SOLUTIONSplus REPLICATION GUIDE

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PROJECT PARTNERS

ABOUT

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TITLE

SOLUTIONSplus Replication Guide

DISCLAIMER

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PICTURES

All the pictures are provided by SOLUTIONSplus partners

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CONTENTS

EXECUTIVE SUMMARY

SOLUTIONSplus: DRIVING THE GLOBAL SHIFT TO SUSTAINABLE URBAN MOBILITY

SOLUTIONSplus, an INCO Flagship Project, stands as a global leader in accelerating the transition towards low-carbon urban mobility. This ambitious initiative aligns itself with critical international agreements like the Paris Agreement, Sustainable Development Goals, and the New Urban Agenda, recognizing the crucial role of electric vehicles (EVs) in achieving these objectives. SOLUTIONSplus tackles the challenge of sustainable urban mobility through a multi-pronged approach: Demonstrating Integrated e-Mobility Solutions: Real-world city demonstrations serve as a testing ground for innovative and integrated e-mobility solutions. These demonstrations take place across diverse regions, including Europe, Asia, Africa, and Latin America, ensuring the solutions address the specific needs and conditions of each location.

Fostering Global Collaboration: SOLUTIONSplus recognizes that achieving a sustainable urban mobility future requires a united effort. The project facilitates collaboration between key stakeholders: cities, industries, research institutions, implementing organizations, and financing partners. This collaboration fosters knowledge sharing, resource pooling, and the development of effective e-mobility solutions.

SOLUTIONSplus: A CATALYST FOR CHANGE

The Replication Guide aims to share the learnings from the SOLUTIONSplus project with current and future project implementers aiming to replicate the project's successes. The guide contains examples and experiences tailored to the target audience. Through support from other partners, the guide will relate to the local context while capturing the innovation aspects of business models. The overarching goal is to ensure that the project's knowledge and accomplishments can be effectively disseminated and applied beyond its original scope. Local authorities, urban planners, entrepreneurs, and policymakers will benefit from the readily available resources and guidelines. These materials will enable them to implement sustainable and innovative solutions that have been proven effective by the SOLUTIONSplus project, ultimately contributing to improved urban mobility and quality of life in their respective regions. By fostering collaboration, innovation, and practical implementation, SOLUTIONSplus serves as a catalyst for a global shift towards sustainable urban mobility. This project holds immense potential to transform urban environments, leading to cleaner air, reduced greenhouse gas emissions, and a more sustainable future for cities worldwide.

SOLUTIONSplus REPLICATION GUIDES

The SOLUTIONSplus project is geared towards scale-up and replication. For this a broad network of partners has been established, along with a wide range of follow-up activities, including knowledge repositories and regional hubs. As part of this effort a series of replication guides aim to support current and future project implementers and funders to deliver innovation and implementation projects more efficiently, boosting impact and using resources effectively.

SOLUTIONSplus REPLICATION GUIDE

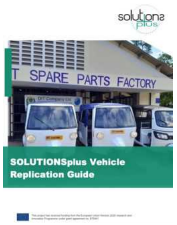
This provides an overview on all components of the SOLUTIONSplus project. The main focus of this guide is on the overall project concept and design whereas the other guides focus on a deeper dive on specific aspects from a technical and methodological perspective.

IMPACT ASSESSMENT GUIDE

This provides an overview on all components of the SOLUTIONSplus project. The main focus of this guide is on the overall project concept and design whereas the other guides focus on a deeper dive on specific aspects from a technical and methodological perspective.

LIVING LAB GUIDE FOR ACADEMICS

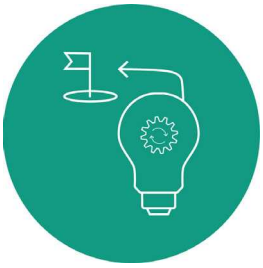
This provides an overview on all components of the SOLUTIONSplus project. The main focus of this guide is on the overall project concept and design whereas the other guides focus on a deeper dive on specific aspects from a technical and methodological perspective.



VEHICLE REPLICATION GUIDE

This provides an overview on all components of the SOLUTIONSplus project. The main focus of this guide is on the overall project concept and design whereas the other guides focus on a deeper dive on specific aspects from a technical and methodological perspective.

STRUCTURE OF THIS GUIDE

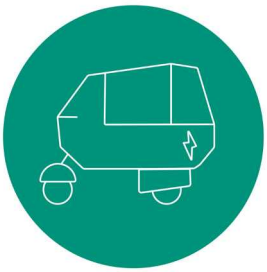


WHY

This chapter reflects on the starting points of the SOLUTIONSplus project, the global climate and sustainable development targets, and outlines some of the key challenges of international cooperation projects in the area of sustainable electric mobility.

HOW

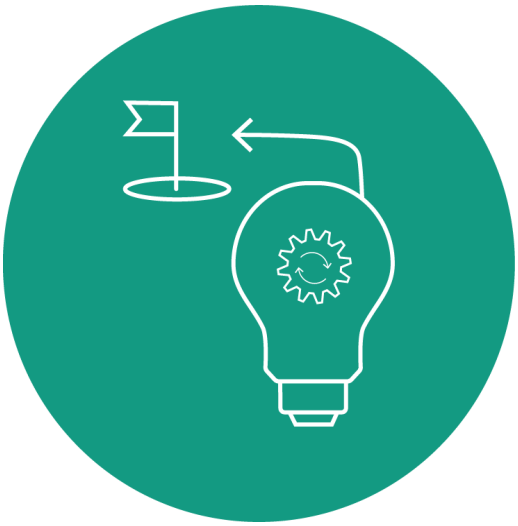
The second chapter of the Replication Guide focuses on the practical and conceptual steps towards implementation at the project and wider programming level. This aims to provide some practical guidance to project implementers for efficient operations and also to project funders for more effective programming.



WHAT

This section provides a short summary of the innovative urban e-mobility solutions that have been tested across various transport modes by the SOLUTIONSplus team. A vast repository of knowledge products is being provided in the emobility toolbox and on the SOLUTIONSplus website.

WHY



NEEDS AND OPPORTUNITIES

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NEEDS AND OPPORTUNITIES

The global transport sector is a significant contributor to greenhouse gas emissions, accounting for nearly a quarter of global CO2 emissions. This sector is also a major source of urban air pollution, contributing to health problems and environmental degradation. The rapid urbanization seen worldwide, particularly in developing regions, is increasing the demand for efficient, affordable, and sustainable urban mobility solutions. The Paris Agreement and the Sustainable Development Goals (SDGs) underscore the importance of transforming the transport sector to meet global climate targets. This transition is not only essential for environmental sustainability but also for enhancing the quality of life in urban areas, reducing health risks associated with pollution, and improving overall urban livability.

The SOLUTIONSplus project is designed to address these urgent needs by facilitating the transition to sustainable urban mobility through the development and deployment of electric mobility solutions. The project leverages the potential of electric vehicles (EVs) to reduce emissions, improve air quality, and provide efficient mobility solutions tailored to urban environments, create jobs and business opportunities. The local demonstrations in very diverse operating environments in Europe, Asia, Africa and Latin America on electric mobility solutions for public transport, shared fleets and logistics, aim to create scalable and replicable solutions that can be adapted to different contexts globally

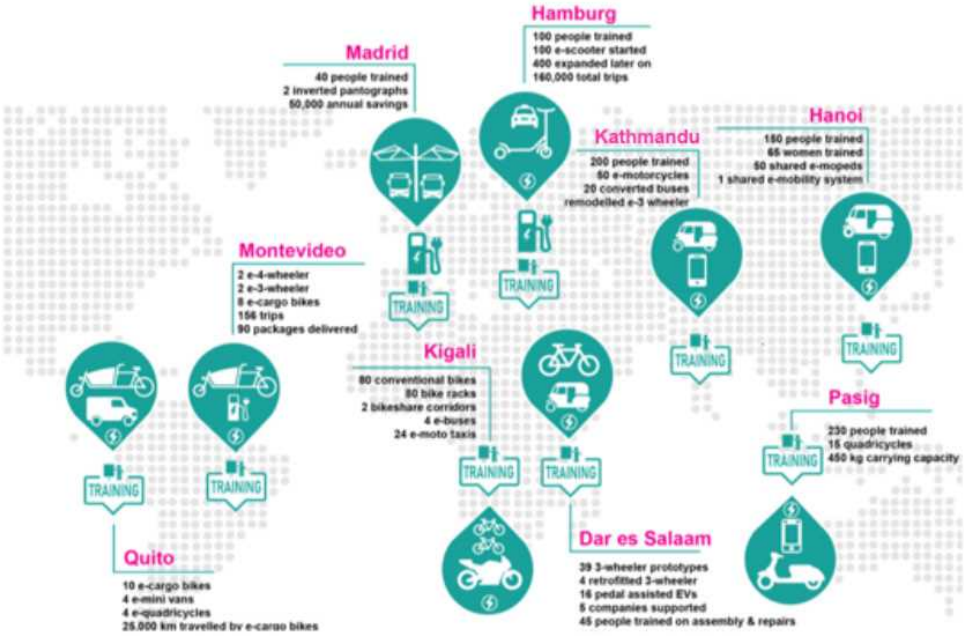


Figure 1: SOLUTIONSplus primary Living Labs

SOLUTIONSplus goes beyond merely promoting electric vehicles; it aims to create an integrated approach to urban mobility. This includes developing comprehensive business models, fostering industry collaborations, and implementing innovative financing mechanisms to support the large-scale adoption of e-mobility solutions. The project also emphasizes the importance of policy integration and capacity building, ensuring that local and national policies support the sustainable transition and that stakeholders have the necessary skills and knowledge to implement and sustain these innovations.

The SOLUTIONSplus project builds on the insights and experiences of various stakeholders, including cities, SMEs, industry partners, and knowledge institutions. It adopts a Living Lab approach, where innovative e-mobility solutions are tested and validated in real-world settings. This approach ensures that the solutions are not only technologically feasible but also economically viable and socially acceptable. By involving local, regional, and national decision-makers, the project fosters a collaborative environment that enhances the scalability and replicability of successful models.

Key components of the SOLUTIONSplus framework include:

1. **Innovation and Demonstration**: Testing e-mobility solutions in diverse urban contexts to validate their effectiveness and adaptability. This includes the deployment of electric buses, two- and three-wheelers, and integrated charging infrastructure.
2. **Capacity Building**: Providing training and resources to local authorities, transport operators, and entrepreneurs to ensure they have the skills and knowledge to implement and manage e-mobility solutions.
3. **Policy Integration**: Working with local and national governments to integrate e-mobility solutions into Sustainable Urban Mobility Plans (SUMPs) and National Urban Mobility Policies (NUMPs).
4. **Business Model Development**: Creating viable business models that can sustain the deployment and scaling of e-mobility solutions, involving local and international business partnerships.
5. **Global and Regional Cooperation**: Establishing platforms for knowledge exchange and cooperation among cities, regions, and international partners to foster the global replication of successful solutions.

The SOLUTIONSplus project represents a critical step towards addressing the environmental and social challenges posed by urban transportation. By fostering innovation, building capacity, and creating sustainable business models, the project aims to transform urban mobility and set a precedent for global replication. The need for action is urgent, but the opportunities for creating a sustainable and equitable transport future are immense. Through the collaborative efforts of diverse stakeholders, SOLUTIONSplus is paving the way for a cleaner, more efficient, and more inclusive urban mobility landscape. The journey towards sustainability is multifaceted and varied across different sectors. The electricity sector provides a testament to the efficacy of the Safe System approach. The shift towards renewable energy sources like wind, solar, and hydroelectricity has been implemented without drastic lifestyle changes for consumers. This systemic change in how electricity is produced and distributed has allowed individuals to continue their daily lives with minimal disruption, while benefiting from more sustainable power sources. This seamless transition demonstrates how systemic interventions can shield consumers from the brunt of transformative change. The heating sector is also beginning to experience such changes, integrating more sustainable heating solutions and gradually transitioning towards a low-carbon trajectory.

However, the transport sector presents a more complex challenge. While the current narrative emphasizes the shift towards electric vehicles (EVs), this addresses only part of the sustainability issue. Electrifying the vehicle fleet reduces carbon emissions but does not solve all problems. Larger, resource-intensive vehicles like electric SUVs still pose issues of high resource utilization, safety concerns, and urban noise pollution. Additionally, the dominance of vehicles, whether electric or not, continues to monopolize urban spaces, detracting from pedestrian areas and green zones, exacerbating congestion, and prioritizing vehicles over people in urban planning. To truly reimagine the transport

sector sustainably, a Safe System approach must address these multifaceted challenges. It is not just about electrification; it's about reconceiving urban spaces, rethinking mobility choices, and prioritizing people and the planet over mere vehicular transition.

Economic and Environmental Benefits of Sustainable Mobility

The transition to sustainable mobility has the potential to unlock trillions of dollars in cost savings and create more sustainable travel patterns, along with substantial co-benefits that transform cities into more liveable and economically efficient centers. However, policy interventions in this sector can have unintended consequences, both positive and negative, as they rarely affect only one objective. For example, air quality measures may negatively impact fuel efficiency, or biofuels may have land-use change implications. Therefore, linking and packaging policies is vital to generate synergies and co-benefits between measures, providing a basis for coalitions that can align different stakeholders. While there is a general assumption that the transformation towards sustainability in the transport sector will be costly, the overall benefits and savings far outweigh these costs. A sustainable mobility future would require only a fraction of the costs and resources compared to a business-as-usual scenario in the global transport sector. The transformation of the transport sector is driven by several levels of intervention that shape not just vehicle technology, but also mobility patterns and urban form.

Key Aspects of sustainable mobility that were guiding principles for the vehicle design and service provision in the SOLUTIONSplus project:

1. **Accessibility**:

Accessibility is a key sustainable development goal. Providing high-quality public transport services and walking and cycling infrastructure is essential for accessibility for all. Densification, characterized by compact city development, can help achieve this by promoting mixed-use, polycentric structures and short travel distances.

2. **Sharing**:

Shared mobility should include pooling and public transport feeder systems, as well as access to shared cars and ride-hailing services. Harmonizing pricing systems across these services can encourage the use of the most efficient options.

3. **Efficiency and Electrification**:

Efficiency improvements include downsizing vehicle size and power, which is highly cost-effective, along with advancements in internal combustion engines. This counters the trend towards bigger, faster, and more powerful cars, which have eradicated almost all efficiency gains in power-train technologies. Electrification should focus on the most viable and resource-efficient types of vehicles (small) and vehicle usage (public or shared).

4. **Technological Innovations**:

Technological innovations should complement public transport systems and enable access, avoiding competition with non-motorized transport. This is vital for the viability of public transport services and encourages healthy, active mobility. Automation may also play an important role in providing on-demand mobility services in rural areas where traditional public transport options are not viable.

5. **Policy Integration and Coalition Building**:

To achieve these goals, policy integration and coalition building are crucial. Policies must be designed to generate synergies and co-benefits, aligning various stakeholders to support a common vision of sustainable mobility. By packaging policies that address multiple objectives simultaneously, we can create more effective and resilient transportation systems.

SAVING TRILLIONS WITH A SAFE SYSTEM FOR SUSTAINABLE TRANSPORT: CHALLENGES AND OPPORTUNITIES

The transformation to a sustainable mobility system, leveraging the Safe System approach, offers profound economic, environmental, and social benefits. By focusing on accessibility, sharing, efficiency, electrification, and technological innovations, and by integrating policies and building broad coalitions, we can create a just and efficient transition. This shift addresses the critical issues of climate change, air pollution, and urban congestion, while enhancing accessibility and affordability for all, paving the way for a sustainable future in urban mobility.

This short overview aims to set the stage for the subsequent discussion on the key aspects of social and economic opportunities from sustainable, low-carbon public services and infrastructures, emphasizing the comprehensive benefits of a well-planned transition to sustainable transport.

The global transport sector is on the cusp of a transformative shift driven by the urgent need to address economic inefficiencies, air pollution, climate change, and urban congestion. This transition is centered on replacing conventionally fueled individual cars with electric shared and public transport solutions. By adopting a Safe System approach, this shift not only addresses environmental and economic challenges but also enhances urban livability, social equity, and cost efficiency. This chapter explores the challenges and opportunities associated with implementing a Safe System for sustainable transport, drawing on comprehensive analysis and scenarios that build on the concept of "Three Revolutions" in urban mobility.

This section explores the fundamental changes in travel that could occur in a well-developed electric and shared vehicle system and what this means for travel patterns and costs. The scenarios, apart from a Business-as-Usual (BAU) that is private car-dominated, are built upon a strong transition to electric vehicles and a strong shift in travel away from private light-duty vehicles toward shared mobility systems, along with greater use of public transit, cycles, and electric bikes. Apart from dramatically lowering the number of cars moving within cities at any given time, there are far fewer vehicles needed in general, with the vehicles that are present used more intensively and efficiently. This results in very large reductions in vehicle stock, the cost of this stock, and operating/energy costs. It also means fewer parking facilities, more available urban space, and a number of other benefits (air quality, safety, livability) that we don't attempt to quantify in this study. This works builds on a collaboration of the SOLUTIONSplus project with the University of California, Davis.

SCENARIOS AND THEIR IMPLICATIONS

Business-as-Usual (BAU) Scenario:
In the BAU scenario, 20th-century technologies and systems persist into the future, and trips remain dominated by private internal combustion engine (ICE) vehicles, mostly with single occupancy. This scenario expects to see more car travel, more overall traffic, and little if any reduction in CO2 emissions. By 2050, private LDV travel more than doubles compared to 2015, both in terms of passenger kilometers and vehicle kilometers of travel.

High EV/Shift Scenario:
The High EV/Shift scenario assumes widespread global vehicle electrification of light-duty vehicle (LDV) and two-wheeler sales by 2040, and of stocks by 2050. EVs reach

half of all new LDV sales by 2030 and nearly 100% by 2050. In addition, travel patterns change significantly by 2030 and especially by 2050, via greater "active" travel (walking and cycling), greater use of public transport (with much more investment in transit facilities and infrastructure), and more pooled trips including both ride-hailed trips and more car sharing.

By 2050, all vehicles are fully electrified, and private car use is at a minimum. Other travel modes dominate, while private automobiles (and SUVs) are nearly eliminated from roads around the world. Walking and cycling trips become more practical as cities become denser (or retain their density but add important sidewalk and other safety infrastructure). Longer cycling trips are replaced with e-bikes, which also eventually replace most motorcycle travel. Ride hailing and car sharing with (typically 4-7 seat) LDVs grow, while shared trips in 12-15 seat microbuses also grow rapidly in new areas from 2025.

Passenger and Vehicle Kilometers Traveled:
In the BAU scenario, patterns from 2015 to 2050 reflect a rapid increase in private LDV ownership and travel, while other modes do not grow significantly. There are about 2 passenger kilometers per vehicle kilometer in this world. LDV travel more than doubles between 2015 and 2050.

In the High EV/Shift scenario, there is a massive shift from private vehicles to walking, cycling, and public modes: transit systems, ride hailing, and car sharing. There is also a reduction in total passenger kilometers compared to the BAU because the scenario includes increased urban densities, closer origins and destinations, and shorter trips. The impact on passenger kilometers traveled (PKT) by 2050 is significant, about 30% lower than in BAU. However, the effect on vehicle kilometers traveled (VKT) is far larger, with 2050 total VKT across all modes cut by over 50% compared to the BAU. This is especially true for private cars, which are largely replaced by shared mobility LDVs by 2050.

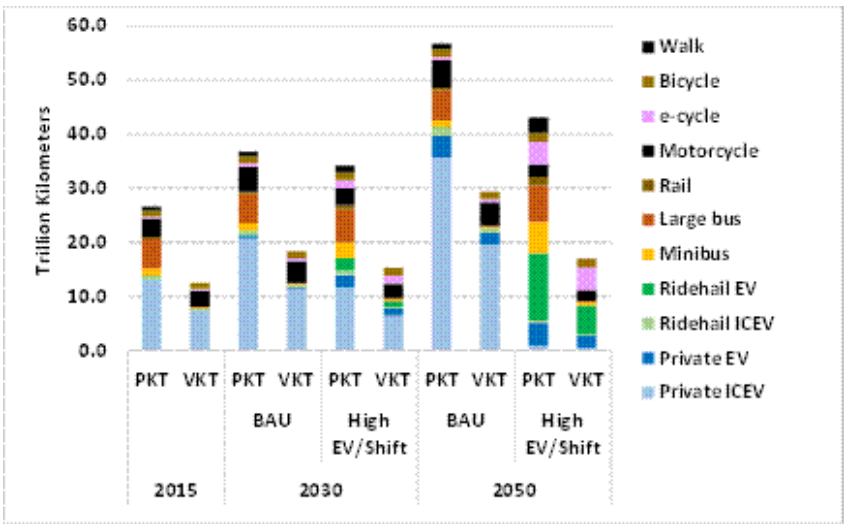


Figure 2. Passenger and vehicle kilometers traveled by mode and scenario worldwide. Abbreviations: AV, automated vehicle.

