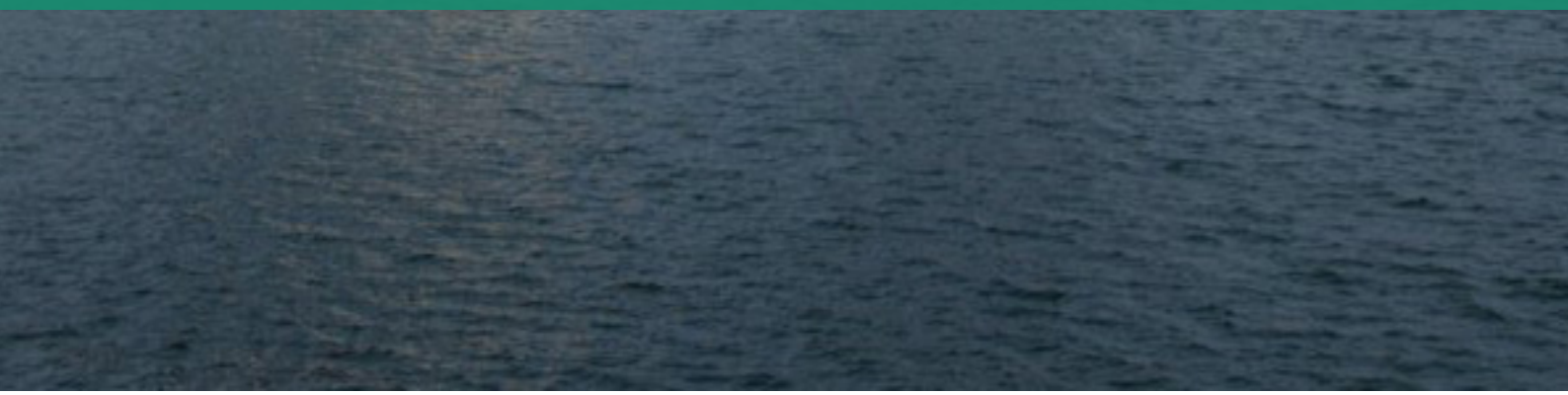
Dar es Salaam, Tanzania

SOLUTIONSPLUS I LIVING LABS UPDATE



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PROJECT PARTNERS

ABOUT

This is a summary of the paper, submitted to the journal 'Sustainable Earth Review' developed under SOLUTIONSplus project. Currently the paper is under peer review.

TITLE

Capacity and market potential for local production and distribution of electric two-wheelers in Southeast Asia, focused on Thailand, Indonesia, and Vietnam

PREPARED BY

Hyung Ju Kim, Wuppertal Institute (Visiting scholar)/ National Institute of Green Technology Korea
Shritu Shrestha, Wuppertal Institute
Kanya Pranawengkapti, Wuppertal Institute

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DISCLAIMER

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LAYOUT

Yasin Imran Rony, WI

PICTURES

All the pictures are provided by the ITDP

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DAR ES SALAAM, TANZANIA

The SOLUTIONSPlus project aimed to accelerate the transition to sustainable urban mobility through innovative and integrated e-mobility solutions. To this end, the consortium partners created Living Labs at city level to test different types of innovative and integrated e-mobility solutions. Living Labs reach beyond the implementation of technological innovations and also include elements of information, inspiration and initiation to achieve a stronger and sustainable impact of the project activities.

INFORM

Boost capabilities of local and national authorities, public transport operators and entrepreneurs about innovative urban e-mobility solutions across various transport modes by **informing them about tools** to plan, assess, implement and operate e-mobility solutions.

INSPIRE

Foster the take-up of e-mobility innovations by businesses, start-ups, local and national governments and transport operators by **inspiring** officials, operators, industry and businesses through peer-to-peer exchange on innovative e-mobility products and services.

INITIATE

Strengthen policy and business **collaboration** by **initiating** partnerships between local and national governments and local and European entrepreneurs and supporting the development of new e-mobility models business implementation plans.

IMPLEMENT

Create reference models for e-mobility innovation by **implementing** demonstration actions to test innovative e-mobility technologies and services, foster their **replication** and ensure their long-term **sustainability**.

IMPACT

Contribute to global **sustainability and climate goals** by boosting the **impact** of this project through the integration of the innovative concepts into policy, funding, operation, research and business practice.

