging stations to be used by around 400 E tuk-tuks owners in the city. One station is already in operation and the others are scheduled to be up and running next year. The charging stations are able to generate 50 kilowatts of electricity and can serve as many as four E tuk-tuks simultaneously. It takes between 7 to 8 hours for a full recharge the battery, enabling the E tuk-tuks to travel 100 to 150 kilometers (ABB, 2017). The solar panels in the station are also connected to the state grid to feed in additional power generated through net metering (The Economic Times, 2017) (ABB, 2017a).

Results

Currently 400 licensed E tuk-tuks are planned for operation in Jabalpur. The city's ultimate aim is to convert 5000 fossil-fueled auto rickshaws that are running in the city to a cleaner, greener mode of propulsion, which could remove 46 tons of CO_2 everyday. The battery charging in solar powered station is also 30% cheaper than grid connected power, as it costs 30 Indian rupees (46 US cents) only which otherwise costs 40-50 Indian rupees (about 60-70 US cents) from the grid (The Economic Times, 2017).

Case study: Public transport E tuk-tuks (Safa Tempo) in Kathmandu, Nepal

Kathmandu is the capital of Nepal. The Kathmandu valley includes 3 cities – Kathmandu, Lalitpur and Bhaktapur – and has a population of 2.5 million with an annual growth rate of 4.63% (3.5 million unofficially). Air pollution is the leading cause of death in the valley, including pollution due to fossil-fuel run transport. Nepal imports 100% of its fossil fuels, leading to many issues, including energy security. The Government of Nepal is supporting the promotion of electric vehicles in the country through favorable policies and actions.

Besides a few electric cars and buses , an E tuk-tuk model named 'Safa Tempo', with a seating capacity of 6-8 people, is running in the valley. It is considered to be an easy and affordable means of public transport which can pass through narrow streets of the city and stop at shorter distances (Shrestha, 2018).

In action

After diesel energy three-wheelers were banned in the 1990s due to air pollution, the clean and environmentally-friendly Safa Tempo was introduced in the Kathmandu valley. More than 600 of them run the valley, each travels 100-120 km per day with 2 sets of lead-acid batteries. Batteries are swapped in the charging station. On average 127,000 people use the Safa Tempo daily (Bhatt, 2013). Though the Safa Tempo is a success story for EV in the valley, its design, technology and battery are quite old and need modification, and a battery disposal plan needs to be in place. As Nepal's main electricity generation is from hydropower, the power supply for EVs is fairly clean. With few new hydropower construction, Nepal will have soon surplus power generated through hydropower.

Results

About 17,500 kg of CO2 will be reduced per day if a passenger uses Safa Tempo instead of a fossil-fuel run bus or minibus; microbus reduction potential is about 22,700 kg of CO2 per day (Bhatt, 2013).

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More Information

Implementing Partners

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