Reduction in Vehicle Stock:
While vehicle travel in 2050 drops by 50% in the High EV/Shift scenario, light-duty vehicle stocks drop even more. This reflects the shift to shared vehicles and very high travel levels per vehicle, replacing the low travel of privately owned vehicles. Specifically, these vehicles travel upwards of 100,000 km per year, rather than the less than 20,000 km per year traveled by private cars. Automation makes this easier, as the vehicles can run virtually all day without changing drivers.

When two-wheelers are also considered, the High EV/Shift scenario has nearly the same stocks as the BAU scenario. Bicycles continue to play a major role, which is often ignored and underestimated in terms of their role in the travel landscape around the world. The scenario features a massive increase in travel by electric bicycles, reflecting a major shift from car travel and from traditional ICE motorscooters and motorcycles. E-bikes, being much lighter, less expensive, more efficient, and more urban-friendly, are expected to become a major mode of transportation for urban trips of 5 km or less.

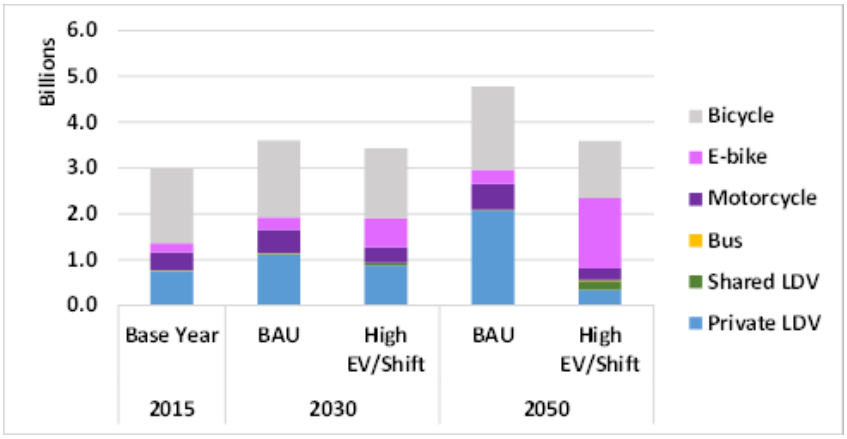


Figure 3. Global vehicle stocks by mode, scenario and year

Trip Mode Shares:
From the trip point of view, it is important to add walking, which is a critical part of mobility. Walking is estimated to account for about half of all trips today around the world. In the High EV/Shift scenario, the share of walking trips increases over time, with fewer long walks and more opportunities for short walks (0.5-1 km) as facilities and safety improve.

Among other modes, shared trips (via ride-hail or car-sharing programs) provide the largest share of trips of any mode. This reflects a paradigm shift away from private LDV ownership toward on-demand mobility services as an affordable door-to-door option. As the number of shared rides increases, more shared opportunities emerge that are convenient. With an average of 2.5 persons per trip, shared mobility can become a “baseload” form of urban travel. Two-wheelers also play an important role on a trip basis, but typically transport only one person at a time. Finally, buses, especially smaller (and mainly on-demand) buses, provide an increasingly important role in providing trips.

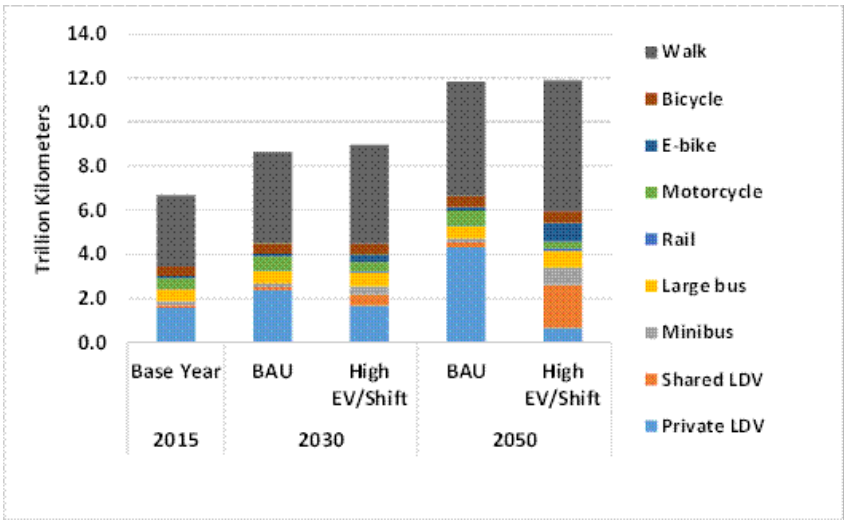
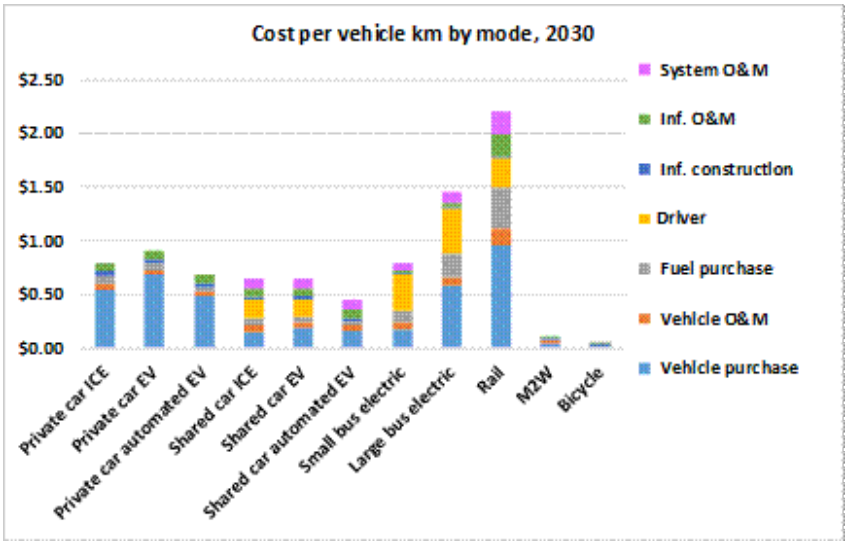


Figure 4. Global average trip mode shares by scenario, year

Cost Implications:
The High EV/Shift scenario shifts travel to much lower-cost modes than those that dominate today. The cost estimates vary somewhat by region and year, but generally, the results show significant savings. We considered seven types of costs: vehicle purchase, operating and fuel costs, driver costs, infrastructure construction and maintenance costs, and the cost of operating systems (transit and shared mobility). While modes like rail transit are quite expensive on a per vehicle-km basis, they provide among the lowest costs on a per-passenger km basis when well-utilized.

The analysis clearly shows that a private car-dominated future is far more expensive than one dominated by transit and two-wheeler systems. Automation further reduces the cost of ride-hailing, making it one of the cheapest light-duty-vehicle modes. Total



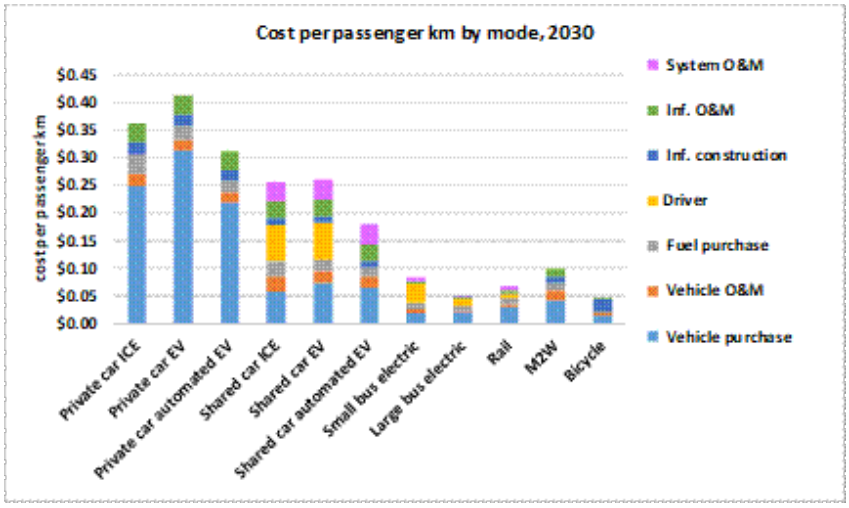


Figure 5. Global average costs by mode, 2030, per vkm (left figure) and pkm (right figure)

Total Costs by Scenario:

Given all the assumptions and projections included in each scenario, the total costs of each scenario in a given year can be obtained by multiplying the per-kilometer costs by total kilometers for each mode. By 2050, the High EV/Shift scenario is far cheaper than the BAU scenario. A primary source of cost savings is the reduction in vehicles, particularly privately owned vehicles. Shared vehicles transport many more people per day, so far fewer are needed. Even with intensive use and faster turnover of these vehicles, the costs of purchase and operation are far lower than for private vehicles.

Additionally, the scenarios account for the cost of infrastructure construction, operations, and maintenance, amortized across all passenger kilometers over time in proportion to their use of this infrastructure. The overall infrastructure costs are significantly lower in the High EV/Shift scenario since much less parking and road construction and maintenance are needed. Higher costs for expanded transit systems, as well as more sidewalks and bike lanes, add relatively little cost globally compared to vehicle and road infrastructure-related savings.

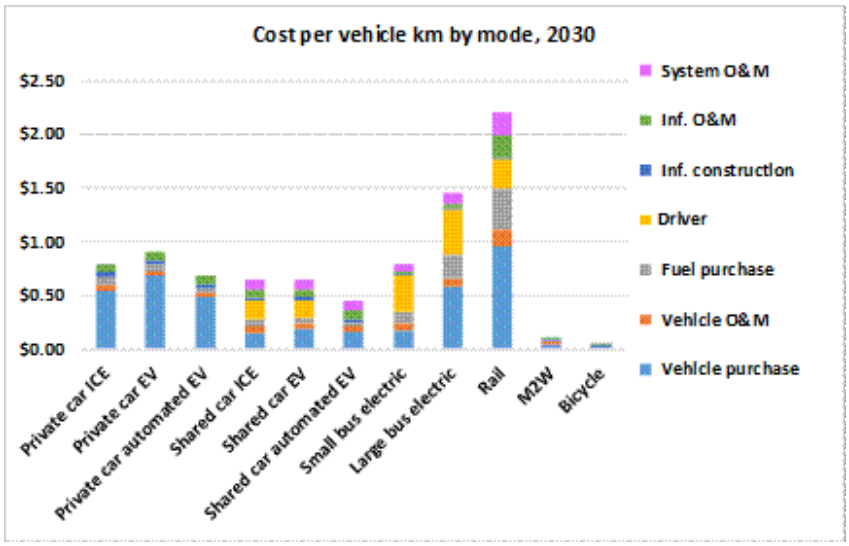


Figure 6. Total cost by scenario and mode.

Investment and Operating Costs:
The costs of these scenarios reflect both investment and operating costs and include both private and public costs. One catch with the High EV/Shift scenario is that while private costs drop dramatically, some public costs rise. For example, publicly run transit systems, which expand operations considerably in this scenario, require a large increase in ongoing funding. Nevertheless, the overall massive savings in this scenario, on the order of $10 trillion per year by 2050, suggest there should be a large amount of funds available to help build the needed systems.

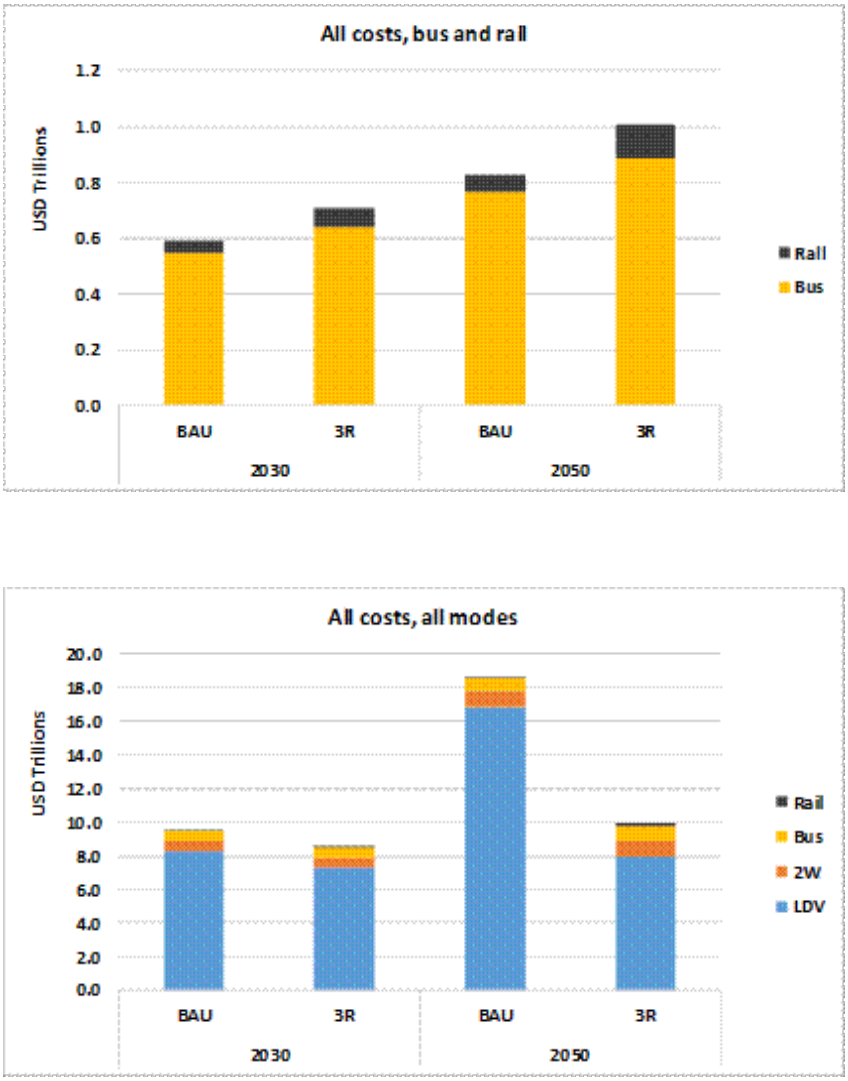


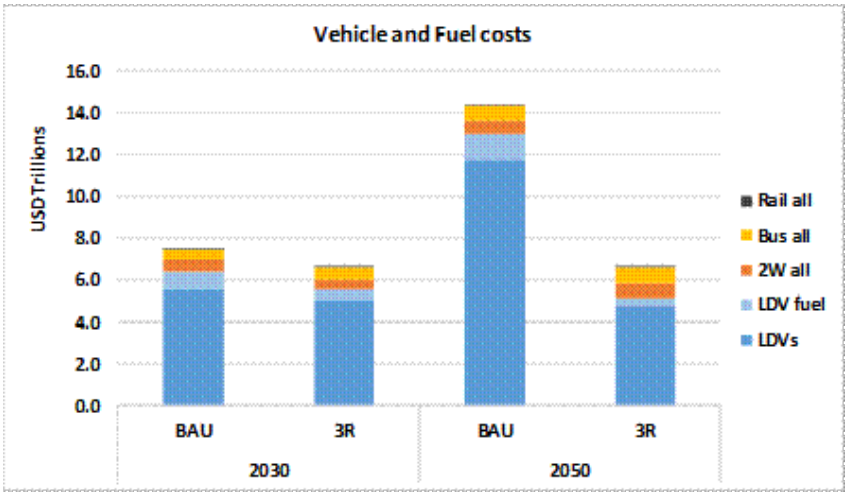
Figure 7. a and b. Cost by mode in 3R scenario

One way to look at this is as follows: The total costs of all transit systems, including vehicles, drivers, operations, and maintenance, and even construction and maintenance of infrastructure, projected for 2030 in the High EV/Shift scenario, is about $650 billion worldwide, versus about $600 billion in the BAU scenario. This $50 billion difference grows to $200 billion in 2050, with High EV/Shift spending at about $1 trillion per year on transit versus $800 billion in the BAU scenario. The need to spend an additional $200 billion per year by 2050 to build and operate these transit systems is a significant amount of additional money—except when compared to what the world will spend on private vehicles.

Figure 6 (b) shows the transit costs (highly compressed with the adjusted y-axis scale), along with the costs for LDVs and two-wheelers (motorbikes, e-cycles, bicycles). The costs for LDVs dwarf everything else. In the BAU scenario, the world will spend over $8 trillion on purchasing and owning cars and SUVs in 2030, along with the costs of building and maintaining roads for those cars (even accounting for some of those costs for trucks and buses). The savings in the High EV/Shift scenario is about $1 trillion, 20 times more than the additional cost of transit in that year (and more than the entire cost of the world's transit systems). By 2050, the savings in High EV/Shift from fewer LDVs is enormous ($8 trillion), due to deep reductions in the number of vehicles, total vehicle travel, needed infrastructure, and energy use. This $8 trillion in savings would now pay for the additional $200 billion in transit costs 40 times over, and would pay all the transit costs worldwide ($1 trillion) eight times over.

Vehicle and Fuel vs. Infrastructure Costs:

How much of this cost breakout and savings is actually for the vehicles and fuels, versus the infrastructure? How does transit compare with LDVs on vehicle/fuel costs, and how does it compare on infrastructure costs? Figure 7 shows this breakout for each of the four vehicle types. Noting the different scaling of the y-axis (vehicle/fuel costs overall are typically 3-4 times the costs associated with infrastructure), LDVs dominate on both types of costs. Even for infrastructure, the costs of roads and parking far exceed the costs of building and operating tracks and allocated road space for buses (including Bus Rapid Transit, BRT). Thus, even when looking solely at the infrastructure side of the system, shifting to a transit-oriented system generates substantial savings.



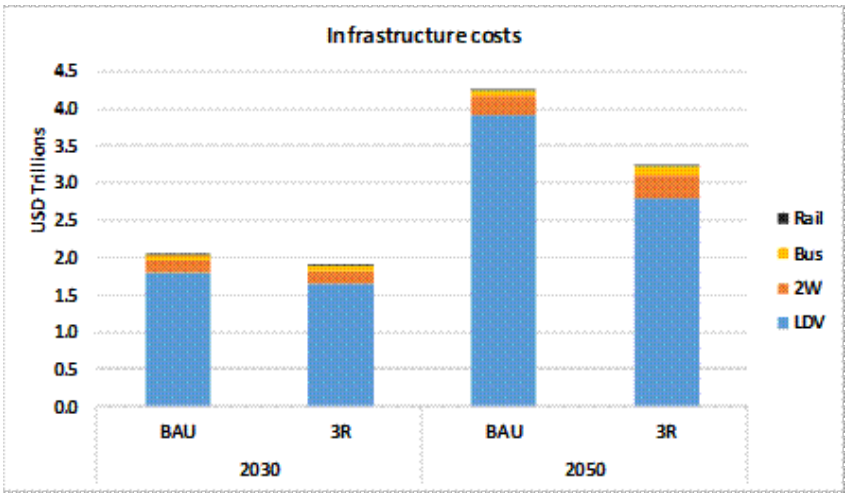


Figure 8. costs broken out by vehicle/fuel vs infrastructure

A world dominated by private vehicles—purchasing and maintaining those vehicles, buying fuel for those vehicles, and paying for roads and parking for those vehicles—is a very expensive world. A High EV/Shift scenario with far fewer private vehicles, more shared mobility, and more transit and electric two-wheeler use is a far less expensive and more cost-effective world.

The transition to sustainable mobility has the potential to unlock trillions of dollars in cost savings through more sustainable travel patterns, along with substantial co-benefits that help transform cities into more liveable and economically efficient centers. Policy interventions in this sector can have unintended consequences, both positive and negative, as they rarely affect only one objective. For example, air quality measures may negatively impact fuel efficiency, or biofuels may have land-use change implications. Therefore, linking and packaging policies is vital to generate synergies and co-benefits between measures, providing a basis for coalitions that can align different veto players.

There is a general assumption that the transformation towards sustainability in the transport sector will be very costly. While shifts towards more sustainable mobility infrastructures, services, and vehicle technologies will require innovation and investments, the overall benefits and savings far outweigh the costs. A sustainable mobility future would only require a fraction of the costs and resources compared to a business-as-usual scenario in the global transport sector.

The transformation of the transport sector is driven by multiple levels of intervention that shape not just vehicle technology but also mobility patterns and urban form. Accessibility is a key sustainable development goal. Providing high-quality public transport services and walking and cycling infrastructure is essential for accessibility for all. Densification characterized by compact city development can help with mixed-use, polycentric structures and short travel distances. Sharing should include pooling and public transport feeder systems, as well as access to shared cars and ride-hailing services. Pricing systems should be harmonized across these services and encourage the use of the most efficient options.

Efficiency and electrification are crucial. Downsizing vehicle size and power is highly cost-effective, along with improvements in internal combustion engines themselves. This

counters the trend of the last decades towards bigger, faster, and more powerful cars, which has eradicated almost all efficiency gains in powertrain technologies. Similarly, electrification should focus on the most viable and resource-efficient types of vehicles (small) and vehicle usage (public or shared). Other technological innovations such as automation should focus on complementarity to public transport systems and enable access, avoiding competition with non-motorized transport. This is vital to the viability of public transport services and encourages healthy and active mobility.