Dar es Salaam, the largest city and economic hub of Tanzania, is a vibrant coastal metropolis situated along the eastern shores of the Indian Ocean. It is home to a substantial and rapidly growing population of 5.38 million people in 2021 and with an average annual population growth rate of 5% (The United Republic of Tanzania, 2022; Dar es Salaam City Council, 2021). The city's significance as a major urban centre and gateway to Tanzania is underscored by its high population density, influenced by factors such as urbanisation, economic opportunities, and infrastructure development. However, in response to rapid urban growth and increased individual motorization, Dar es Salaam faces chronic congestion. Most of the city dwellers travel by minibus or walk: 51.2% of residents use public transport by minibus (47.9%) or the Bus Rapid Transit (BRT) buses (3.3%), 39% walk, 4.9% use motorcycles, 3.7% cars, 0.5% bicycles, 0.4% commuter rail, and 0.3% ferry (JICA, 2018). In areas unserved by minibuses, for-hire three-wheeled motorised vehicles ("bajajs" or "bajajis") or motorcycle taxis offer a de-facto public transport service filling a gap in the transport system. Yet, despite significant benefits for people's mobility and much-needed employment opportunities, two- and three-wheelers have contributed to increased pollution in the city. At the national level, the transport sector contributes to

57.6% of the total CO2 emissions due to fuel combustion. Motorised two- and three-wheelers have considerably expanded in Tanzania from 52,015 in 2007 to 1.2 million now, which poses a challenge due to their reliance on fossil fuels.

Recognising these challenges, Dar es Salaam pioneered the transition to sustainable urban mobility in East Africa with the creation of a dedicated public transport agency (Dar Rapid Transit Agency - DART) in 2007, and the subsequent operation of the first BRT line in 2016. The city is implementing five other BRT corridors which will include integration with non-motorised transport infrastructure to improve accessibility. Currently, 201 fossil-fueled buses connect the city center to the Western suburbs. Expansion plans include new routes and the addition of further buses, potentially powered by Compressed Natural Gas (CNG) or electricity. Remarkably, Dar es Salaam was the first African city to receive the Sustainable Transport Award in 2018.

Along with the promotion of transit-oriented development centred around public transport and active mobility, a shift has recently started towards the introduction of low-emission vehicles as part of the city's green urban mobility agenda. An ecosystem of companies providing electric vehicles is emerging, accompanied by efforts from research institutions and international organisations. The Tanzania Climate Action Plan recognises the importance of low-emission mobility, with the Flagship Action n°23 planning an increased use of alternative energy sources such as electricity within the vehicle fleet. Under the transport sector, the NDC commits to expanding the BRT system, and promote non-motorised transport in cities. DART supported the electrification of existing three-wheelers providing feeder services to the BRT.

DEMONSTRATION ACTION IN DAR ES SALAAM

The SOLUTIONSplus project aims to accelerate change towards sustainable urban mobility through innovative and integrated electric mobility solutions. In Dar es Salaam, the project promotes the electrification of three-wheelers ("bajajs") already providing feeder services to the BRT, tests new mobility options in the form of pedal-assist electric bicycles used for urban deliveries, raises awareness on electric mobility, and identifies policies to remove barriers to sustainable and electric urban mobility. The partners forming the SOLUTIONSplus Living Lab in Dar es Salaam are the Rapid Transit Agency (DART), UN-Habitat, UN Environment, the Urban Living Lab Center (ULLC), a UN-Habitat Collaborative Center gathering the Urban Electric Mobility Initiative (UEMI) and the Wuppertal Institute (WI), the Institute for Transportation and Development (ITDP Africa), the Deutsches Zentrum für Luft- und Raumfahrt – German Aerospace Center (DLR), FIER Automotive, and PluService.

Very positive results have been achieved. While there were no electric three-wheelers ("e-bajajis", also "e3Ws" hereafter) for passenger services in 2020 at the start of SOLUTIONSplus, five companies supported by SOLUTIONSplus now test different new or retrofitted bajajis using lithium-ion batteries. These companies represent the largest fleet using lithium-ion batteries instead of less efficient and environmentally damaging lead-acid batteries. SOLUTIONSplus introduced pedal-assist electric bicycles for urban deliveries, a vehicle type not previously used in Dar es Salaam. The E-Mobility Forum in March 2023, opened by the Delegation of the European Union, was the first large event on electric and sustainable urban mobility in Dar es Salaam gathering key Tanzanian and sub-Saharan stakeholders.

INFORM

The SOLUTIONSplus partners recognised a lack of data on the current fleet and usage of ICE bajajs, which would have significantly hindered the identification of appropriate charging and vehicle technologies, and therefore a robust transition to electric bajajs. As a result, the SOLUTIONSplus team undertook extensive data collection in 2021 and 2022 to assess the feasibility of electrifying e-bajajs in Dar es Salaam. This included GPS tracking, driver and user surveys, and careful analysis of operational and business strategies.