The joint objective of fostering energy and resource efficiency and boosting local value generation has been a driving factor throughout the SOLUTIONSplus project and its various follow-up activities. The following chapter will provide some practical insights on the perspective of integration of the SOLUTIONSplus e-mobility solutions into a wider set of policies and investments at the local and national level to ensure that the innovations supported by the project create opportunities for the businesses and authorities involved as well as fostering societal benefits.

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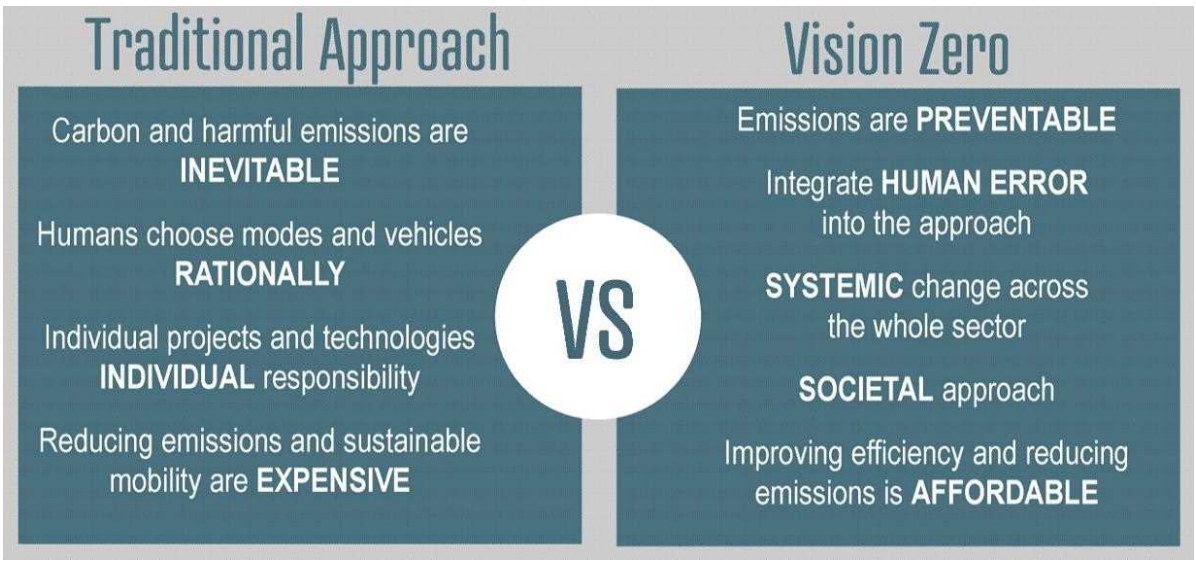
VISION ZERO FOR TRANSPORT

The electrification of the vehicle fleet represents a critical component in the quest for improved air quality and is an essential building block for global climate change mitigation strategies. New e-mobility solutions and electric vehicle (EV) concepts hold immense potential for economic development, far beyond traditional transport solutions. However, the introduction of EVs and other technologies, such as drones and ride-hailing applications, can create the illusion that innovation alone can solve our sustainability challenges. While electric mobility is a vital cornerstone in decarbonizing the transport sector, it is only part of a broader transition necessary to combine climate action with universal access, safe roads, clean air, and livable cities. A future with two billion cars on our roads will be unsustainable, regardless of propulsion technologies, if traffic congestion persists, public land is consumed by highways and parking lots, and precious resources and funds are misused. Thus, to achieve truly transformative change, the approach to decarbonizing transport must extend beyond vehicles and even the sector itself. A multi-modal, multi-level sustainable transport package should tackle all aspects of the mobility system and seek alignment with national and local policies, as well as actions from both the public and private sectors.

The Need for Systemic Change

To achieve a sustainable, decarbonized transport system, we must move away from the traditional perspective that views air pollution, greenhouse gas (GHG) emissions, congestion, and road crashes as inevitable consequences of mobility access. This old viewpoint assumes rational individual choices of transport modes and vehicles, counts on personal responsibility, and claims that reducing emissions is more expensive than maintaining the status quo. Instead, we need to embrace a systemic approach to sustainable, decarbonized transport. This perspective builds on years of experience from the road safety realm, such as Sweden's "vision zero" adopted in 1997, which revolutionized road safety improvements. Integrated and systemic change to achieve sustainable mobility for all focuses on four interconnected pillars: users, technologies, services, and infrastructures.



Integrated and Systemic Change

There are numerous technological and operational options available that can drastically reduce CO2 emissions and improve local air quality. By providing sustainable choices to transport users and signaling clear preferences through pricing or regulation, we can nudge consumers towards more sustainable choices. Individual projects and technologies can contribute to this change, but only an integrated and systemic change across the whole sector—and beyond, including the energy and resource dimensions—will enable a shift towards a net-zero transport system. This requires a societal perspective to identify appropriate solutions and leverage cost savings from a sustainable mobility system.

A "safe system" approach to transport, which aims for net-zero emissions and enables access to sustainable mobility for all, needs to focus on minimizing the carbon content in vehicle technologies. The shift to electric mobility plays a vital role in decarbonizing the sector. However, the overall contribution of electric mobility to climate change mitigation and sustainable development critically depends on its integration with other pillars of the system. EVs must be resource- and energy-efficient, well-integrated with other mobility services and infrastructure, and designed for mobility as a service, ensuring access for all.

Unlocking the Full Potential of the Transition

Adopting a "safe system" approach requires a better understanding of the needs and opportunities for key players in the sector, including industry, mobility service providers, infrastructure developers, local and national policymakers, and transport users. Essential building blocks for the transition to sustainable mobility include complementary measures at local and national levels that provide a framework for transformative change, encompassing planning, infrastructure, fiscal, regulatory, and informational measures.

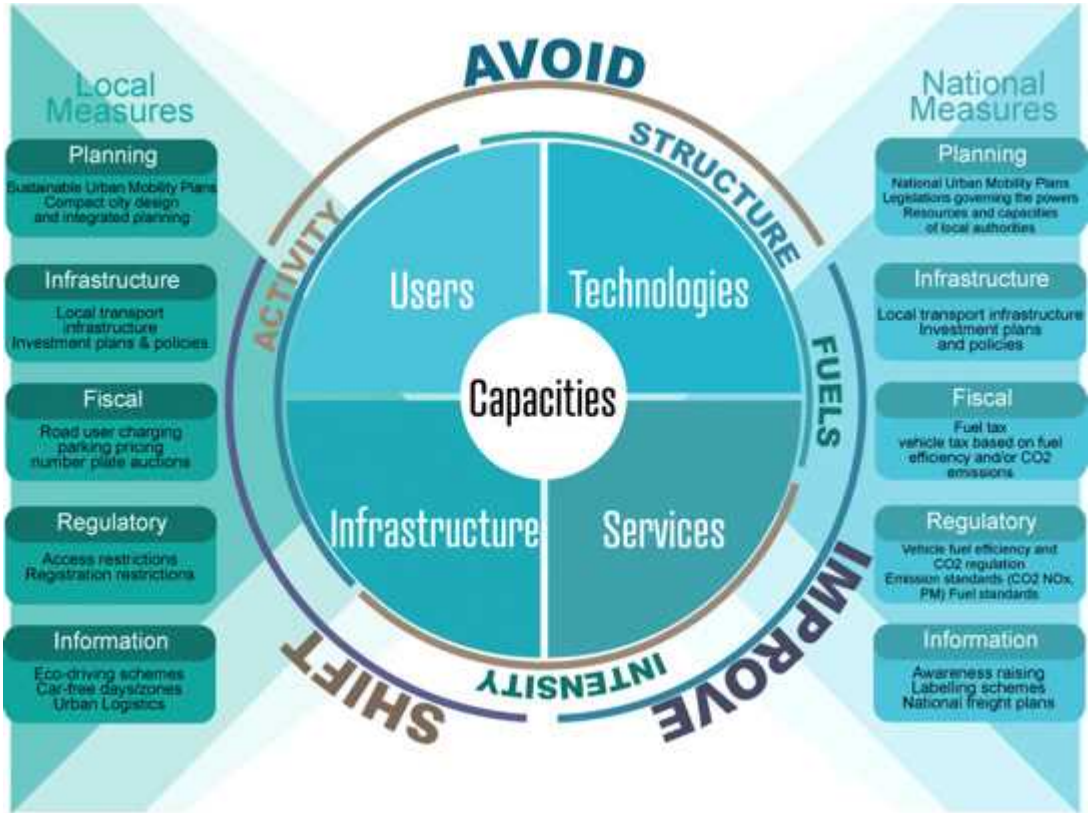
A transition to a systemic approach has the potential to unlock trillions of dollars in cost savings from a whole-society perspective. By 2050, a low-carbon mobility system could cut transport-related annual costs by over $5 trillion globally. More sustainable travel patterns can generate substantial complementary benefits, transforming cities into more livable and economically efficient centers.

Policy interventions to foster the electrification of the sector can help achieve objectives such as air quality improvements and GHG emissions reductions. However, addressing all key objectives—including access to safe roads and livable cities for all—requires a broader package of measures. Linking and packaging policies is a key tool to generate synergies between different measures and align various players.

Integrating Electric Mobility within a Wider System Approach

Electric mobility must be embedded within an overarching approach consisting of several intervention levels that shape vehicle technology, mobility patterns, and urban form. An integrated approach includes:

The systemic approach requires a change from an individual perspective towards mobility as a product to a societal perspective towards mobility as a service. To enable this local and national policy measures need to be closely aligned and cover planning, infrastructure, fiscal, regulatory and supporting levels of intervention.



The transformation towards sustainable transport may seem costly, but the overall benefits and savings far outweigh the costs. A sustainable mobility future will require only a fraction of today's costs and resources. The SOLUTIONSplus demonstrations focused specifically on the most energy and resource efficient types of vehicles and services.

Lah, Oliver (2022): Vision zero: Integrating electric mobility with wider systemic change. Edited by bp and The Economist Group. Available online at https://impact.economist.com/sustainability/project/the-rev-index/sustainable-mobility/

Lah, O. (2024). Safe System for Sustainable Development. Sustainable Earth Reviews. https://doi.org/10.1186/s42055-024-00072-z

INTERNATIONAL COOPERATION

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INTERNATIONAL COOPERATION

Transport plays a crucial role in the fight against climate change, contributing approximately 23% of global energy-related greenhouse gas emissions. Developing nations face increasing mobility demands, leading to rising emissions, traffic congestion, and safety concerns. However, these challenges also present significant economic opportunities through localized sustainable mobility solutions. The pursuit of low-carbon transport is not just an environmental initiative; it is an opportunity to collaborate with emerging economies in Africa, Asia, and Latin America to address local and global challenges and generate economic benefits. This chapter explores the importance of international cooperation, drawing on insights from the SOLUTIONSplus project.

The Role of International Cooperation

International cooperation is vital for maximizing the impact of sustainable urban mobility initiatives. A Team Europe approach, harmonizing research and innovation, development cooperation, and climate action programs, has been central to SOLUTIONSplus. This integrated approach enables the development of comprehensive strategies that go beyond technical deployments to include policy formation, financing mechanisms, and alignment with local energy mixes and regulatory landscapes.

Learnings from SOLUTIONSplus

The SOLUTIONSplus project demonstrated the value of international cooperation through various city-level demonstrations and global collaborations. Key insights from the project include:

1. **Comprehensive E-Mobility Frameworks:** SOLUTIONSplus emphasized the importance of creating comprehensive e-mobility frameworks in major urban hubs across Asia, Africa, and Latin America. These frameworks involved participatory processes that encompassed governance, financial structures, and regulations, serving as capacity-building templates for other cities.
2. **Tailored Local Solutions:** The project implemented tailored e-mobility initiatives in medium-sized cities, leveraging lessons from larger lighthouse projects. These pilots demonstrated scalability and adaptability across different public and private sector contexts.
3. **Ecosystem Creation:** By fostering sustainable funding avenues and efficient implementation blueprints, SOLUTIONSplus created an ecosystem that synchronized local and international stakeholders. This holistic approach ensured that e-mobility solutions were supported by a conducive environment for growth and sustainability.
4. **Capacity Building and Knowledge Sharing:** The project established platforms for research, funding, and partnerships while facilitating educational and professional training avenues in e-mobility. This focus on capacity building ensured that local communities, policymakers, and industry stakeholders were equipped to support and sustain the transition to electric mobility.
5. **Local Value Chain Formation:** SOLUTIONSplus promoted the indigenization of e-automotive industries, reinforcing local ownership and fostering the decarbonization trajectory. By supporting local manufacturing and assembly of electric vehicles, the project created job opportunities and stimulated economic growth in the participating regions.

Regional Insights

Latin America: Characterized by a high concentration of buses and clean electricity grids, Latin America offers significant opportunities for electrification. Governments are aligning with international conventions and evolving their legislative and policy infrastructures to support electric mobility. Cities are integrating substantial numbers of electric buses into their fleets, supported by a burgeoning ecosystem of startups and training programs.

Africa: In Sub-Saharan Africa, innovative e-mobility solutions are addressing urban challenges and a growing population. The region has seen a surge in electric two-wheeler startups, with countries like Rwanda and Kenya leading in adoption. Electric motorbikes as taxis provide last-mile connectivity and create opportunities for co-developing products and services tailored to local markets.

Asia: Asia, with its massive fleet of two- and three-wheelers, presents a significant growth potential for electrification. Countries like India and China dominate the production and market share of these vehicles, contributing to the competitive landscape. The region's urban density and high demand for affordable and efficient mobility solutions make it an ideal market for electric two- and three-wheelers. Localized manufacturing, combined with supportive government policies and infrastructure development, can drive substantial growth in this segment. The competition from India and China in producing cost-effective and technologically advanced vehicles poses both a challenge and an opportunity for collaboration and innovation.

Guidance for Future Project Implementers

Based on the experiences and lessons from SOLUTIONSplus, the following recommendations are provided for future implementers of international e-mobility projects:

1. **Holistic Planning:** Comprehensive planning that integrates vehicle technologies, infrastructure development, service enhancement, and user engagement is essential. This ensures all aspects of the mobility system work together to achieve sustainability goals.
2. **Collaborative Partnerships:** Building strong partnerships with local governments, industry stakeholders, and international organizations is crucial. These collaborations facilitate knowledge exchange, resource sharing, and coordinated efforts, enhancing the scalability and replicability of sustainable mobility solutions.
3. **Adaptability to Local Contexts:** Solutions must be tailored to local conditions and needs. Customizing vehicle designs, service models, and infrastructure to suit different urban environments helps address specific challenges and leverages local opportunities.
4. **Policy Support and Incentives:** Advocating for supportive policies and incentives is necessary to promote the adoption of electric mobility solutions. Financial incentives, regulatory support, and public awareness campaigns can drive consumer acceptance and industry investment.
5. **Continuous Monitoring and Improvement:** Implement ongoing monitoring and evaluation to assess the performance of implemented solutions. Regular assessment allows for the identification of areas for improvement and ensures the long-term sustainability and effectiveness of initiatives.

Potential Formats for Collaboration

- **Lighthouse Projects:** Comprehensive e-mobility frameworks in major urban hubs, emphasizing participatory processes and serving as templates for other cities.
- **Pilot Localized E-Mobility Solutions:** Tailored initiatives for medium-sized cities, ensuring scalability across public and private sectors.
- **Ecosystem Creation:** Integrating sustainable funding avenues, efficient implementation blueprints, and synchronization of stakeholders.
- **Working Groups and Capacity Building Hubs:** Platforms for research, funding, and partnerships, facilitating educational and professional training.
- **Value Chain Formation:** Indigenizing e-automotive industries, reinforcing local ownership and fostering decarbonization.

The electrification of the transport sector is a pivotal response to global climate challenges. The SOLUTIONSplus project has demonstrated the potential of international cooperation in developing and deploying sustainable urban mobility solutions. By leveraging the strengths and expertise of diverse stakeholders, future projects can build on these insights to create comprehensive, integrated solutions that transform urban mobility and contribute to global sustainability goals. Through continued collaboration, we can achieve a low-carbon transport system that is efficient, accessible, and resilient.

HOW

LIVING LAB APPROACH

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LIVING LAB APPROACH

Cities are dynamic and multifaceted environments with interconnected social, economic, and environmental issues that require innovative and participatory solutions. Traditional top-down and fragmented approaches to urban development and problem-solving often fall short of addressing the complexities of urban challenges. The importance and urgency of sustainability and climate change mitigation and adaptation are increasingly recognized and emphasized. Governments at all levels must urgently take action to address sustainability challenges. Implementing solutions can be complex because they require transformations that are likely to be contested or require coordination between actors still working in silos.

The Role of Collaboration and Support

Collaboration and support are crucial to identifying and implementing sustainable and inclusive solutions. Bringing all key actors together can address the challenges of knowledge and fragmentation of responsibilities. Urban Living Labs (ULLs) provide a platform for heterogeneous stakeholders, including government agencies, academia, businesses, community organizations, and residents, to learn and co-create innovative solutions that are then tested in real-world urban contexts. By involving diverse actors and stakeholders, living labs tap into their collective knowledge, expertise, and resources, fostering collaboration and boosting buy-in. Actual physical experimentation is critical as it allows feedback and potential iterations, tests viability, and provides a basis for scale-up and replication.

Characteristics of an Urban Living Lab

Typically, five principles should characterize an Urban Living Lab:

1. **Geographical Embeddedness:** Mostly through physical environments, with various urban configurations possible depending on the project.
2. **Learning and Experimentation:** Learning about an innovation before testing it to adapt it to the local context or identify the need for iterations.
3. **Participation:** Involvement from four groups: users or citizens, public entities, knowledge institutes, and private actors.
4. **Leadership and Ownership:** Central coordination and local champions with decision-making power for all participants.
5. **Evaluation and Refinement:** Producing knowledge, evaluating the innovation, and scaling up or replicating successful solutions.

Benefits of Urban Living Labs

Due to their collaborative, participatory, and experimental approach, urban living labs promote sustainable and innovative urban development. Key benefits include:

- Cooperation between heterogeneous and complementary stakeholders.
- Flexibility and temporary interventions to test innovations.
- Testing innovations in other locations to analyze their fitness to the local context or create entirely new solutions.
- Integrating solid impact assessment and monitoring for the sustainability of the pilot, scale, and replication of successful components.

Typical Structure of an Urban Living Lab

To integrate all elements, a simple but effective way to operationalize an Urban Living Labs project is the 5-Is: Inform, Inspire, Initiate, Implement, and Impact.

Inform: Develop stakeholder capacities and increase awareness related to the topic.
Inspire: Encourage decision-makers to adopt innovative approaches in their local context.
Initiate: Develop solutions to identified problems through co-creation.
Implement: Pilot activities where solutions are tested.
Impact: Develop strategies and tools for assessing the ULL, scaling up, and replication.

SOLUTIONSplus adopted the Five I's Framework: Inform, Inspire, Initiate, Implement, and Impact. This framework provided a structured process for developing and co-creating Urban Living Labs.

Stage 1: INFORM: Capacity Building and Awareness Raising
The first stage focused on building stakeholder capacities and raising awareness about the innovation and its potential benefits. This involved training workshops and seminars to equip decision-makers, students, and community stakeholders with knowledge of participatory approaches, inclusive governance, and collaborative processes—for example, SOLUTIONSplus organised workshops for African city officials on e-mobility solutions and participatory planning methods. Additionally, educational materials and resources, such as manuals on e-mobility solutions and sustainability strategies, were developed and disseminated among stakeholders. Public events and campaigns were also organised to raise public awareness and engage the community in the Urban Living Labs activities.

Stage 2: INSPIRE: Stakeholder Motivation
The second stage aimed to inspire and motivate participants by showcasing successful case studies and providing opportunities for peer learning. Success stories from established Urban Living Labs were shared with participants, demonstrating tangible benefits and motivating local stakeholders. Hosting inspirational speakers and thought leaders from academia and industry further boosted participant motivation. These experts shared their experiences at SOLUTIONSplus conferences, providing valuable insights and fostering a sense of possibility and engagement among participants.

Stage 3: INITIATE: Co-development
The third stage focused on bringing participants together to identify challenges and opportunities and develop potential solutions jointly. This was achieved by facilitating the co-development partnerships and process through interactive exchanges throughout the project. This not only included, workshops and events, but meant a constant engagement with local stakeholders in to develop solutions that help addressing urban mobility challenges. Demonstration concepts were co-developed to test proposed solutions in the Living Lab context, allowing stakeholders to refine and adapt solutions, which also helped to identify synergies with other projects.

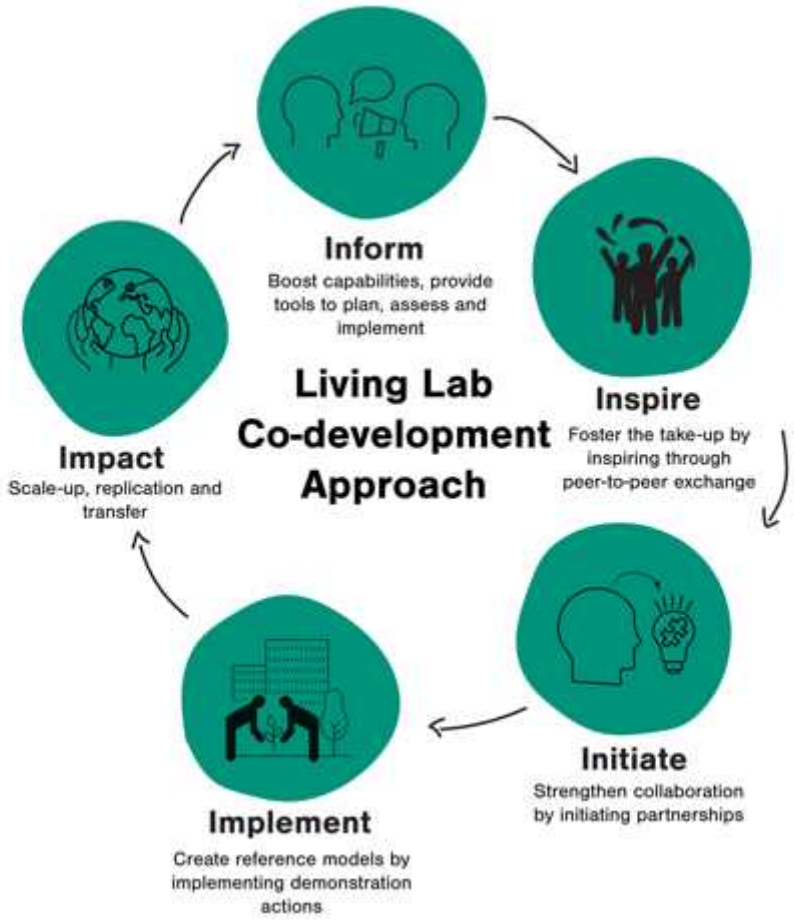
Stage 4: IMPLEMENT: Co-creation
The fourth stage involved the practical application of co-developed solutions, emphasising collaboration and real-world implementation. Stakeholders collaborated to design and implement the Urban Living Lab, incorporating diverse perspectives to ensure comprehensive solutions. For example, in Latin America, stakeholders collaborated to design and implement a bike-sharing system tailored to local needs. Establishing

monitoring and evaluation processes was also crucial at this stage, as it allowed tracking progress and assessing the impact of implemented solutions. Monitoring systems were set up to evaluate the performance of e-mobility solutions in partner cities, providing data for continuous improvement.

Stage 5: IMPACT: Assessing and Scaling Impact

The final stage focused on evaluating the outcomes and identifying opportunities for replication and scaling up. Robust evaluations were conducted to assess the impact on urban sustainability and inclusivity. For example, evaluations of pilot projects in Asia measured reductions in emissions and improvements in public transportation usage. Developing strategies and forming partnerships were essential to support the replication or scaling-up of successful initiatives. Partnerships with international organisations provided additional resources and expertise necessary for expanding e-mobility solutions to new regions.

The SOLUTIONSplus 5Is approach



Living Labs can create a collaborative environment that goes beyond individual projects and levels of intervention. In the context of SOLUTIONSplus this focused on the co-development of e-mobility solutions for both urban and rural operating environments for passenger and freight transport, but it also explored wider aspects of the sustainability transition in transport and also in closely related sectors such and energy and urban development. The SOLUTIONSplus Living Labs facilitate real-world experimentation and the iterative refinement of innovations in partnership with local stakeholders, fostering

the practical application of academic research. This approach addresses the research-implementation gap by ensuring that innovations are not only theoretically sound but also practically viable. This also included peer exchanges, regional communities of practice and educational programmes on sustainable mobility solutions, which facilitates knowledge sharing among peers from local and national authorities, academics, and private sector actors across Africa, Europe, Asia, and the Americas. Such exchanges promote the dissemination of best practices and innovative solutions, bridging the gap between research and practical application.

Urban Living Labs in an International Cooperation Context

Most development cooperation activities support decision-makers in developing strategies and solutions that address social, environmental, and economic issues. Participatory approaches are often employed, but constraints such as centralized decision-making and power dynamics exist. For rapidly changing urban issues, we need solutions that can be tested, revised, and adapted to local needs. The ULL approach builds on participatory approaches by introducing the element of experimentation into developing solutions, enabling local stakeholders to develop consensual solutions. Scaling-up and replication need consideration while developing the solution.

Implementing the ULL Approach in Development Cooperation

Urban Living Labs can foster a Just Transition in development cooperation by:

- Mapping key objectives and involving co-development actors and stakeholders in project design.
- Explicitly including the ULL approach in activities and closely involving partners in implementation.
- Engaging a diverse set of stakeholders, including local businesses and entrepreneurs.
- Contextualizing the approach by analyzing socio-economic, cultural, and environmental factors.
- Promoting a shared vision and co-creation methodology.
- Investing in local capacity to conceptualize, develop, implement, and monitor solutions.
- Creating an environment for iterative learning with active feedback.
- Embedding long-term sustainability and innovative financing and partnership options from the start.

Urban Living Labs differ from other forms by focusing on the urban area, implying spatial embeddedness and addressing sustainability challenges concentrated in cities. Co-creation and real-life testing are essential, along with capacity-building for participants.

Theoretical Aspects of Sustainable Transitions

Transition and transformation are interrelated concepts in sustainability. Transition management is a methodical and intentional way of guiding the move towards sustainability, prioritizing innovation, collaboration, and learning. Adaptive governance introduces flexibility and iterative testing to implement strategies, ensuring collaboration and inclusivity.

Experimentation in an Urban Context

Urban areas significantly impact sustainable development, offering opportunities

for resource management, energy efficiency, and renewable energy adoption. Experimentation in urban settings involves small-scale innovations influencing larger socio-technical systems, generating new ideas and perspectives within specific locations.

Defining Urban Living Labs

Urban Living Labs are platforms addressing urban complexity through experimentation, participation, and collaboration. They focus on sustainability transitions in urban areas, involving co-creation, real-world testing, and iterative processes. The European Network of Living Labs defines them as open innovation ecosystems in real-life environments, emphasizing co-creation, rapid prototyping, testing, and scaling-up innovations.

Expected Benefits and Typologies of Urban Living Labs

Urban Living Labs offer diverse goals, topics, and contexts, reflecting local needs and focus areas. They cover sustainability topics such as nature-based solutions, sustainable housing, public spaces, circular economy, urban mobility, energy systems, and more. The diverse typologies ensure flexibility and adaptability to various urban challenges.

Case Studies of Urban Living Labs

Examples of Urban Living Labs, such as SOLUTIONSplus in Dar es Salaam, Urban Pathways in Belo Horizonte, and air quality monitoring in Kigali, illustrate the five principles of ULLs: geographical embeddedness, experimentation and learning, participation, leadership and ownership, and evaluation and refinement.

Challenges in Urban Living Labs

Challenges include maintaining commitment from partners, securing financial resources, communication issues, and unforeseen outcomes. Addressing these challenges requires robust evaluation, capacity-building, and adapting solutions to local contexts.

Stakeholder Engagement

Stakeholder engagement is crucial for the success of Urban Living Labs. Involving public actors, civil society, academia, and private actors ensures diverse perspectives and expertise. Participatory approaches and inclusive governance foster collaboration and innovation, leading to sustainable urban solutions.

THE SAFE SYSTEM APPROACH

SAFE SYSTEM APPROACH

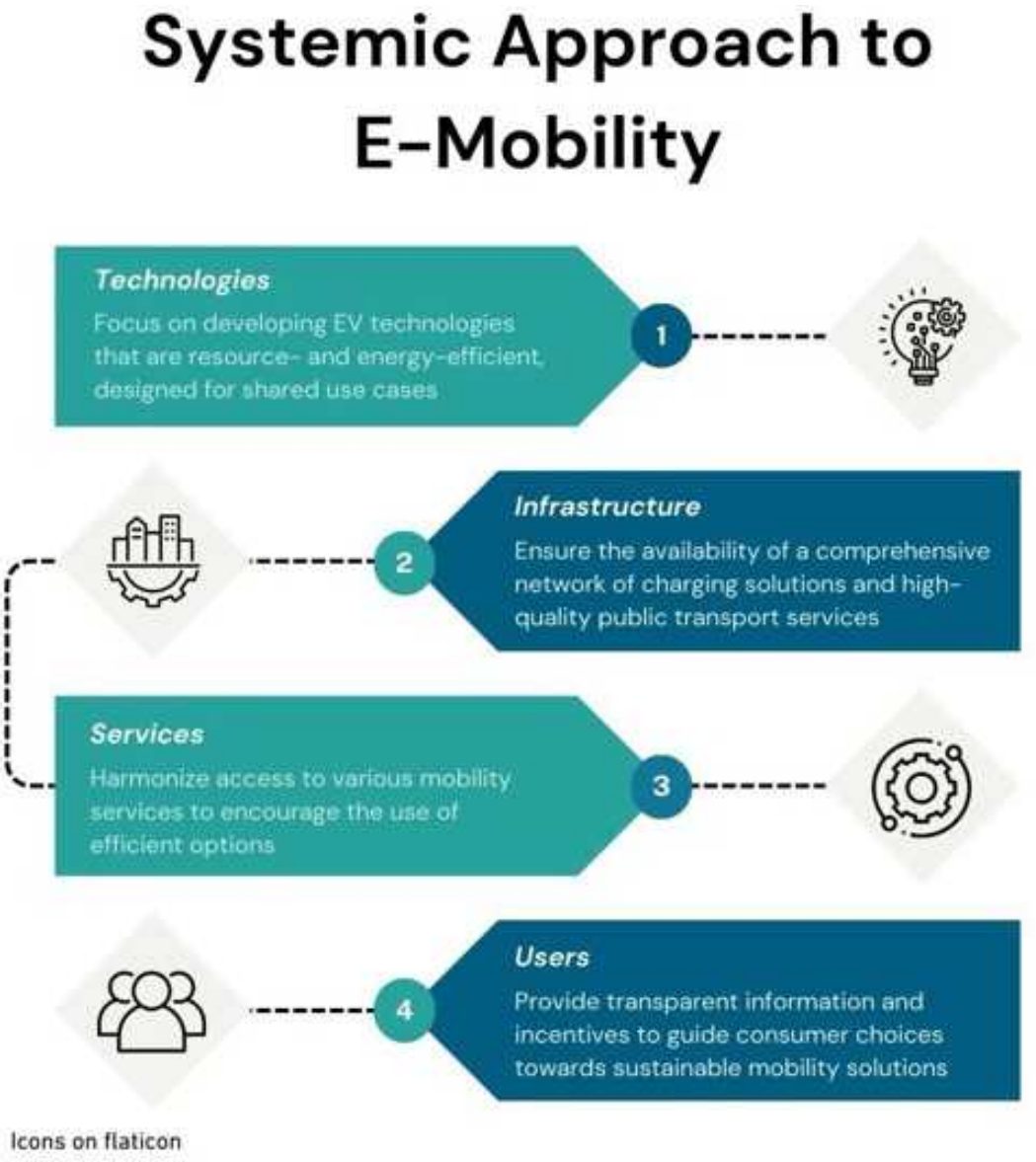
The Safe System Approach has been a guiding principle for the SOLUTIONSplus project, aiming to foster sustainable urban mobility through integrated and systemic changes. This approach shifts the focus from individual behavioral changes to creating enabling environments that inherently guide individuals and communities towards sustainable actions. The SOLUTIONSplus project implemented this approach in various demonstrations and has provided valuable insights for future project implementers.

The Safe System Approach, originally developed for road safety, aims to create an environment where errors do not result in serious harm. In the context of sustainable mobility, it focuses on four interconnected pillars: users, technologies, services, and infrastructures. The approach emphasizes the integration of these elements into a cohesive system that prioritizes sustainability and safety. Urban transportation is a major contributor to greenhouse gas emissions and air pollution. The need for sustainable urban mobility solutions is urgent, given the rapid urbanization and increasing demand for transport. Traditional governance models, which rely heavily on individual responsibility, have been insufficient in achieving the required level of decarbonization and sustainability. The Safe System Approach addresses these shortcomings by creating systemic changes that make sustainable actions the default choice for individuals and communities.

Implementation in SOLUTIONSplus

The SOLUTIONSplus project demonstrated the application of the Safe System Approach through various city-level demonstrations and global collaborations. The project aimed to accelerate the adoption of electric mobility solutions by integrating them into broader urban mobility systems. Key aspects of the implementation included:

1. **Technological Integration:** The project focused on developing and deploying electric vehicles (EVs), including two-wheelers, three-wheelers, buses, and logistics vehicles. The emphasis was on ensuring that these EVs were resource and energy-efficient, well-integrated with other mobility services, and designed for shared use-cases.
2. **Infrastructure Development:** The project supported the development of comprehensive charging infrastructure and other necessary facilities to support the widespread adoption of EVs. This included establishing charging stations in strategic urban locations and integrating them into existing urban infrastructure.
3. **Service Enhancement:** SOLUTIONSplus promoted the integration of EVs into existing transport services, such as public transport and ride-hailing services. This helped to enhance the accessibility and efficiency of urban mobility systems while reducing emissions and congestion.
4. **User Engagement and Education:** The project included extensive capacity-building activities to educate users, policymakers, and industry stakeholders about the benefits of electric mobility and the importance of systemic changes for sustainability.



LESSONS LEARNED AND RECOMMENDATIONS

The SOLUTIONSplus project provided several key lessons for future implementers of the Safe System Approach:

1. Holistic Planning: Successful implementation requires comprehensive planning that integrates various elements of the urban mobility system, including vehicle technologies, infrastructure, services, and user engagement.
2. Collaboration and Partnerships: Building strong partnerships with local governments, industry stakeholders, and international organizations is crucial for the successful deployment and scaling of sustainable mobility solutions.
3. Flexibility and Adaptability: The ability to adapt solutions to local contexts and conditions is essential. This includes customizing vehicle designs, service models, and infrastructure to meet the specific needs of different urban environments.
4. Policy Support and Incentives: Supportive policies and incentives are necessary to promote the adoption of electric mobility solutions. This includes financial incentives, regulatory support, and public awareness campaigns.
5. Continuous Monitoring and Improvement: Ongoing monitoring and evaluation are essential to assess the performance of implemented solutions and make necessary

adjustments. This helps to ensure the long-term sustainability and effectiveness of the initiatives.

The Safe System Approach provides a robust framework for integrating electric mobility within broader sustainable transport systems. The experiences and lessons from the SOLUTIONSplus project demonstrate the feasibility and benefits of this approach, offering valuable insights for future projects. By focusing on systemic changes and creating enabling environments, the Safe System Approach can help achieve sustainable urban mobility and contribute to global climate goals.

System Integration: The Safe System Approach necessitates integrating electric mobility solutions into the broader urban transport system. This integration ensures that EVs are not standalone solutions but part of a comprehensive strategy that includes public transport, non-motorized transport, and shared mobility services. The SOLUTIONSplus project demonstrated this through the deployment of electric buses, two- and three-wheelers, and logistics vehicles, ensuring they complemented existing transport services rather than competing with them.

Infrastructure Development: A critical aspect of the Safe System is the development of infrastructure that supports sustainable mobility. This includes not only charging stations for EVs but also infrastructure for walking and cycling, and efficient public transport systems. SOLUTIONSplus facilitated the establishment of charging networks in urban areas, integrated these with public transport hubs, and promoted the development of pedestrian and cycling paths.

User-Centric Design: The approach emphasizes designing systems that are intuitive and safe for users. This involves providing clear information about mobility options, ensuring the affordability and accessibility of services, and engaging users in the planning process. SOLUTIONSplus incorporated extensive capacity-building activities, educating users, policymakers, and industry stakeholders about the benefits and practicalities of electric mobility.

Lah, O. (2024). Safe System for Sustainable Development. Sustainable Earth Reviews. https://doi.org/10.1186/s42055-024-00072-z
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CONNECTING SECTORS AND ACTORS

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CONNECTING SECTORS AND ACTORS

Throughout the SOLUTIONSplus project, we have observed the critical importance of the Safe System approach in developing a comprehensive framework that emphasizes sustainability and safety in urban mobility. This chapter aims to share our learnings and provide practical guidance for future project implementers. It focuses on addressing sectoral disconnects, aligning diverse policy objectives, and enhancing coordination among key actors. By integrating insights from the project, we highlight how Living Labs can be instrumental in co-creating, testing, and implementing sustainable urban mobility solutions.

Understanding the Safe System Approach

Our experience has shown that the Safe System approach shifts the focus from individual behavioral changes to creating environments that inherently guide communities towards sustainable actions. This involves integrating users, technologies, services, and infrastructures into a cohesive system that prioritizes sustainability and safety.

Identifying Critical Disconnects

Through the SOLUTIONSplus project, we identified several critical disconnects that need to be addressed to effectively operationalize the Safe System approach. These disconnects are not merely gaps but represent systemic barriers that challenge our collective journey towards a greener, more equitable future. The pursuit of climate action and sustainable development involves navigating and overcoming these intricate webs of disconnects that shape and often impede our progress in addressing environmental challenges.

Sectoral Disconnects

Sectoral disconnects present a significant barrier to achieving sustainable development goals. Different sectors, such as energy, transportation, and urban planning, often operate in isolation without recognizing their interdependencies and potential synergies. This siloed approach leads to inefficient resource utilization and conflicting objectives, ultimately impeding comprehensive sustainability strategies. Institutional structures often reinforce sectoral boundaries with separate policies, budgets, and governance mechanisms, creating barriers to effective communication and collaboration.

During the SOLUTIONSplus project, we observed that integrating renewable energy solutions in urban planning or leveraging public transportation to reduce carbon emissions can create significant sustainability benefits. Implementing integrated policy frameworks that consider the interconnections between sectors is vital for overcoming these disconnects. Encouraging interdisciplinary research and collaboration can bridge the gaps between sectors, fostering a more holistic approach to sustainable development.

Disconnect Among Various Policy Objectives

The disconnect among various policy objectives is another critical challenge in developing integrated and coherent sustainability strategies. Policies developed with a singular focus often fail to recognize the interconnected nature of sustainability goals, leading to suboptimal outcomes and missed opportunities for creating holistic solutions. For example, narrowly focused policies can overlook the broader impacts of urban design, which can promote or hinder sustainable transportation modes like cycling or walking.

Developing integrated policy frameworks that consider the interconnections between various sustainability objectives is crucial for overcoming this disconnect. Policies should be designed to simultaneously address multiple goals, such as environmental sustainability, economic growth, and social equity. This approach can lead to more robust and comprehensive development strategies that offer greater benefits across different domains.

Lack of Coordination Among Key Actors

The lack of coordination among key actors, including governments, NGOs, the private sector, and local communities, is perhaps the most overarching disconnect in sustainable development. This disjointed approach often results in suboptimal utilization of resources and capabilities, as efforts are not effectively aligned or harmonized towards common goals. Fragmented efforts due to inadequate coordination can lead to duplicated efforts, resource wastage, and projects that are poorly aligned with local needs.

Establishing platforms for collaboration and ensuring alignment among various stakeholders are essential for propelling global efforts towards shared sustainability goals. Creating forums and networks where stakeholders from various sectors can converge, share ideas, and collaborate can significantly enhance the coherence and effectiveness of development projects. Engaging local communities in the planning and implementation of projects ensures that interventions are tailored to the specific needs and conditions of the area, enhancing the sustainability and impact of development efforts.

Research-Implementation Project Disconnect

Mapping previous and ongoing projects as part of SOLUTIONSplus revealed significant opportunities for mutual benefit in areas such as electric first/last-mile connectivity solutions, electric minibuses and cargo vans, and electric Bus Rapid Transit systems. Specific formats for integrating these opportunities into a broader perspective were identified to contribute to closer coordination among research and innovation, development cooperation, and climate action programs.

One effective format is Living Lab Projects, which focus on the co-development of e-mobility solutions for both urban and rural environments. Living Labs facilitate real-world experimentation and iterative refinement of innovations in partnership with local stakeholders, fostering the practical application of academic research. Another format is Peer Exchange on Mobility Solutions, which promotes knowledge sharing among peers from local and national authorities, academics, and private sector actors across various regions. Such exchanges bridge the gap between research and practical application, enhancing the dissemination of best practices and innovative solutions.

Additionally, the creation of an ecosystem that establishes an umbrella for transformative change, efficient implementation blueprints, and synchronization of stakeholders is proposed. This holistic approach helps to align disparate policy objectives and fosters integrated, sustainable development strategies. Working Groups and Innovation Hubs are also crucial, providing platforms to synergize research, funding, and partnerships. These hubs facilitate the synchronization of research and innovation projects with scale-up implementation projects, fostering impact and longer-term collaboration.

Disconnects in the Context of Development Cooperation

Development cooperation is integral to addressing global challenges like climate change and sustainable development. However, it frequently encounters systemic disconnects that impede effective collaboration and implementation. This chapter explores these disconnects within the broader framework of enhancing synergies across sectors, aligning research with implementation, and fostering local value creation in development initiatives.

The global development landscape is significantly shaped by the dynamics of aid dependence and the consequences of debt financing. While both tools are essential in the development toolkit, their misuse or overemphasis can lead to severe economic and societal challenges, particularly in low-income countries. This context sets the stage for understanding the broader disconnects in development cooperation and how they impede effective implementation.