The resulting body of data was used to inform appropriate technical specifications for vehicles, charging infrastructure and operational strategies, with a focus on driver needs and preferences. This collaborative and inclusive approach was recognised as a positive case study in the global C40 publication 'City guide for two and three-wheeler management and electrification'.

SOLUTIONSplus Dar es Salaam partners were informed about the modalities and characteristics of electric mobility through capacity building and knowledge products available on the SOLUTIONSplus online toolbox. In particular, several guides on the electrification of three-wheeled vehicles in Asia and electric bicycles have been integrated and used by the Dar es Salaam Living Lab partners, as these two types of vehicles are the core of the Dar es Salaam demonstration action.

Lastly, a thorough monitoring and impact assessment process was followed throughout the project lifetime, deriving a baseline, an ex-ante, ex-post and a scale-up scenario.

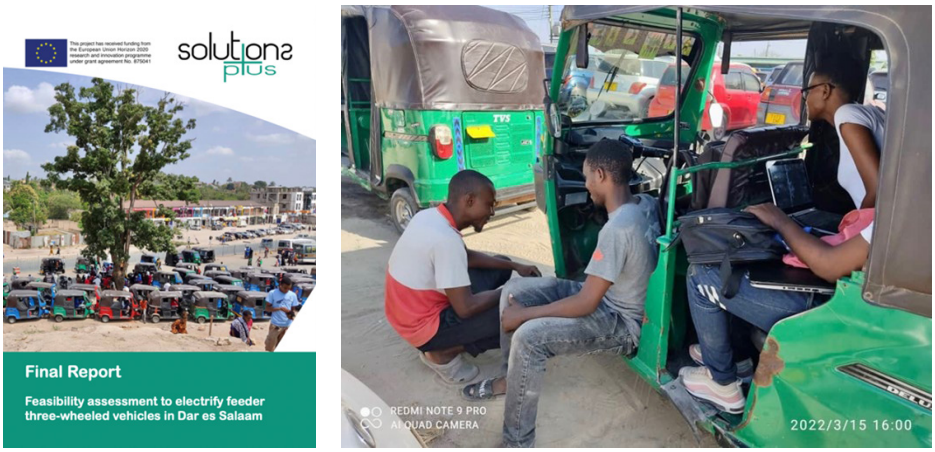

Figure 1. Feasibility Assessment, data collection via GPS, survey, and interviews with bajaj drivers

INSPIRE

In addition to the online e-mobility e-courses and resources available to all SOLUTIONSplus partners worldwide, stakeholders in Dar es Salaam benefited from several regional and city training sessions focusing on training topics identified as priority areas in 2020. Week-long training sessions covered EV charging infrastructure for all modes (2021), EV battery technologies and end-of-life management (2022), and electrification of public transport (2023).

A high-level E-Mobility Forum opened by the Delegation of the European Union to Tanzania was organised in 2023, gathering key Tanzanian and sub-Saharan stakeholders, providing an area for exchanges on e-mobility in Tanzania and Africa, and organising an EV Exhibition Fair. This was the first event on e-mobility in Dar es Salaam, raising large interest from decision-makers and the private sector.

Additionally, peer-to-peer exchanges were facilitated with stakeholders from the SOLUTIONSplus city network on electric three-wheelers. An exchange with Indian cities, which are more advanced in these vehicles, took place in July 2022. Partners from DART exchanged with Hamburg transport stakeholders on bus electrification and electric micromobility, as well as other demonstration actions partners across the globe, during the study visit in Hamburg in September 2022.

INITIATE

Five local start-ups received financial and technical support in Dar es Salaam: four working on electric three-wheelers (DIT/Auto Truck, SESCOM, ZioTio UN Limited-TRI, Ekoglobe) and one local cooperative operating pedal-assist electric bicycles (FASTA).

The project followed a two-phase approach. Phase I focused on promoting local Research & Development, in the form of either ICE bajajs retrofitted to electric bajajs or prototypes of fully new electric bajajs. Vehicles were locally designed, manufactured, and assembled, using locally sourced materials or components as much as possible (2020-2023; DIT/ Auto Truck and SESCOM for a total of 6 vehicles, including 4 retrofitted vehicles and 2 new prototypes). Phase II looked to expand the e-fleet with a total of 37 vehicles, locally designed and locally assembled, a progress compared to the mainstream practice of importing fully or semi-assembled vehicles previously (2023-2024; Ziotio Company-brand TRI and Ekoglobe). More information on the two phases is given in section “Implement”.