Grant Dependence: Implications and Alternatives

Grant aid, though crucial for many development initiatives, can inadvertently foster a dependency that undermines the very objectives it aims to achieve. Grant dependence can engender rent-seeking behavior among recipient governments, where the focus shifts from generating internal revenue to maintaining the status quo to continue receiving aid. This dependency syndrome can cripple local initiatives by discouraging innovation and self-reliance.

The sustainability of grant aid is enhanced when coupled with mechanisms that promote local capacity building and revenue generation. Integrating grant aids with initiatives that bolster local industries and service sectors can catalyze a multiplier effect in the economy, gradually reducing dependency on external grants. This underscores the need for aid structures that encourage—not replace—government and private sector efforts in generating sustainable income and services.

Overemphasis on Debt Finance: Challenges and Sustainable Practices

Debt finance, while necessary for large-scale infrastructure projects and other capital-intensive initiatives, can lead to unsustainable debt levels if not managed with prudence. High-level debt in developing countries can result in debt distress and economic instability. A balance between grant-based funding and prudent borrowing is essential. A shift towards financing mechanisms that involve less debt accumulation could involve a combination of fiscal policy measures that generate revenue and disincentivize inefficient use of energy and resources, as well as a stronger focus on local business and industry development in areas of low-carbon technologies and services.

Enhancing Local Capacity: The Role of Local Businesses and Knowledge Institutions

Building on the analysis of aid dependence and debt finance, there is a compelling argument for enhancing local businesses and knowledge institutions as a strategy to foster sustainable development. Strengthening local entities can mitigate some of the challenges discussed previously and lead to more enduring and self-sustaining development outcomes. Supporting local businesses is pivotal in creating value that remains within the local economy. Aid effectiveness is greatly enhanced when local enterprises are supported through direct financial aid, capacity building, and market access facilitation. This approach bolsters local economic resilience and fosters a

business ecosystem that can innovate and compete both locally and globally. The role of local knowledge institutions cannot be overstated in the quest for sustainable development. These institutions, including universities and research centers, are crucial for building local capacity and reducing reliance on international consultants. Investing in local educational and research institutions sustains development gains and supports informed decision-making and innovative solutions to local and global challenges. By focusing on local value creation through the support of businesses and knowledge institutions, development strategies can move towards a more sustainable and self-reliant model. This approach addresses the pitfalls of aid dependence and debt finance while leveraging local strengths and capabilities, fostering a development paradigm that is inclusive, sustainable, and adaptable to future challenges.

Sectoral Disconnects: Integrating Energy, Transportation, and Urban Planning

SOLUTIONSplus recognized that fragmentation within and between sectors such as energy, transportation, and urban planning led to inefficiencies and missed opportunities. To combat these sectoral disconnects, the project implemented Living Labs in cities like Hanoi, Pasig, Kathmandu, Kigali, Dar es Salaam, and Quito. These Living Labs served as environments where integrated e-mobility solutions were co-developed, tested, and refined. For example, in Quito, the project focused on developing e-logistics solutions for urban deliveries, integrating electric cargo bikes and vans with the city's broader urban mobility plan. In Dar es Salaam, the project focused on integrating transportation and energy sectors by developing locally adapted electric vehicle prototypes, ensuring a seamless integration of e-mobility solutions with the city's transport infrastructure.

The integrated approach in Quito led to significant improvements in urban logistics efficiency and reductions in carbon emissions. By using electric cargo bikes and vans, the project reduced dependency on fossil-fuel-powered vehicles, demonstrating the viability of sustainable urban logistics solutions. The success of the pilot projects in Quito has set the stage for scaling up these solutions across other areas in the city and replicating them in the context of a project funded by the Global Environment Facility (GEF).

In Dar es Salaam, the integration of locally adapted electric 3-wheelrs improved last-mile connectivity to the Bus Rapid Transit system. The collaborative efforts are being taken forward in collaboration with the DG INTPA of the European Commission and the Belgian development agency ENABEL.

Bridging Research-Implementation Gaps

SOLUTIONSplus addressed the divide between academic research and practical application by fostering direct collaboration between researchers, industry partners, and local communities. The Living Labs facilitated translational research, converting scientific discoveries into practical, scalable solutions. For example, in Kigali, the project focused on the development and deployment of electric motorcycles with battery-swapping services. The collaboration between local universities, international research institutions, and private companies ensured that the solutions were tailored to the local context and needs. In Kathmandu, SOLUTIONSplus introduced electric buses and three-wheelers, working closely with local research institutions and industry partners to adapt the vehicles to the city's specific requirements. The project also involved extensive training programs for local engineers and technicians, ensuring that the knowledge and skills necessary for maintaining and operating the vehicles were locally available.

The direct involvement of local stakeholders in Kigali led to the successful deployment

of electric motorcycles, fostering new business models and supporting the viability of the vehicle technology and associated operations. The battery-swapping service ensured that the vehicles were convenient and efficient for local users, promoting wider adoption. Plans for scaling up include expanding the network of battery-swapping stations and increasing the fleet of electric motorcycles. In Kathmandu, the introduction of electric buses and three-wheelers contributed to a reduction in urban air pollution and provided a sustainable alternative to conventional fossil-fuel-powered vehicles. The training programs empowered local engineers and technicians, ensuring the long-term sustainability of the e-mobility solutions. The project is set to scale up by increasing the number of electric buses and three-wheelers and expanding the charging infrastructure to support broader adoption.

Aligning Diverse Policy Objectives

SOLUTIONSplus aimed to align various sustainability-related policy goals through integrated policy frameworks that addressed multiple objectives simultaneously. The project promoted policies that spanned sectors and encouraged cross-sectoral synergies. For example, in Quito, the project aligned urban mobility policies with environmental and social objectives by promoting the use of electric cargo bikes for last-mile deliveries. This policy alignment ensured that the e-mobility solutions contributed to broader sustainability goals, including reducing emissions and improving urban air quality. In Dar es Salaam, the project developed integrated policy frameworks that supported the adoption of e-mobility solutions. These frameworks considered environmental sustainability, economic growth, and social equity, ensuring that the policy initiatives were cohesive and mutually reinforcing.

The integration of e-mobility solutions with environmental and social policies in Quito resulted in significant improvements in urban air quality and logistics efficiency. The project demonstrated the potential for policy coherence to drive sustainable urban development. Plans for scaling up include extending the use of electric cargo bikes to other parts of the city and replicating the policy frameworks in other urban areas. In Dar es Salaam, the integrated policy frameworks facilitated the adoption of e-mobility solutions that addressed multiple policy objectives, leading to more effective and sustainable urban development. The alignment of policy goals ensured that the solutions were well-supported by local authorities and stakeholders, promoting long-term sustainability. The project plans to scale up by implementing similar policy frameworks in other cities and expanding the network of electric vehicles.

Enhancing Coordination Among Key Actors

SOLUTIONSplus facilitated coordination among governments, NGOs, the private sector, and local communities through platforms for collaboration. The Living Labs acted as hubs for stakeholder engagement, ensuring that efforts were aligned and resources were effectively utilized. For example, in Kigali, the project brought together local authorities, industry players, and research institutions to co-develop e-mobility solutions. This collaborative environment transitions from the SOLUTIONSplus project to other climate action and development cooperation projects, reaping the benefits and the groundwork carried out by SOLUTIONSplus. The enhanced coordination in Kigali led to the successful integration of various projects and programmes, e.g. by the EU, GIZ, IKI, GEF, JICA and many others. This collaborative approach fostered the urban mobility transition and enables more efficient project delivery across the actors involved. The project demonstrated the potential for coordinated action to drive sustainable urban development and enhance the overall effectiveness of urban mobility solutions.

Recommendations

To ensure effective project implementation and better coordination among sectors, actors, projects, and programs, we recommend the following:

Adopt the Living Labs Framework: Use Living Labs to foster collaboration among stakeholders and ensure that innovations are co-created, tested, and refined in real-world settings.

Build Capacity and Raise Awareness: Organize continuous training workshops and seminars to equip stakeholders with knowledge on sustainable solutions and collaborative processes.

Motivate Stakeholders: Share successful case studies and facilitate peer learning to inspire and engage participants.

Co-develop and Co-create Solutions: Engage stakeholders in identifying challenges and developing contextually relevant solutions through workshops and pilot projects.

Establish Monitoring and Evaluation Processes: Set up robust systems to track progress and assess the impact of implemented solutions, allowing for continuous improvement.

By following these guidelines, future project implementers can create more effective, inclusive, and sustainable urban mobility solutions, contributing to long-term positive outcomes for communities worldwide.

PROJECT METHODOLOGY

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PROJECT METHODOLOGY

The SOLUTIONSplus project aimed to establish a global platform for shared, public, and commercial e-mobility solutions to initiate a transition towards low-carbon urban mobility. This ambitious objective was achieved through city-level demonstrations, a comprehensive toolbox, capacity development, and replication activities. These efforts maximized the impact by bringing together committed cities, industry partners, research institutions, implementing organizations, and finance partners.

The project's approach involved numerous synergistic projects, networks, and strong technical expertise within the consortium. Partner cities provided direct co-funding, working closely with UN Environment and the International Energy Agency (IEA) on a joint global urban e-mobility program. This collaboration significantly boosted replication and impact, making the SOLUTIONSplus consortium a leading global platform for urban electric mobility. The overall objective of SOLUTIONSplus was to accelerate transformational change towards sustainable urban mobility through innovative and integrated electric mobility solutions. The project boosted the availability of electric vehicles, fostered operational efficiency, and supported the integration of various e-mobility types in large urban areas, addressing user needs and local conditions in Europe, Asia, Africa, and Latin America.

Specific objectives included enhancing the capabilities of local and national authorities, public transport operators, and entrepreneurs regarding innovative urban e-mobility solutions. This was achieved by informing them about tools for planning, assessing, implementing, and operating e-mobility solutions. The project inspired the take-up of e-mobility innovations by businesses, start-ups, local and national governments, and transport operators through peer-to-peer exchange on innovative e-mobility products and services.

The SOLUTIONSplus project strengthened policy and business collaboration by initiating partnerships between local and national governments and local and European entrepreneurs. It supported the development of new e-mobility business models and implementation plans. Additionally, the project created reference models for e-mobility innovation by implementing demonstration actions to test innovative technologies and services, fostering their replication, and ensuring their long-term sustainability. By integrating innovative concepts into policy, funding, operation, research, and business practices, the project contributed to global sustainability and climate goals.

To deliver on these objectives, the project created a global program on innovative e-mobility technologies and business models, tested in demonstration actions to initiate a large-scale transition towards smart electric mobility. These activities aimed to provide access for all, contribute to climate change mitigation, improve air quality and safety, and ensure efficient energy and resource use. The project developed economically feasible and socially acceptable e-mobility solutions that enhanced the overall transport system's efficiency and accessibility.

SOLUTIONSplus defined strategies to promote the adoption of smart e-mobility solutions in cities and created action plans for their implementation. The project accelerated the electrification of captive fleets, such as public transport, taxi services, urban logistics and delivery services, car-sharing, bike-sharing, commercial vehicle fleets, and the integration of individual, public, and shared e-mobility solutions into sustainable urban mobility planning.

The project's work program focused on addressing climate change, energy security, and local air pollution, emphasizing the critical role of cities as hotspots of economic development, energy consumption, and global greenhouse gas emissions. By bringing together leading networks, industry actors, knowledge and implementation organizations, and motivated cities, SOLUTIONSplus tested innovative e-mobility solutions to address these challenges. The consortium developed, tested, and replicated innovative, intermodal e-mobility solutions to meet the increased demand for personal and freight transport.

Key developing and emerging economies represented different socio-economic, political, geographic, and technological aspects, complemented by experiences in European cities. The project focused on shaping energy use, providing access for all, creating business opportunities, and developing concepts that directly contributed to low-carbon development through e-mobility. Emphasizing shared and public transport fleets helped address urban congestion, access to jobs and services, and influenced land use.

SOLUTIONSplus implemented an integrated and balanced approach, addressing social, economic, and environmental issues. The project's objectives and content were fully aligned with the H2020 topic 'LC-GV-05-2019,' with special emphasis on addressing the financial sustainability barrier experienced by previous e-mobility projects. The project developed concrete plans to scale-up and roll-out innovations with the support of financial partners and worked closely with private sector partners inside and beyond the consortium to enable the long-term commercial sustainability of e-mobility innovations.

The project brought together 46 partners and over 100 associated partners from Asia, Africa, Latin America, and Europe, including key actors from industry, research, local and national governments, public transport operators, city networks, and associations. Through a structured approach, the project provided training for city officials, transport operators, local businesses, and industry as part of an international knowledge exchange program. The comprehensive toolbox developed advanced management strategies for private and public electric mobility, including operational tools, user preference and acceptance understanding, and methods for stakeholder involvement and coalition building among key actors.

Business models for demonstration actions covered various types of electric vehicles, innovative charging solutions, ways to integrate e-mobility services, and aligned e-mobility options to address user needs. Comparative demonstrations in cities involved local partners and included at least one demonstrator in Europe, Asia, Africa, and CELAC, with a minimum of four city demonstrators. Implementation concepts to scale-up demonstration activities included sustainable planning of city and transportation infrastructure, dedicated plans for financing solutions, and regional and international replication conditions to reach more cities and countries.

SOLUTIONSplus developed partnerships with Global Environment Facility and several development banks, ensuring the scale-up and financing of demonstration actions. The methodology for bankability assessments was discussed with financial partners, ensuring a smooth transition from demo actions to long-term funding and support programs. Private sector cooperation and sustainability were strengthened through partnerships with key industry players, local transport operators, and businesses, creating business opportunities sustained beyond the project's lifetime.

Replication actions were facilitated through a global platform and regional platforms

focusing on knowledge exchange, capacity building, and replication. Cooperation and synergies with ongoing activities undertaken with international initiatives, such as Decarbonising Transport, the Urban Electric Mobility Initiative, and Mobilise Your City, were actively sought. The project brought together relevant partners from these initiatives to combine their strengths and build on their work. The SOLUTIONSplus concept and methodology addressed e-mobility innovation as an intermodal concept that assisted in the wider transition towards sustainable urban mobility. The project tested innovative urban e-mobility solutions at different Technology Readiness Levels (TRL 6-9) in various environments to enable replication and contribute to a supportive political, legal, economic, and fiscal landscape. Mobility was approached as a socio-technical system consisting of technologies, regulations, institutional settings, the economic system, interests, influence and power structures, behavioral patterns, and social norms. E-mobility integration with existing transport services and networks within sustainable urban mobility planning tailored to specific local contexts was vital.

The integration of e-mobility innovations into wider frameworks, such as Sustainable Urban Mobility Plans (SUMPs), local air quality plans, and National Urban Mobility Programs, was a key objective. This enabled wider roll-out of the e-mobility innovations developed, demonstrated, and evaluated by SOLUTIONSplus, ensuring long-term sustainability. The project's five-pillar conceptual approach represented different progress levels towards efficiently integrating e-mobility in urban transport systems. These pillars included:

- Developing capabilities for policy, business models, and e-mobility solution operations.
- Facilitating peer-to-peer exchange to inspire policy, technology, and business model adoption.
- Initiating partnerships for joint business model development.
- Implementing demonstration projects to provide evidence-based innovations.
- Integrating e-mobility innovations into policy, finance, and business decision-making processes.

SOLUTIONSplus generated synergies between European Member States and international programs, boosting the impact of EU-funded projects and initiatives. The project developed business models and implemented demonstration actions for integrated e-mobility concepts in urban passenger and freight transport in Europe, Asia, Latin America, and Africa. Bankable project concepts were developed, triggering transformational change beyond the project's lifetime, and assisting city officials, transport operators, and energy providers in implementing technologically viable business and e-mobility solutions.

The SOLUTIONSplus project team consisted of cities, SMEs, industries, networks, knowledge partners, finance, and implementing agencies, balancing capabilities, responsibilities, and perspectives for successful implementation and achieving expected impacts. The team was dedicated to substantially contributing to decarbonizing the urban transport sector in Europe, Asia, Latin America, and Africa. Partner cities had engaged with local transport operators and electricity providers for the project's purposes and beyond. The SOLUTIONSplus consortium acted as an innovator of e-mobility solutions, a provider of expert knowledge, a knowledge liaison, and a facilitator of exchange between city administrations, industry, mobility service providers, finance and funding institutions, and development institutes. The viability of e-mobility solutions depended on local circumstances, including user acceptance and long-term financial viability. The methodology implemented the project's concepts through three core elements:

- Methods and tools for capacity building and e-mobility implementation.
- Demonstrations to validate tools and prove feasibility and reliability in different contexts.
- A structured replication process to boost the project's impact.

The SOLUTIONSplus toolbox, a key project output, guided the Innovation Action and boosted key actors' capability to implement e-mobility solutions globally. The toolbox included measures for assessing demonstration results, designing and optimizing e-mobility integration, managing efficient demonstrations, reinforcing stakeholder knowledge and skills, and ensuring e-mobility innovations' sustainability through business models. Accessible on the project website, the toolbox contained capacity-building material, business plans and models, innovations tested in demonstrations, operations and management tools, financing and funding information, impact assessment tools, factsheets, and policy briefs.

Assessment tools supported technical feasibility, financial viability, social impacts, environmental and health impacts, and replication and scale-up potential. These tools guided demonstration activities, linked to business model development and capacity building, and provided a solid basis for up-scaling demo actions and seeking finance from domestic and international sources. Design tools supported decision-makers in defining integrated e-mobility strategies, from the definition of integrated e-mobility strategies (passenger and freight) to launching implementation projects. These tools covered methodological guidance, stakeholder involvement, governance, institutional and finance aspects, simulation tools for optimizing infrastructure locations, and cost estimation for analyzing project profitability dimensions. Operational tools optimized e-mobility resources, such as apps for route planning, software for managing electric fleets, charging planning, vehicle monitoring, energy consumption tracking, and maintenance. Capacity building tools tailored advice and training material to boost competences and skills of key actors, including peer-to-peer exchange, e-learning courses, workshops, factsheets, policy and business briefs, case studies, and academic programs.

The project developed several business models for innovative e-mobility technologies and services, covering topics such as electric two- and three-wheelers, minibuses, cargo e-bikes, vans, trucks, e-BRT, and related technologies, services, charging systems, operations, and sharing schemes. These models were part of the SOLUTIONSplus toolbox and shared through partnership opportunities between European industry, SME partners, and local companies and start-ups in partner countries.

Demonstration actions tested innovative e-mobility technologies and services in different contexts, ensuring high replicability and long-term sustainability. The project carefully selected demonstration cities, established strong partnerships between local and European partners, and developed implementation concepts addressing local conditions. Interdisciplinary teams and implementation frameworks were established to support these actions.

The consortium established partnerships with cities in Europe, Asia, Africa, and Latin America, representing diverse socio-economic, policy, geographic, and structural factors, modal shares, and energy mixes. Partner cities ranged in experience with sustainable urban transport and electric mobility, with beneficial conditions for urban e-mobility solutions uptake. Initial EV-Readiness Assessments were carried out, and the results informed the selection of partner cities.

Implementation concepts were developed in cooperation with local and international experts, focusing on urban e-mobility technologies and business models tested in demonstration actions. The project emphasized public and shared e-mobility solutions, including integrated multimodal e-mobility hubs for efficient urban mobility system interchanges. These hubs connected public transport with other e-mobility modes, incorporating bicycle parking, e-bike-sharing stations, car-sharing, last-mile logistics solutions, and e-cargo-bike hire/share stations. Unified ticketing systems enabled seamless travel on all modes using a single ticket or smart app. Living Labs were established in partner cities, enabling the testing of innovative e-mobility technologies and business models. EV-Readiness Assessments were carried out for each city, focusing on policy environment, costs and benefits, implementation partnerships, finance requirements, demonstration project plans, technology requirements, business opportunities, technical barriers, electricity mix, grid reliability, policy and governance requirements, implementation feasibility, and steps towards implementation.
The demonstration actions included testing innovative e-mobility technologies and services in various contexts with high replicability and long-term sustainability potential. Partner cities demonstrated different levels of experience with sustainable urban transport and electric mobility. Several partner cities offered active project support through co-funding for e-buses and other measures. The project mobilized co-funding from the Global Environment Facility (GEF), enabling work with nine cities

and replicating innovations in an additional 20 cities, significantly exceeding call text requirements. Innovative e-mobility solutions tested in the Living Labs included electric 2- and 3-wheelers, electric buses, e-BRT, minibuses, and taxis. Retrofitting electric (mini)-buses were tested in Kathmandu, integrating new and existing e-mobility solutions with smart charging solutions. Charging solutions utilized existing systems and grids, with innovative models for seamless charging, parking providers bundling charging facilities into parking provision, and household electricity sharing for charging EVs.

The project explored Mobility as a Service (MaaS) solutions, eco-routing, network planning and management tools, fleet bundling, and inner city and last-mile e-delivery shared services. Business models for these innovations included developing new vehicles, operation solutions, and integration approaches. Collaboration with utility companies, telecommunication providers, and traffic management systems facilitated multi-purpose charging and efficient service provision. The SOLUTIONSplus project built on international partnerships, engaging with established networks like the Urban Electric Mobility Initiative (UEMI), MobiliseYourCity (MYC), and Decarbonising Transport, among others. These partnerships supported the development, testing, and roll-out of innovative e-mobility solutions globally. The project leveraged synergies with related projects, such as the GEF-7 Global Electric Mobility Programme, to enhance impact and visibility.

The interdisciplinary approach of the project included collaboration with local, regional, and national authorities, mobility experts, planners, service providers, scientists, consultants, businesses, international organizations, and financing institutions. This approach ensured comprehensive consideration of local value-chains, affordability, liveability, public health, user acceptance, and job creation in developing sustainable urban mobility solutions.

The replication strategy involved global and regional platforms, regional expert teams, and replication cities, ensuring a high level of action replication in similarly sized and structured cities. International cooperation with projects like UEMI, MYC, and Decarbonising Transport facilitated the integration of SOLUTIONSplus innovations into global dialogues and national strategies. Gender and vulnerable population considerations were integral to the project. Travel behavior differences among women, children, and men were addressed in user acceptance assessments and solution designs. The project actively involved actors representing women's needs and perspectives on sustainable mobility. Similarly, the needs of vulnerable populations, such as those caring for children, disadvantaged individuals, and those living in underserved areas, were considered in planning and interventions.

The ambition of SOLUTIONSplus was to substantially contribute to the decarbonization of the urban transport sector, delivering on the Sustainable Development Goals (SDGs) and the New Urban Agenda. The project aimed to foster the large-scale uptake of smart electric mobility solutions, providing direct benefits to various stakeholder groups. Partner cities received extensive technical and process-oriented support, benefiting from lessons learned and tools developed during the project. Local and national authorities, decision-makers, vehicle manufacturers, transport operators, and e-mobility service providers were engaged in developing and implementing innovative e-mobility solutions.

The project's demonstration activities featured high levels of innovation in vehicle and charging technology, business models and operations, and integration, policy, and planning. Progress beyond the state-of-the-art included introducing and integrating electric buses, minibuses, taxis, 2- and 3-wheelers in partner cities, innovative charging

solutions, intermodal route planning, eco-routing, and demand-responsive services. The SOLUTIONSplus consortium consisted of cities, SMEs, industries, networks, knowledge partners, finance, and implementing agencies, balancing capabilities, responsibilities, and perspectives for successful implementation and achieving expected impacts. Together, the team made substantial contributions to decarbonizing the urban transport sector in Europe, Asia, Latin America, and Africa.

The SOLUTIONSplus project's approach, grounded in comprehensive planning, strong partnerships, innovative solutions, and robust capacity-building efforts, significantly advanced the transition towards sustainable urban mobility through e-mobility. This project serves as a model for future initiatives, demonstrating the importance of integrated, collaborative, and innovative approaches to achieving transformational change in urban mobility systems.

The SOLUTIONSplus project structured its efforts into various work packages (WPs), each designed to address specific aspects of the e-mobility implementation process. This approach created a division of labor that helped achieve project results effectively. Here's how the project applied this structure and how future implementers can benefit from these insights:

Work Package 1 (WP1): Tools and Assessment Framework

- **Objective:** Create a toolbox for efficient electric mobility solutions, an assessment framework for evaluation, and assess potential impacts on society and the environment.
- **Impact:** WP1 provided essential inputs to other work packages, such as capacity building (WP2), business model development (WP3), and demonstration actions (WP4). The toolbox and evaluation framework were critical in upscaling and financing plans (WP5).
- **Key Activities:** Developing a scalable and harmonized toolbox, creating modules for "Models and Assessment" and "Planning and Implementation," and establishing an evaluation framework with relevant key performance indicators (KPIs).
- **Reflection:** This comprehensive approach ensured that all aspects of e-mobility, from planning to implementation, were covered systematically, providing a solid foundation for other work packages.

Work Package 2 (WP2): Capacity Building

- **Objective:** Boost the capacities of local and national policy makers, practitioners, and operators to develop, implement, and operate innovative urban electric mobility innovations.
- **Impact:** WP2 fostered sustainability and replication of the project by enhancing the skills and knowledge of key stakeholders, ensuring long-term viability of the solutions.
- **Key Activities:** Conducting needs assessments, developing capacity building tools and methodologies, organizing peer-to-peer exchanges, and facilitating regional and global trainings.
- **Reflection:** The focus on capacity building ensured that local actors were equipped with the necessary skills and knowledge, which is essential for the successful implementation and scaling of e-mobility solutions.

Work Package 3 (WP3): Business Models and Partnerships

- **Objective:** Develop and test different business models, fostering partnerships to increase the uptake of innovations.
- **Impact:** WP3 established a comprehensive catalogue of e-mobility measures, facilitated partnerships between local and international businesses, and developed sustainable business models for demonstration actions.
- **Key Activities:** Creating a solutions catalogue, forming industry and local business partnerships, developing business models and plans, and supporting start-ups.
- **Reflection:** The structured approach to business model development and partnerships helped align e-mobility solutions with market needs, ensuring economic viability and fostering innovation.

Work Package 4 (WP4): Demonstration Actions

- **Objective:** Test innovative e-mobility solutions in different socio-economic and policy environments to ensure replicability and long-term sustainability.
- **Impact:** WP4 provided practical insights and real-world data through Living Labs, which were essential for assessing the feasibility and impact of e-mobility solutions.
- **Key Activities:** Developing demonstration implementation plans, conducting Living Labs, facilitating regional implementation, and supporting replication of successful solutions.
- **Reflection:** The hands-on approach of Living Labs allowed for real-time adjustments and learning, which is crucial for the successful implementation and scaling of e-mobility innovations.

Work Package 5 (WP5): Scale-Up and Financing

- **Objective:** Facilitate the scale-up and sustainability of e-mobility innovations through developing concepts and implementation plans for larger projects.
- **Impact:** WP5 ensured that the innovations tested could be scaled up and sustained beyond the project's lifespan by developing pre-feasibility studies and engaging with funding organizations.
- **Key Activities:** Developing project concepts, conducting pre-feasibility studies, policy development, and facilitating funding and financing.
- **Reflection:** Focusing on scale-up and sustainability ensured that the project's impact extended beyond the initial demonstration actions, enabling wider adoption of e-mobility solutions.

Work Package 6 (WP6): Dissemination and Exploitation

- **Objective:** Exploit and replicate the innovations, and disseminate project results.
- **Impact:** WP6 maximized the project's visibility and impact through strategic communication, ensuring that stakeholders were informed and engaged.
- **Key Activities:** Developing a dissemination and communication strategy, participating in high-level events, and producing targeted outreach materials.
- **Reflection:** Effective dissemination and exploitation activities were crucial for engaging stakeholders and promoting the adoption of e-mobility solutions globally.

Work Package 7 (WP7): Management

- **Objective:** Provide management support and ensure the smooth implementation of the project.
- **Impact:** WP7 ensured that the project met its objectives, maintained high ethical standards, and kept all partners well-informed and coordinated.
- **Key Activities:** Project coordination, quality control, impact assessment, data management, and risk management.
- **Reflection:** Strong management and coordination were essential for maintaining the project's momentum and ensuring the timely delivery of results.

Guidance for Future Implementers

Future projects can benefit from adopting a similar work package structure. This division of labor ensures that all aspects of the project are systematically addressed, from initial planning and capacity building to business model development, implementation, and scaling. By clearly defining objectives and tasks for each work package and establishing robust coordination and communication mechanisms, projects can achieve their goals more efficiently and effectively.

Figure 9. SOLUTIONSplus Theory of Change

IMPACT ASSESSMENT

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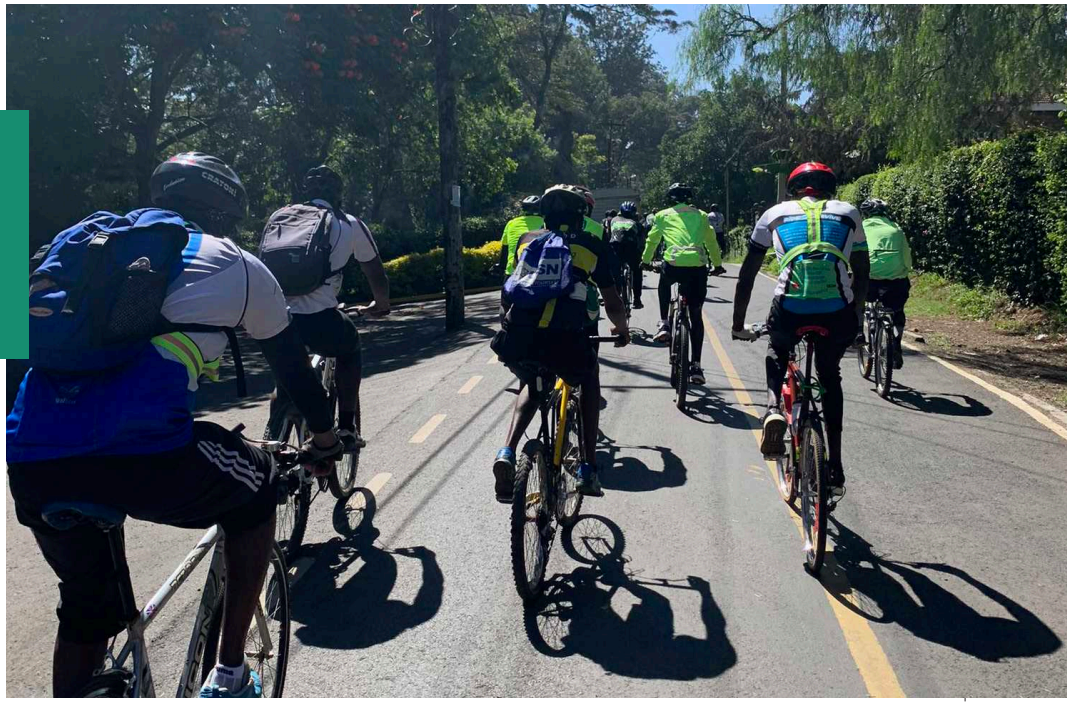

IMPACT ASSESSMENT

The SOLUTIONSplus project has provided valuable insights into the impact assessment of Living Lab projects focused on urban e-mobility solutions. This chapter outlines practical guidance on the impact assessment work package of SOLUTIONSplus.

Approach to Impact Assessment

1. Establish Baselines
Establishing a baseline is crucial for assessing the impact of any intervention. The baseline represents the status quo before the implementation of the project, enabling clear comparison and isolation of the intervention's effects from other external factors. For SOLUTIONSplus, the baseline includes all relevant activities in the sector of interest in the demonstration city, excluding the SOLUTIONSplus activities .

2. Define Clear Objectives and KPIs
Defining clear objectives and key performance indicators (KPIs) is essential for a structured impact assessment. KPIs should be aligned with the project's goals and reflect the interests of various stakeholders involved. For instance, KPIs in the SOLUTIONSplus project covered areas such as greenhouse gas (GHG) emissions, air quality, traffic safety, and user acceptance .

3. Conduct Ex-Ante, On-Going, and Ex-Post Assessments

- Ex-Ante Assessment: Conducted before implementation, this assessment predicts the expected impacts based on planned activities. It involves defining a do-nothing scenario to compare against the intervention outcomes .
- On-Going Assessment: While SOLUTIONSplus did not include formal on-going assessments due to the short project duration, continuous monitoring during implementation can track progress and allow for adjustments .
- Ex-Post Assessment: Conducted after project completion, this assessment measures the realized impacts by comparing post-implementation data against the baseline and ex-ante predictions .

4. Use a Holistic Assessment Framework

The holistic assessment framework developed by SOLUTIONSplus includes several steps:

- Establish baseline
- Perform ex-ante impact assessment
- Conduct ex-post impact assessment
- Scale-up impact assessment for future projections
- Derive overarching conclusions based on cross-cutting evaluations

Establish Baselines

Establishing a baseline is crucial for assessing the impact of any intervention. The baseline represents the status quo before the implementation of the project, enabling clear comparison and isolation of the intervention's effects. In the SOLUTIONSplus project, baseline data included environmental metrics (e.g., air quality, GHG emissions), social metrics (e.g., user satisfaction, accessibility), and economic metrics (e.g., cost savings, job creation). Collecting comprehensive baseline data ensures that changes attributable to the project are accurately measured.

Develop a Comprehensive Evaluation Framework

A robust evaluation framework defines the parameters and methodologies for impact assessment. The SOLUTIONSplus project utilized the following components in its evaluation framework:

- **Key Performance Indicators (KPIs):** KPIs covered environmental, social, and economic aspects, such as energy consumption, user acceptance, and cost-benefit analysis. These indicators provided measurable and quantifiable targets for assessment.
- **Data Collection Methods:** The project combined quantitative methods (e.g., sensor data, surveys) with qualitative methods (e.g., interviews, focus groups) to gather comprehensive data.
- **Multi-Criteria Analysis:** This approach facilitated the evaluation of different dimensions of e-mobility solutions, ensuring a holistic understanding of their impacts.

Engage Stakeholders

Engaging stakeholders throughout the project is vital for accurate impact assessment. In SOLUTIONSplus, local governments, public transport operators, businesses, and citizens were involved from the outset. This engagement ensured that the project addressed real-world needs and that the assessment captured diverse perspectives and experiences.

Utilize Iterative Feedback Loops

Continuous improvement through iterative feedback loops was a key aspect of the SOLUTIONSplus approach. Regular updates and adjustments based on ongoing monitoring and feedback from stakeholders helped refine the project implementation and impact assessment processes. This adaptive approach ensured that the project remained responsive to emerging challenges and opportunities.

Focus on Scalability and Transferability

Assessing the scalability and transferability of e-mobility solutions was integral to the SOLUTIONSplus project. Impact assessments were designed to evaluate how solutions could be scaled up or replicated in different contexts. This involved:

- **Comparative Analysis:** Comparing results across different demonstration sites to identify best practices and key success factors.
- **Documentation and Reporting:** Detailed documentation of methodologies, outcomes, and lessons learned to support replication efforts.

Linkages to other SOLUTIONSplus activities

Active Stakeholder Engagement

Engaging stakeholders throughout the project lifecycle is critical. SOLUTIONSplus involved local, regional, and international actors in the co-design and implementation phases. This ensured that the solutions were contextually relevant and had buy-in from key players .

Address Sectoral Disconnects

SOLUTIONSplus effectively addressed sectoral disconnects by integrating e-mobility solutions with urban planning, energy, and transportation sectors. This holistic approach led to more efficient and sustainable outcomes .

Capacity Building and Knowledge Sharing

Building local capacity and facilitating knowledge transfer were key components of SOLUTIONSplus. Training workshops, seminars, and educational resources were used

to equip stakeholders with the necessary skills and knowledge to sustain and scale the interventions .

Monitoring and Evaluation Systems
Implement robust monitoring and evaluation (M&E) systems to track performance and impact continuously. In SOLUTIONSplus, M&E processes were integral during the implementation stage to ensure continuous improvement and data collection for impact assessment .

Scaling and Replication
Plan for scalability and replication from the outset. SOLUTIONSplus developed strategies for scaling successful pilot projects and forming partnerships to support broader adoption of e-mobility solutions in other regions.

Practical Learnings and Recommendations

- Define clear project objectives and KPIs at the beginning to guide data collection and assessment. This ensures that all stakeholders have a shared understanding of what success looks like.
- Utilize a combination of data sources to capture a comprehensive picture of project impacts. Quantitative data from sensors and surveys should be complemented with qualitative insights from interviews and focus groups.
- Maintain ongoing communication and collaboration with stakeholders. Their insights and feedback are crucial for understanding the broader impacts of the project and for identifying areas for improvement.
- Be prepared to adapt and iterate based on feedback and preliminary findings. Flexibility is essential for addressing unforeseen challenges and for optimizing project outcomes.
- Thoroughly document all aspects of the project, from methodologies to outcomes and lessons learned. Sharing this knowledge through reports, publications, and presentations can support the wider adoption of successful practices.

SOLUTIONSplus reports for further guidance:
D1.1 Toolbox for efficient e-mobility
D1.2 Evaluation framework
D1.3 User needs assessments
D1.4 Data collection plan
D1.5 Data storage repository
D1.6 Impact assessment results
D4.10 Impact Assessment Guidance of Urban e-mobility Innovations

https://cordis.europa.eu/project/id/875041/results

CAPACITY BUILDING

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CAPACIY BUILDING

The Capacity building is a critical element for ensuring the successful implementation and replication of e-mobility solutions. The SOLUTIONSplus project has pioneered several effective capacity-building strategies, addressing the diverse needs of stakeholders through innovative approaches. This chapter shares learnings from the SOLUTIONSplus capacity building activities.

Holistic Approach to Capacity Building:
A holistic approach to capacity building involves understanding the broader context of urban mobility and the specific needs of different stakeholders. SOLUTIONSplus emphasized the integration of theoretical knowledge with practical applications, which proved to be effective in bridging the gap between planning and implementation.

Key Actions:

- Develop training programs that cover a wide range of topics, including technology, policy, operations, and community engagement.
- Ensure that training content is adaptable to different regional contexts and can address local challenges effectively.
- Integrate practical components such as on-the-job training, internships, and living labs to provide hands-on experience.

Diverse Learning Formats:
The SOLUTIONSplus project utilized various formats for capacity building, including e-learning, webinars, peer-to-peer exchanges, and in-person workshops. This blended learning approach ensured that different learning preferences and logistical constraints were accommodated

Key Actions:

- Implement a blended learning approach combining online and offline activities.
- Use e-learning platforms to provide accessible, flexible training opportunities that can be scaled up.
- Organize regional and local training sessions to address specific needs and foster community engagement.
- Facilitate peer-exchanges and train-the-trainer programs to build a network of knowledgeable practitioners.

Adaptation and Flexibility:

The COVID-19 pandemic highlighted the need for adaptive strategies in capacity building. The SOLUTIONSplus project effectively transitioned to digital platforms, ensuring continuity in training and stakeholder engagement.

Key Actions:

- Develop contingency plans for capacity-building activities to adapt to unforeseen circumstances, such as pandemics.
- Leverage digital tools for remote learning and ensure they are user-friendly and accessible.
- Reinforce bilateral online exchanges between cities, industry, and start-up partners to maintain momentum.

Focus on Change Makers:

Identifying and nurturing change makers within communities is crucial for sustainable urban transformation. SOLUTIONSplus engaged a diverse group of stakeholders, including students, professionals, and researchers, to act as facilitators, educators, and advocates for sustainable mobility.

Key Actions:

- Engage diverse stakeholders in capacity-building activities, ensuring inclusivity and representation.
- Provide continuous learning opportunities to empower individuals and organizations to stay updated with the latest advancements.
- Encourage active participation in community projects and collaborative initiatives.

Practical and Contextualized Training:

Training needs to be practical and contextualized to be effective. The SOLUTIONSplus project emphasized the importance of tailoring training content to the specific needs and contexts of the demonstration cities.

Key Actions:

- Conduct thorough needs assessments to identify the specific training requirements of stakeholders.
- Develop modular and flexible training materials that can be adapted to different contexts.
- Incorporate real-world case studies and examples to illustrate practical applications of e-mobility solutions.

Continuous Improvement and Feedback:

Continuous improvement based on participant feedback is essential for effective capacity building. The SOLUTIONSplus project regularly updated its training content and strategies based on feedback and evolving best practices.

Key Actions:

- Establish mechanisms for collecting feedback from participants and stakeholders.
- Regularly update and refine training materials and methods to reflect new insights and technological advancements.
- Foster a culture of continuous learning and improvement among project implementers and participants.

Practical Insights and Lessons Learned

Empowering Local Leaders and Champions:
Local leaders and champions play a critical role in driving the adoption and sustainability of e-mobility solutions. SOLUTIONSplus focused on empowering these individuals through targeted training and support.

Key Actions:

- Identify local leaders and champions early in the project and provide them with tailored training and resources.
- Foster leadership skills and provide opportunities for these individuals to lead training sessions and workshops.
- Encourage local leaders to share their experiences and success stories to inspire others.

Building Partnerships and Networks:
Strong partnerships and networks are essential for the success of capacity-building initiatives. SOLUTIONSplus built extensive networks among cities, industry partners, academia, and civil society organizations.

Key Actions:

- Establish formal partnerships with local and international organizations to enhance the reach and impact of capacity-building activities.
- Create platforms for ongoing communication and collaboration among partners.
- Leverage existing networks and alliances to disseminate training materials and best practices.

Incorporating Gender and Social Inclusion:
Incorporating gender and social inclusion considerations into capacity-building activities ensures that the benefits of e-mobility are equitably distributed. SOLUTIONSplus made a concerted effort to include women and marginalized groups in its training programs.

Key Actions:

- Develop gender-sensitive training materials and ensure that training sessions are accessible to women and marginalized groups.
- Promote the participation of women and underrepresented groups in all capacity-building activities.
- Address specific barriers that these groups may face in accessing training and resources.

Monitoring and Evaluation:
Effective monitoring and evaluation (M&E) mechanisms are essential to assess the impact of capacity-building activities and identify areas for improvement. SOLUTIONSplus implemented robust M&E processes to track progress and outcomes.