Alongside seed funding, SOLUTIONSplus provided technical advice support though consortium members or external EU organisations selected through EU matchmaking calls. In Dar es Salaam, start-ups received technical support on battery sizing and on the retrofitting process through the SOLUTIONSplus partner IDIADA and the Germany-based PEM Motion selected through an EU matchmaking call. In June 2024, a technical training programme on electric mobility for local technicians was organised by SOLUTIONSplus with DIT, EURIST and FABIO in Dar es Salaam.

With regards to electric bicycles, in the absence of local companies prototyping these vehicles, SOLUTIONSplus partners selected the German organisation EURIST during an EU matchmaking process. EURIST, working with the German company HNF Nicolai and the

Uganda-based training organisation FABIO, provided electric bicycles. DIT staff and students were trained at DIT to a assemble, maintain, repair and use electric bicycles during three training sessions ranging from to a day to a full week, at regular intervals during the project. Through this process, EURIST transformed into a new company known as AfricroozE GmbH with an important market potential, now with 300 electric bicycles present in 8 African countries.

At the academic level, students of the Technical University of Berlin in developed a proposal for integrating three-wheelers into the BRT system in collaboration with stakeholders from the city.

IMPLEMENT

In the pursuit of sustainable and innovative transportation solutions, the SOLUTIONSplus Dar es Salaam concentrated on two key areas: transition towards electric three-wheelers in place of current ICE ones, and introduction of pedal-assist electric bicycles as a fully new mobility option in Dar es Salaam. The endeavor involved a multifaceted approach, encompassing the development of prototypes, local partnerships, and extensive data collection.

One key aspect of this initiative is the introduction of electric three-wheelers designed for passenger feeder services to the BRT system. In total, SOLUTIONSplus enabled the roll-out of 43 electric three-wheelers in Dar es Salaam, deployed by four different companies. These electric three-wheelers are either retrofitted (converted) fossil-fuel bajajs into electric bajajs, or fully new electric three-wheelers. Hence, a wide range of vehicle designs and technologies were tested. The project carefully studied the patterns of ICE bajajs to identify the adequate combination of technical specifications – in particular, the battery capacity – and the charging strategy (SOLUTIONSplus Feasibility assessment to electrify feeder three-wheeled vehicles in Dar es Salaam, 2023). Lastly, all electric three-wheelers all use lithium-ion batteries, comparatively more performing than lithium-ion batteries, more adapted to the needs of the drivers of bajajs, and representing a shift away from other electric three-wheelers found using polluting and less efficient lead-acid batteries.

During Phase I focusing on promoting local Research & Development, two companies were financially supported by UN-Habitat. Auto Truck assembled two new electric bajajs and retrofitted one ICE bajaj at the Dar Institute of Technology (DIT). The collaboration with the DIT has provided strong local anchorage, enabling the assembly of vehicles and the training of engineering students. The vehicles have been tested and are undergoing the certification process with TBS for new vehicles, which will allow for registration with TRA and subsequent commercialisation. Designs for the fleet application management system were developed in collaboration with the Kenyan branch of the hardware supplier Teltonika, a company based in Lithuania.

Another company, Sustainable Energy Services Company (SESCOM) retrofitted three ICE bajajs. After finalising a retrofitting manual and proceeding to the technical operational testing, the vehicles were tested and are currently undergoing the certification process by TBS. They will then be registered with TRA and LATRA Authorities and deployed along the Tangi Bovu – Goba route. This route connects to the Mbezi Mwisho BRT terminal, and to other minibus bus stops, such as the Ulomi bus stop.

Figure 2. Phase I - Auto Truck/DIT Company Ltd (left) and SESCOM (right)

During Phase II looking to expand the e-fleet locally assembled (2023-2024), Ziotio Company (brand TRI) and Ekoglobe were selected to provide additional vehicle design and charging approach, with seed funding provided by UEMI. Ziotio Company (brand TRI) is a company registered in Tanzania and with a holding in the Netherlands. Via SOLUTIONSplus, TRI deployed 20 electric bajajs of the E1 model using plug-in charging overnight and topped up during the day, and 5 further vehicles of the iterated bajaj model E2. In addition, TRI was selected by the DART Agency to install and operate four charging stations for electric three-wheeler at or near BRT stations, leaning on current feeder patterns and waiting points (see figure 4).

Ekoglobe follows an alternative and innovative approach of 10 electric bajajs and 2 electric bajajs used to dispatch charged batteries to drivers (mobile battery dispatching vehicles, a model deployed in India).