Key Actions:

- Develop a comprehensive M&E framework with clear indicators and targets for capacity-building activities.
- Collect data regularly to monitor progress and measure the impact of training programs.
- Use the insights gained from M&E activities to refine and enhance training strategies and content.

Disseminating Knowledge and Best Practices:
Disseminating knowledge and best practices ensures that the learnings from capacity-building activities are shared widely and can benefit other projects and stakeholders. SOLUTIONSplus created various dissemination channels for this purpose.

Key Actions:

- Develop and maintain an online repository of training materials, case studies, and best practices.
- Organize webinars, conferences, and workshops to share knowledge and experiences with a broader audience.
- Publish regular updates, reports, and newsletters to keep stakeholders informed about project progress and outcomes.

Sustainability and Legacy:
Ensuring the sustainability and legacy of capacity-building efforts is crucial for long-term impact. SOLUTIONSplus focused on creating sustainable capacity-building programs that can continue beyond the project's lifetime.

Checklist for Capacity Building Organizers:
SOLUTIONSplus aimed to enhance the capacities of local and national policymakers, transport operators, entrepreneurs, and other stakeholders to implement and scale up innovative urban e-mobility solutions. This was achieved through a structured capacity-building framework that included needs assessments, tailored training programs, and ongoing support:

Needs Assessment: Conducted detailed surveys and interviews with stakeholders in partner cities to identify existing skills, gaps, and future needs. This informed the development of targeted training programs.

Training Programs: Delivered a mix of e-learning modules, webinars, peer-to-peer exchanges, and hands-on workshops. Topics covered included technology adoption, policy formulation, business model development, and operational management.

Peer Exchanges: Facilitated exchanges between cities, allowing stakeholders to learn from each other's experiences and best practices. This included site visits, joint workshops, and mentoring sessions.

Resource Development: Created a comprehensive toolkit with training materials, case studies, guidelines, and other resources to support ongoing learning and implementation.

Monitoring and Evaluation: Implemented a robust M&E framework to track the effectiveness of capacity-building activities, gather feedback, and make continuous improvements.

The SOLUTIONSplus project demonstrated the importance of a well-rounded and adaptable approach to capacity building. Future project implementers can leverage these insights to design and deliver effective capacity-building programs that empower stakeholders, foster collaboration, and ensure the sustainable implementation of innovative e-mobility solutions. By focusing on inclusivity, adaptability, and continuous improvement, capacity-building initiatives can drive significant and lasting impacts in the field of sustainable urban mobility.

- Define clear project objectives and KPIs at the beginning to guide data collection and assessment. This ensures that all stakeholders have a shared understanding of what success looks like.
- Utilize a combination of data sources to capture a comprehensive picture of project impacts. Quantitative data from sensors and surveys should be complemented with qualitative insights from interviews and focus groups.
- Maintain ongoing communication and collaboration with stakeholders. Their insights and feedback are crucial for understanding the broader impacts of the project and for identifying areas for improvement.
- Be prepared to adapt and iterate based on feedback and preliminary findings. Flexibility is essential for addressing unforeseen challenges and for optimizing project outcomes.
- Thoroughly document all aspects of the project, from methodologies to outcomes and lessons learned. Sharing this knowledge through reports, publications, and presentations can support the wider adoption of successful practices.

SOLUTIONSplus reports for further guidance:
D2.1 The SOLUTIONSPLUS capacity building plan
D2.2 Capacity building tools and updates
D2.3 Peer-to-peer Capacity Building on EV innovation - activity report
D2.4 Regional training activity report D2.5 eLearning report
D2.6 Collection of good practices from SOLUTIONSplus capacity building activities
https://cordis.europa.eu/project/id/875041/results

BUSINESS DEVELOPMENT

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BUSINESS DEVELOPMENT

The SOLUTIONSplus project has provided a wealth of insights into the effective strategies for fostering business development within the urban electric mobility (e-mobility) sector. This guidance offers detailed reflections and practical advice derived from the project's experiences, aimed at aiding future project implementers in developing robust business models, forging strategic partnerships, and fostering sustainable innovation.

Identifying and Leveraging Business Opportunities

Comprehensive Needs Assessment:

- **Thorough Market Analysis:** Conduct detailed market analyses to understand the current state and potential of the e-mobility ecosystem within target regions. This involves identifying existing e-mobility solutions, mapping out the competitive landscape, and pinpointing gaps and unmet needs in the market.
- **Stakeholder Engagement:** Engage a broad range of stakeholders, including local governments, transport operators, industry players, and end-users, to gather comprehensive insights into their needs and expectations. Use surveys, interviews, focus groups, and public consultations to ensure a holistic understanding of stakeholder perspectives.
- **Tailored Solutions:** Develop solutions that are specifically tailored to the unique needs and contexts of different regions. This requires adapting global best practices to local realities, considering factors such as regulatory environments, cultural preferences, and existing infrastructure.

Creating a Network of Local Innovators:

- **Innovation Ecosystem:** Establish a vibrant innovation ecosystem by launching calls for local innovators. Encourage the sharing of knowledge and collaborative development of complementary solutions that enhance the mainstream options provided by EU industry partners.
- **Online Catalogue:** Develop a dynamic online catalogue of e-mobility solutions that is easily accessible and regularly updated. This should include detailed information on available technologies, business models, and case studies of successful implementations.
- **Network Events:** Facilitate regular network events, such as innovation fairs, hackathons, and match-making sessions, to connect SMEs with potential business opportunities and foster collaborations between local and international stakeholders.

Developing and Testing Business Models

Business Model Incubation:

- **Support Framework:** Create a comprehensive support framework for business model incubation, including access to funding, mentorship, technical expertise, and market insights. This framework should be designed to nurture innovative ideas from inception through to market readiness.
- **Pilot Projects:** Implement pilot projects to rigorously test new business models in real-world settings. These pilots should be closely monitored and evaluated to gather data on their effectiveness, scalability, and sustainability.
- **Iterative Development:** Adopt an iterative approach to business model development, where initial concepts are refined based on feedback and learnings from pilot projects. This ensures continuous improvement and adaptation to changing market conditions.

Engaging EU Industry Partners:

- **Collaborative Development:** Foster active collaboration between local innovators and EU industry partners. This involves joint development projects, shared research initiatives, and co-creation workshops to leverage the strengths and expertise of both parties.
- **Technology Transfer:** Facilitate the transfer of advanced technologies and best practices from EU industry partners to local innovators. This helps bridge the gap between global innovations and local implementations.
- **Integration of Innovations:** Ensure that the solutions developed are fully integrated, addressing all aspects of the e-mobility value chain from vehicles and charging infrastructure to user interfaces and operational management.

Building Sustainable Partnerships

Facilitating Matchmaking and Coaching:

- **Matchmaking Platforms:** Establish platforms that facilitate matchmaking between local needs and international expertise. These platforms should provide detailed profiles of potential partners, including their capabilities, experience, and areas of interest.
- **Coaching Programs:** Develop coaching programs that offer tailored support to local businesses. These programs should cover areas such as business strategy, financial management, technical development, and market penetration.
- **Sustained Engagement:** Ensure sustained engagement through regular follow-ups, progress reviews, and continuous support. This helps maintain momentum and address any challenges that arise during the partnership development process.

International Cooperation:

- **Leveraging Partnerships:** Leverage existing international partnerships and networks to enhance the impact of business development activities. Engage with global initiatives such as UEMI, MobiliseYourCity, and Decarbonising Transport to share resources, insights, and best practices.
- **Global Standards:** Promote the adoption of global standards and best practices to ensure the interoperability and scalability of e-mobility solutions. This includes standards for vehicle performance, charging infrastructure, data management, and user interfaces.
- **Cross-Border Collaborations:** Foster cross-border collaborations that enable the exchange of knowledge, technologies, and business models. These collaborations should aim to replicate successful solutions in new markets, adapting them to local contexts where necessary.

Implementing Peer-to-Peer Learning and Exchange Programs

Structured Peer-to-Peer Programs:

- **Secondment Programs:** Develop structured secondment programs that enable local authorities and transport operators to gain hands-on experience from peers in other cities. These programs should include clear objectives, expected outcomes, and mechanisms for knowledge transfer.
- **Cluster-Based Learning:** Organize peer-to-peer learning sessions and site visits based on thematic clusters, such as electric buses, e-taxis, e-bikes, and logistics solutions. This facilitates focused learning and the sharing of practical experiences and best practices.
- **Knowledge Repositories:** Create knowledge repositories that capture the insights and learnings from peer-to-peer programs. These repositories should be easily

accessible and regularly updated to serve as a valuable resource for future projects.

Regional and Global Training Initiatives:

- **Regional Workshops:** Organize regional workshops that bring together stakeholders from different cities and regions. These workshops should focus on specific aspects of e-mobility, such as policy frameworks, business models, technical innovations, and user engagement.
- **Training Platforms:** Utilize existing training platforms to disseminate training materials and expand the reach of capacity-building efforts. Develop e-learning modules, webinars, and online courses that cater to different stakeholder needs and preferences.
- **Continuous Learning:** Promote a culture of continuous learning and improvement. Encourage stakeholders to participate in ongoing training and development activities to stay abreast of the latest trends, technologies, and best practices in e-mobility.

Supporting Start-Ups and SMEs

Incubator and Seed-Funding Support:

- **Innovation Challenges:** Launch innovation challenges to identify and support start-ups with high potential. Provide seed funding, access to expert mentors, and opportunities for market validation and pilot testing.
- **Local Start-Up Ecosystems:** Foster the development of local start-up ecosystems by organizing hackathons, start-up events, and networking sessions. This helps build a vibrant community of innovators and entrepreneurs who can drive the growth of the e-mobility sector.
- **Market Integration:** Support start-ups in integrating their solutions into existing market structures. This includes helping them navigate regulatory requirements, secure partnerships with established players, and scale their operations.

Scaling and Replicating Business Models:

- **Scalability Assessments:** Conduct thorough assessments to determine the scalability of business models. This involves analyzing market potential, operational feasibility, financial viability, and stakeholder acceptance.
- **Replication Frameworks:** Develop frameworks for replicating successful business models in new markets. These frameworks should provide detailed guidelines on adapting solutions to different contexts, securing funding, and engaging stakeholders.
- **Visibility and Marketing:** Enhance the visibility of successful start-ups and business models through focused marketing and communication efforts. Showcase their achievements at relevant events, conferences, and through online platforms.

Integrating Interdisciplinary Approaches

Interdisciplinary Collaboration:

- **Holistic Approach:** Adopt a holistic approach that integrates various aspects of e-mobility, including technology, policy, economics, and social factors. This ensures that solutions are comprehensive and address all relevant dimensions.
- **Stakeholder Inclusion:** Involve a diverse range of stakeholders in the development process, including local authorities, mobility experts, service providers, and end-users. This fosters a sense of ownership and ensures that solutions meet the needs of all stakeholders.

- **Systemic Thinking:** Encourage systemic thinking by considering the interdependencies and interactions between different components of the e-mobility ecosystem. This helps identify synergies and optimize the overall impact of solutions.

Knowledge Sharing and Capacity Building:

- **Comprehensive Toolbox:** Develop and disseminate a comprehensive toolbox that includes guidelines, case studies, best practices, and practical tools. This serves as a valuable resource for project implementers and stakeholders.
- **Workshops and Training Sessions:** Organize workshops and training sessions to facilitate knowledge exchange and capacity building. These sessions should be interactive, engaging, and tailored to the needs of different stakeholder groups.
- **Peer Learning Networks:** Establish peer learning networks that enable stakeholders to share experiences, learn from each other, and collaborate on common challenges. This promotes continuous improvement and innovation.

By following these detailed guidelines, future project implementers can build on the SOLUTIONSplus project's successes, fostering sustainable business development and innovation in the e-mobility sector. The comprehensive and practical insights provided here will help ensure that new projects are effectively designed, implemented, and scaled to achieve lasting impact.

SOLUTIONSplus reports for further guidance:
D3.1 Catalogue of e-mobility solutions
D3.2 Collaboration framework
D3.3 Business opportunities and partnerships
D3.4 Global competitiveness report on electric mobility solutions
D3.5 Eight to ten (8-10) business plans (building on the business opportunities) D3.6 Fifteen (15) business models for e-mobility solutions (incl. public transport, logistics, car/bike-sharing, charging)
D3.7 Technical specifications for demo actions
D3.8 Standardisation and harmonisation specifications related to demo actions D3.9 Start-up Summary

https://cordis.europa.eu/project/id/875041/results

DEMONSTRATION AND REPLICATION

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BUSINESS DEVELOPMENT

The SOLUTIONSplus project has established a robust framework for the global transition towards low-carbon urban mobility through various demonstration actions across multiple cities on different continents. This chapter provides a detailed guide for future project implementers to understand the process, concept, and practical aspects of implementing and replicating these demonstration projects.

Process and Concept of Demonstration Actions

Key Elements of Demonstration Actions:

Needs Assessment and Planning:
- **Initial Assessment:** Conduct a comprehensive needs assessment to identify the specific urban mobility challenges and opportunities in the target city. Engage local stakeholders, including government authorities, transport operators, and community groups, to gather insights and ensure alignment with local priorities.
- **Project Planning:** Develop a detailed project plan that outlines the objectives, scope, timeline, and resources required for the demonstration action. This plan should also include risk management strategies and contingency plans.

Stakeholder Engagement:
- **Inclusive Engagement:** Involve a wide range of stakeholders from the beginning, including policymakers, local businesses, transport operators, and end-users. Regular stakeholder meetings and workshops help in maintaining transparency and gathering diverse inputs.
- **Partnership Building:** Form partnerships with local and international organizations to leverage their expertise, resources, and networks. Establish clear roles and responsibilities for each partner to ensure smooth collaboration.

Design and Customization:
- **Solution Design:** Customize e-mobility solutions to fit the local context. This involves adapting vehicle types, charging infrastructure, and operational models to meet the specific needs of the city.
- **Prototype Development:** Develop prototypes of the e-mobility solutions and conduct pilot tests to validate their feasibility and performance. Collect feedback from users and stakeholders to refine the prototypes.

Implementation:
- **Pilot Projects:** Launch pilot projects to test the e-mobility solutions in real-world conditions. Monitor the performance and impact of the solutions, and make necessary adjustments based on the collected data and feedback.
- **Scaling Up:** Based on the success of the pilot projects, gradually scale up the implementation to cover larger areas or more users. Ensure that the scaling-up process is supported by adequate infrastructure, funding, and regulatory frameworks.

Monitoring and Evaluation:
- **Impact Assessment:** Conduct regular monitoring and evaluation to assess the environmental, social, and economic impacts of the e-mobility solutions. Use a comprehensive set of Key Performance Indicators (KPIs) to measure success and identify areas for improvement.
- **Data Collection:** Collect data through various means, including sensors, surveys, and digital tools, to inform the evaluation process. Ensure that data collection methods

are standardized and reliable.

Capacity Building:
- **Training Programs:** Implement training programs for local stakeholders to build their technical, managerial, and financial capacity. Focus on areas such as vehicle maintenance, data management, and business model development.
- **Knowledge Sharing:** Facilitate knowledge sharing through workshops, seminars, and peer-to-peer learning sessions. Encourage cities to share their experiences and lessons learned with other cities facing similar challenges.

Replication Actions

Key Elements of Replication Actions:

Identifying Replication Opportunities:
- **City Selection:** Identify cities that have similar urban mobility challenges and are willing to adopt and adapt the demonstrated solutions. Consider factors such as population size, economic conditions, and existing transport infrastructure.
- **Engagement and Buy-in:** Engage with local governments and stakeholders in the selected cities to secure their commitment and support for the replication project.

Adaptation and Customization:
- **Contextual Adaptation:** Adapt the demonstrated solutions to fit the local context of the replication cities. This may involve modifying vehicle designs, operational models, and business plans to address specific local needs and constraints.
- **Local Partnerships:** Establish partnerships with local businesses, NGOs, and academic institutions to leverage their knowledge and resources for successful adaptation.

Funding and Resources:
- **Securing Funding:** Identify potential funding sources, including government grants, international development funds, and private investments. Develop comprehensive funding proposals that highlight the benefits and feasibility of the replication project.
- **Resource Allocation:** Ensure that adequate resources, including technical expertise, financial support, and infrastructure, are allocated to support the replication efforts.

Implementation:
- **Pilot Replication:** Start with a pilot replication project to test the adapted solutions in a small-scale setting. Monitor the performance and gather feedback to make necessary adjustments.
- **Full-scale Replication:** Once the pilot replication is successful, scale up the project to cover larger areas or more users. Ensure that the replication process is well-coordinated and supported by robust monitoring and evaluation frameworks.

Monitoring and Evaluation:
- **Continuous Evaluation:** Conduct ongoing monitoring and evaluation to assess the impact and effectiveness of the replication project. Use the same set of KPIs as in the original demonstration projects to ensure consistency and comparability.
- **Reporting and Feedback:** Regularly report the findings to stakeholders and use the feedback to improve the replication process. Document the successes and challenges to inform future replication efforts.

Capacity Building and Knowledge Transfer:
- **Training and Support:** Provide training and support to local stakeholders in the

replication cities to build their capacity for implementing and sustaining the e-mobility solutions.

- **Knowledge Transfer:** Facilitate the transfer of knowledge and best practices from the original demonstration cities to the replication cities. Use digital platforms, workshops, and peer-to-peer learning sessions to share experiences and insights.

The SOLUTIONSplus project has provided a comprehensive framework for implementing and replicating innovative e-mobility solutions. By following the detailed process and concepts outlined in this chapter, future project implementers can effectively plan, execute, and scale up demonstration and replication actions to achieve sustainable urban mobility. The key to success lies in thorough planning, inclusive stakeholder engagement, continuous monitoring and evaluation, and robust capacity building and knowledge transfer mechanisms.

SOLUTIONSplus reports for further guidance:
D4.1 Nine (9) demonstration implementation plans
D4.2 Nine (9) demonstration project updates
D4.3 Nine (9) implementation summary reports for the demonstration actions D4.4 Report demo activities funded by other sources
D4.5 Twenty (20) city replication roadmaps
D4.6 Planning and implementation support report
D4.7 SOLUTIONSplus Replication Guide
D4.8 Analysis Report of Charging Ecosystem in Partner Regions
D4.9 Living Lab Methodology Guide for Academic Institutions
D4.10 Impact Assessment Guidance of Urban e-mobility Innovations
https://cordis.europa.eu/project/id/875041/results

SCALE-UP

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SCALE-UP

Scaling up sustainable urban mobility solutions requires a comprehensive and systematic approach. By following the guidance and learnings from the SOLUTIONSplus project, future implementers can effectively replicate and expand these initiatives, contributing to more sustainable and efficient urban transport systems. The key is to remain flexible, continuously engage stakeholders, and ensure that solutions are adaptable to diverse local contexts.

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Understanding the Scale-Up Concept

Scaling up sustainable urban mobility solutions requires a systematic approach that considers technical feasibility, economic viability, social acceptance, and environmental impact. The goal is to transition from small-scale demonstrations to widespread adoption, ensuring that innovations become an integral part of urban transport systems.

Key Steps in the Scale-Up Process

Evaluation and Impact Assessment

- Baseline Studies: Conduct thorough baseline studies to understand the current mobility landscape, including user behavior, infrastructure, and environmental conditions.
- KPIs and Metrics: Develop Key Performance Indicators (KPIs) to measure success. These should cover environmental, social, and economic aspects, such as emission reductions, user satisfaction, and cost savings.
- Continuous Monitoring: Implement a robust monitoring framework to track progress and impact continuously. This ensures that any issues can be identified and addressed promptly.

Stakeholder Engagement and Capacity Building

- **Inclusive Planning:** Engage all relevant stakeholders, including local governments, transport operators, businesses, and the community. Their buy-in is crucial for the success of scale-up actions.
- **Capacity Building:** Conduct training sessions and workshops to build the capacity of local stakeholders. This includes technical training, operational management, and financial planning.

Developing a Scalable Model

- **Pilot Projects:** Start with pilot projects in diverse urban environments to test scalability. These pilots should represent different socio-economic and geographical contexts.
- **Adaptation and Flexibility:** Ensure that the solutions are adaptable to different local contexts. Flexibility in design and implementation is crucial to address varying local needs and challenges.

Business Models and Financing

- **Sustainable Business Models:** Develop and test business models that ensure economic viability. These models should focus on revenue generation, cost recovery, and financial sustainability.
- **Funding Mechanisms:** Identify and secure funding from various sources, including public funds, private investments, and international grants. Develop a financing plan that includes short-term and long-term funding strategies.

Policy and Institutional Support

- **Policy Framework:** Advocate for supportive policies at the local, regional, and national levels. Policies should promote sustainable mobility, provide incentives, and remove barriers to adoption.
- **Institutional Arrangements:** Establish clear institutional arrangements for governance, operation, and maintenance of mobility solutions. This includes defining roles and responsibilities of different stakeholders.

Replication and Dissemination

- **Documentation and Knowledge Sharing:** Document all processes, successes, and challenges. Share knowledge and best practices through reports, case studies, and workshops.
- **Replication Strategy:** Develop a replication strategy that identifies potential cities and regions for scale-up. Tailor the approach to the specific needs and contexts of these areas.