Figure 3.Phase II - Expanding the e-bajaj fleet: new e-three wheelers by TRI (top, left E1 and right E2) and Ekoglobe (bottom, vehicles on the left and awareness-raising campaign on the right).

Figure 4. Location of the chargers deployed by TRI for DART, at or near BRT stations (left), current charging station at DIT (right)

In addition to the electric three-wheeler project, SOLUTIONSplus introduced 16 pedal-assist electric bicycles designed for urban deliveries and the transportation of medical supplies. These vehicles were not present in Dar es Salaam prior to the project.

In 2022, the SOLUTIONSplus team collectively mapped needs and stakeholders, which led to identifying urban deliveries as the most promising use case for the electric bicycles. Partners identified potential receivers and established partnerships with the FASTA Cycling Cooperative and the Dar es Salaam Institute of Technology (DIT). Co-designed by EURIST and the German company HNF Nicolai, these 16 electric bicycles and 5 additional batteries were shipped in October 2022. A three-day workshop held at the Dar Institute of Technology in November 2022 enabled to train DIT staff, students and FASTA cyclists for the first time on the use and the assembly of the electric bicycles. Participants assembled the electric bicycles before the official inauguration ceremony at the Aga Khan Hospital. Currently, the e-bikes are actively employed for transporting medical supplies on behalf of the Aga Khan Health Services, showcasing significant scale-up potential.

Realising that electric bicycles do not receive as much attention as other vehicles in Africa such as electric motorcycles, this pilot prompted SOLUTIONSplus partners to develop an Africa E-Bicycle Start-up Booklet disseminated by UNEP and receiving significant interest among African partners. In addition, the pilot has laid the foundation for a study in 2024 which identified high environmental and financial benefits of approaching aiming to replace conventional motorcycles with electric bicycles for urban deliveries in Dar es Salaam and the broader East African region.

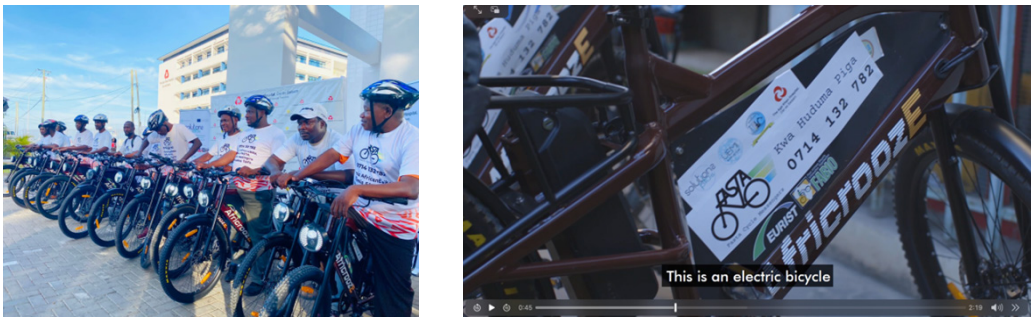

Figure 5. Electric bicycles: official launch in front of the Aga Khan Hospital (left); UN-Habitat communication video (right)

IMPACT

SOLUTIONSPlus paved the way for e-mobility solutions in Dar-es-Salaam by assessing the regulatory, fiscal, and market environment for the introduction of electric three-wheelers. Looking at the wider policy environment, SOLUTIONSplus identified barriers to the uptake of electric mobility jointly with the Africa E-Mobility Alliance. Leaning on this analysis, SOLUTIONSplus issued key recommendations for national and local policies. At national level, SOLUTIONSplus issued a policy paper on electric mobility policies in Tanzania, and a National Urban Mobility Policies and Investment Program. At local level, SOLUTIONSplus developed a City Roadmap identified pathways for sustainable and electric urban mobility in Dar es Salaam. Visibility on electric mobility was significantly increased through the high-level E-Mobility Forum, first event on e-mobility in Dar es Salaam, and EV Exhibition Fair.

The impact assessment, based on the UNEP E-Mob calculator indicates that the cumulative emission mitigation potential sums up to more than 43,000 tons CO2 between 2020 and 2050, and significant reduction of NOx and PM emissions, compared to a business-as-usual scenario. If by 2030, 70% of the three-wheelers that are sold are electric ones, CO2 emissions of the fleet could drop by 29%. Moreover, electrification could have a significant positive impact on the economy, particularly if local manufacturing and maintenance are considered.

REPLICABAILITY

SOLUTIONSplus partners engaged preparations for three key follow-up projects, sharing proposals for a follow-up project with the EU Delegation in Tanzania and ENABEL, and through the already approved eBRT2030 project, funded by Horizon Europe.

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