Practical Learnings from SOLUTIONSplus

Engagement and Buy-In: Continuous engagement with stakeholders and securing their buy-in was crucial. This involved regular consultations, transparent communication, and demonstrating the benefits of sustainable mobility solutions.
Integrated Solutions: Integrating different mobility solutions, such as e-buses, e-scooters, and charging infrastructure, created a more cohesive and efficient transport system. This integration was essential for achieving scale.
Capacity Building: Investing in capacity building ensured that local stakeholders had the skills and knowledge to sustain and expand the mobility solutions. This included technical training, operational management, and financial planning.
Robust Monitoring: Implementing a robust monitoring and evaluation framework helped track progress and identify areas for improvement. This continuous feedback loop was vital for scaling up successfully.
Flexible Business Models: Developing flexible and sustainable business models that could adapt to changing conditions and ensure long-term viability was a key success factor.
Policy Support: Advocating for supportive policies and creating an enabling environment facilitated the scale-up process. This included working with policymakers to develop regulations and incentives that promote sustainable mobility.

SOLUTIONSplus reports for further guidance:
D5.1 15 E-mobility scale-up concepts for 15 cities and 5 prefeasibility studies D5.2 Fifteen (15) policy advice papers
D5.3 Five (5) proposals for National Urban Mobility Programmes
D5.4 Funding, financing and procurement summaries
https://cordis.europa.eu/project/id/875041/results

WHAT

SOLUTIONSPLUS TECHNICAL KNOWLEDGE PRODUCTS

SOLUTIONSplus put a particular focus on the development of viable concepts for electric mobility across all key pillars that are vital for the decarbonization of the sector and its contribution to sustainable development. The knowledge products that are accessible on the SOLUTIONSplus website and the E-Mobility toolbox include:

Vehicle Technologies:
Based on SOLUTIONSplus learnings, we recommend focusing on downsizing vehicle size and power to enhance resource and energy efficiency. Designing EV concepts for shared use-cases can improve access and affordability. It is also important to explore advancements in automation, ensuring they complement public transport systems and support non-motorized transport.

Charging Infrastructure:
Planning and implementing comprehensive charging networks is critical. The project's emphasis on both conventional and wireless charging solutions for various types of vehicles serves as a model. Ensuring reliable availability of charging points supports the shift to EVs.

Business Models for E-Mobility:
Exploring different business models for EV deployment, including shared and ride-hailing services, is crucial. SOLUTIONSplus illustrates successful implementations. Financial planning, budgeting, and identifying funding sources.

Operational Strategies:
Addressing operational aspects of e-mobility, including fleet management, maintenance, and service planning, is vital. Public transport operators and private sector partners play key roles in implementing e-mobility solutions. Tools and methods for assessing the economic, social, and environmental impacts of e-mobility projects are recommended.

Multi-Modal Transport Integration:
Integrating e-mobility solutions with existing public transport systems enhances urban mobility. Intermodal route planning, eco-routing, ticketing, trip planning, and demand-responsive services should be considered. Examples from SOLUTIONSplus demonstrate successful integration projects and their benefits.

Sustainable Urban Planning:
Compact city development and mixed-use structures promote sustainable mobility. High-quality public transport services, as well as infrastructure for walking and cycling, are essential. Polycentric structures and short travel distances reduce urban congestion and improve access to jobs and services.

SOLUTIONSplus guidance:
https://emobility.tools
https://www.solutionsplus.eu/solutionspluspublications

VEHICLE CONCEPTS AND USE CASES

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DESCRIPTION

SOLUTIONSplus has worked with over 40 local entrepreneurs on a wide range of electric vehicles to showcase the potential of the local production of electric vehicles and to test the viability of vehicle concepts. In collaboration with the RWTH Aachen the SOLUTIONSplus team developed a practical guide on the development of an electric 2- and 3-wheeler model, applying a very simplified approach to the production of the vehicle to create the as-easy-as-possible entry level into the business of vehicle production. The SOLUTIONSplus Vehicle Replication Guide aims to empower local entrepreneurs to venture into the production and deployment of electric two- and three-wheelers, focusing on sustainable urban mobility. This guide encapsulates the essential technical knowledge and practical steps required to develop electric vehicles (EVs), offering detailed insights from the SOLUTIONSplus project, which includes various successful demonstrations across different regions. The SOLUTIONSplus Vehicle Replication Guide provides a ste-by-step guidance for local entrepreneurs to develop and deploy electric two- and three-wheelers. By following the detailed technical guidelines and leveraging insights from successful demonstrations, entrepreneurs can contribute to sustainable urban mobility solutions. The guide is available on the SOLUTIONSplus website: https://www.solutionsplus.eu/solutionspluspublications.

General Design Guidelines

Choice of Materials

Selecting the right materials is fundamental to vehicle performance and durability. The balance between strength and weight is crucial; for instance, aluminum offers light weight and corrosion resistance, making it ideal for various vehicle components. Implementing corrosion protection measures, such as cavity sealing and painting, is essential to extend the lifespan of the vehicle and maintain its aesthetics.

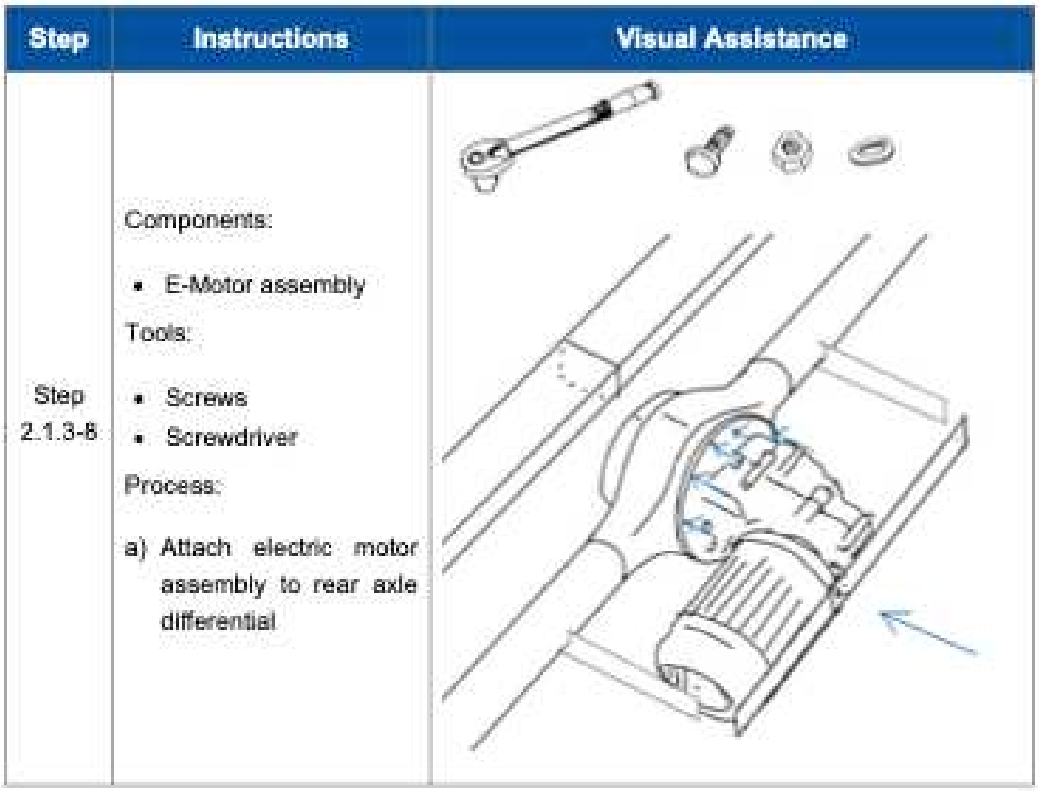


Figure 10. Example of the step-by-step guidance

Mechanics, Dynamics, and Kinematics

Ensuring a low center of gravity through proper mass distribution improves driving stability and handling. Minimizing the weight of moving parts, such as wheels and suspension components, enhances efficiency and responsiveness. These principles are vital for constructing a safe, functional, and durable vehicle.

Production Process

Tools and Equipment

Basic tools such as wrenches, screwdrivers, a welding machine, and a drill are necessary for assembling and fabricating parts. Safety equipment, including safety glasses, gloves, and hearing protection, is paramount to prevent injuries. Precision in fabrication work is ensured using measuring tools like calipers and measuring tapes.

Framework Construction

The vehicle frame is critical for stability and weight efficiency. Utilizing the truss principle in frame design ensures a stable and lightweight structure. Strong, well-designed joints contribute significantly to the overall strength and durability of the frame, with triangular arrangements maximizing structural integrity.

Electric Two-Wheelers (E-Bikes)

Manufacturing electric bicycles involves selecting high-quality materials and integrating advanced components. The frame, typically made from aluminum or steel, is designed for durability and ergonomic efficiency. High-efficiency brushless DC motors and high-capacity lithium-ion batteries provide the necessary power and range. Control systems with digital displays and connectivity options enhance user experience and operational efficiency.

Electric Three-Wheelers (Tuk-Tuks)

The production of electric three-wheelers, such as tuk-tuks, involves assembling a robust frame, integrating an electric motor, and ensuring adequate energy storage. Lightweight materials and a compact design are crucial for maneuverability and efficiency. Key components include the chassis, suspension system, drivetrain, and energy storage units.

Short overview on vehicle concepts and use-cases

The following sections briefly touch on the vehicle concepts, their production and potential use-cases. A wider overview on all businesses involved in SOLUTIONSplus and their respective vehicles is provided in this paper:
https://www.solutionsplus.eu/_files/ugd/de12cd_300f2e7fa2fb44fa801dd88978c51cc6.pdf

E-CARGO BIKES

https://emobility.tools

E-CARGO BIKES

E-cargo bikes are an innovative solution tailored for urban logistics, offering a sustainable and efficient alternative to traditional delivery vehicles. They are particularly suited for last-mile delivery services, small business logistics, and municipal services. This factsheet provides an overview on the production and development of e-cargo bikes, using insights and examples from the SOLUTIONSplus project.

Key Components of E-Cargo Bikes

The production of e-cargo bikes begins with the selection of key components, including the frame and chassis, electric motor and battery system, cargo area, control and monitoring systems, and safety features. The frame and chassis of e-cargo bikes are typically made from lightweight yet durable materials such as aluminum or steel. The design is robust to support heavy loads, with variations such as front-loading, rear-loading, and long-john types. For example, Bixicargo's models include rear-loading, front-loading, and long-john designs to cater to different logistics needs.

The electric motor and battery system are critical for the performance of e-cargo bikes. These bikes are usually equipped with a mid-drive or hub motor for efficient power distribution. High-capacity lithium-ion batteries offer a range of 50-100 km on a single charge, and fast-charging capabilities minimize downtime. Bixicargo's e-cargo bikes incorporated electric motor assistance and control displays to enhance functionality. The cargo area is designed to carry loads ranging from 100 kg to over 300 kg. Customizable cargo boxes, insulated containers for food delivery, and open beds for bulkier items are common configurations. Bixicargo's bikes were tested with various logistic operators for different types of deliveries, demonstrating versatility.

Control and monitoring systems include LCD or LED display units for real-time data on speed, battery level, and diagnostics. GPS and IoT capabilities are integrated for tracking and fleet management. The integration of advanced control displays and connectivity features in Bixicargo's bikes enhanced monitoring and operation. Safety features are paramount. Hydraulic or mechanical disc brakes provide reliable stopping power, while front and rear LED lights ensure visibility. Reflectors, horns, and sturdy kickstands add to the safety and stability during loading and unloading.

Production Process

The production of e-cargo bikes involves several critical stages: design and prototyping, sourcing and manufacturing, assembly and integration, customization and final adjustments, and distribution and deployment.

Design and prototyping start with thorough market research to understand the needs and preferences of potential users. Initial design concepts are created based on research insights, followed by developing prototypes to test the design and functionality. Rigorous testing under various conditions ensures durability and performance. For instance, Bixicargo developed prototypes and tested them with logistic operators to gather valuable feedback and make necessary adjustments.

In the sourcing and manufacturing stage, high-quality materials for the frame, motor, battery, and other components are sourced from reliable suppliers to ensure consistent quality and supply chain stability. Manufacturing facilities are equipped with the

necessary machinery and tools for production, and stringent quality control measures are implemented at every stage to maintain high standards. Assembly and integration involve assembling the frame, motor, battery, and other components according to design specifications. Control systems, safety features, and cargo configurations are integrated, followed by final assembly tests to ensure all components work seamlessly together. Bixicargo's assembly process included integrating advanced motor assistance and monitoring systems to enhance the bikes' performance.

Customization and final adjustments allow for tailoring the bikes to meet specific customer needs. Options for different cargo configurations and branding for business customers are provided. Final adjustments are made based on customer feedback and specific requirements. Customizable cargo boxes and configurations meet diverse logistics needs, such as food delivery, postal services, and municipal waste collection. Distribution and deployment involve planning logistics for distributing the e-cargo bikes to various locations. Bikes are deployed in targeted urban areas, and their performance is monitored. Ongoing support and maintenance services are provided to ensure optimal operation. Bixicargo deployed their e-cargo bikes in Quito, Ecuador, for a pilot program, demonstrating significant efficiency gains and emission reductions.

Business Model and Market Strategies

The target market for e-cargo bikes includes businesses involved in urban logistics, such as e-commerce companies, grocery stores, and postal services, as well as municipal services and small businesses needing efficient and sustainable delivery options. Revenue streams can be generated through direct sales, leasing options for businesses that prefer not to purchase outright, and subscription models that provide access to bikes, including maintenance and support services.

Effective marketing and promotion strategies are essential. Developing a strong brand identity that emphasizes sustainability, efficiency, and innovation is crucial. Digital marketing strategies, including social media, SEO, and content marketing, help reach target audiences. Forming partnerships with local businesses, government agencies, and environmental organizations promotes e-cargo bike usage.

Customer support and maintenance are critical for long-term success. Comprehensive support services, including training, troubleshooting, and repair services, should be offered. Regular maintenance plans ensure the longevity and optimal performance of the e-cargo bikes.

Example: Bixicargo, Ecuador

Bixicargo is an Ecuadorian start-up that focuses on promoting sustainable urban logistics through the use of electric cargo bicycles. Their goal is to support enterprises, small and medium businesses, and public institutions in adopting e-cargo bikes for their logistics needs.

Bixicargo manufactured 10 e-cargo bikes in three different models (rear-loading, front-loading, and long-john). These bikes were tested with seven logistics operators in Quito, covering food distribution, restaurant deliveries, courier services, and waste collection. The bikes traveled 1,071 km, carried 16 tons of cargo, made 229 deliveries, and collected recyclables from 134 points, achieving an estimated reduction in emissions of 491.74 kg CO2e. The pilot showed significant efficiency gains and revealed a high potential for

scale-up and replication. The vehicles were granted permanent custody to the logistic operators who showed the best results during the pilot.

Bixicargo's success can be attributed to several key factors. They worked closely with local businesses and logistics operators to understand their needs and tailor their solutions accordingly. The pilot program provided valuable insights into user behavior, operational challenges, and potential improvements. The integration of electric motor assistance, control displays, and other technical features enhanced the functionality and appeal of the e-cargo bikes. Additionally, Bixicargo focused on designing e-cargo bikes that met the needs of vulnerable groups and social enterprises, promoting inclusivity and social impact.

The production of e-cargo bikes tailored for urban logistics presents a significant opportunity for businesses to contribute to sustainable urban development. By focusing on key components, adhering to a comprehensive production process, and implementing effective market strategies, manufacturers can develop successful e-cargo bike solutions. The example of Bixicargo in Ecuador highlights the potential for innovation and impact, offering valuable insights for new ventures in the e-mobility sector.

E-BIKES (PASSENGER)

https://emobility.tools/

DESCRIPTION

AfricroozE GmbH was formed by the Germany-based NGO EURIST e.V. to boost e-bicycle adoption in Africa, after six years of successful e-bicycle pilot projects promoting socio-economic development in African nations, implemented in partnership with the First African Bicycle Information Organisation (FABIO) based in Jinja, Uganda. Africrooze is currently present in Tanzania, Uganda,
Namibia, Burkina Faso, and Benin.

ACHIEVEMENTS

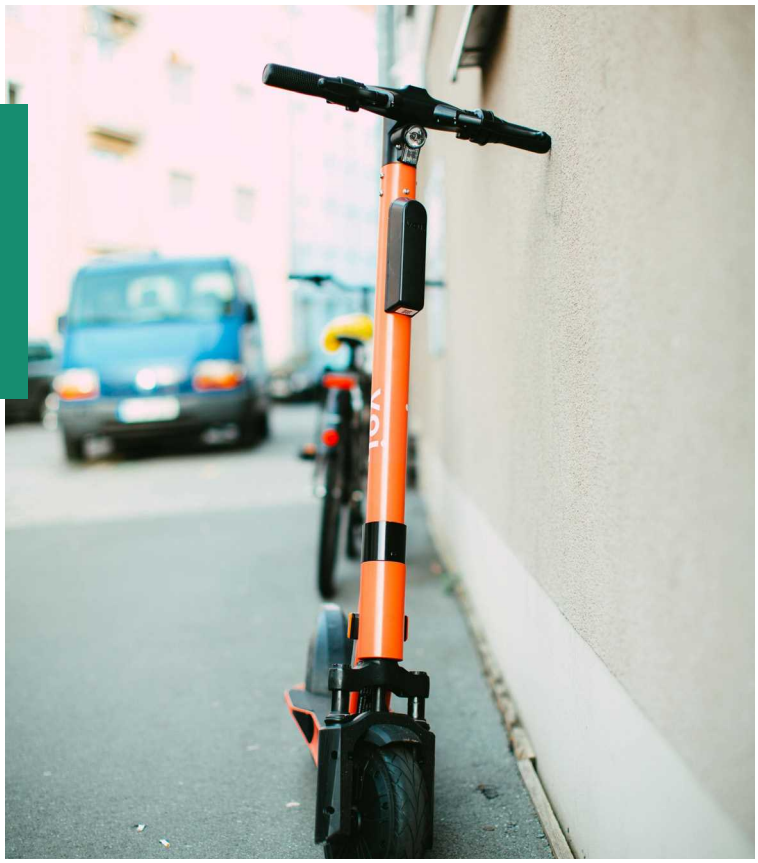
Within SOLUTIONSplus, Africrooze provided 16 pedal-assist electric bicycles and 5 additional batteries. The e-bicycles are jointly designed by EURIST, Hero India and the German company HNF Nicolai. They were assembled at the Dar es Salaam Institute of Technology Company Limited (DIT) by DIT staff, students, and users of the e-bicycles, after a dedicated three-day training provided by EURIST and FABIO. The electric bicycles are used for urban deliveries and the transport of medical supplies by the FASTA Cycling Cooperative, which has
been equipped with a booking application and 10 smartphones.

INNOVATION

Before the pilot, pedal-assist electric bicycles were not present in the Tanzanian market. The Africrooze long-tail e-bicycles were designed with a sturdy frame and 100 kg carrying capacity on the large rear carrier to carry loads or passengers. The design ensures that most spare parts can be found on the East African market and balances quality delivery and low prices. As of June 2024, Africrooze had deployed 532 e-bicycles on the African continent, catering to the growing e-bicycle market in urban and rural Africa for a variety of use cases including deliveries, e-bicycles as ambulances, transport of water bottles, etc. The e-bicycles facilitate access to economic activities and services such as education, water, farming, and the health system, and enable a reduction in transport costs as compared to larger vehicles previously used

E-SCOOTERS

https://emobility.tools/



DESCRIPTION

E-kick scooters have emerged as a popular solution for personal and shared mobility, offering a convenient alternative for short-distance travel. Recent issues with e-scooters include concerns over safety due to frequent accidents and improper public space usage, with scooters often obstructing sidewalks and pedestrian pathways. This factsheet provides an overview the (useful) deployment of e-kick scooters, incorporating insights and examples from the SOLUTIONSplus project, with a specific focus on the demonstration in Hamburg. As SOLUTIONSplus did not focus on the production of

Key Components of E-Kick Scooters

The production of e-kick scooters involves careful selection and integration of several key components, including the frame, electric motor and battery system, control and monitoring systems, safety features, and additional components such as wheels and suspension.

The frame of an e-kick scooter is typically constructed from lightweight yet durable materials like aluminum or high-strength plastic, ensuring the scooter is both sturdy and easy to maneuver. The design focuses on compactness and foldability, making it convenient for storage and transportation, particularly in urban settings.

The electric motor and battery system are crucial to the e-kick scooter's performance. These scooters commonly use brushless DC motors for their efficiency and low maintenance. The motors are typically integrated into the rear wheel (hub motor) to provide direct drive. High-capacity lithium-ion batteries are preferred due to their energy density and longevity, offering ranges from 20 km to over 50 km on a single charge. Fast-charging capabilities are often included to reduce downtime.

Control and monitoring systems include a handlebar-mounted display that provides real-time information on speed, battery level, and other diagnostics. Advanced e-kick scooters may also incorporate Bluetooth connectivity, allowing users to connect their smartphones for additional features such as GPS navigation and ride statistics.

Safety features are essential for user protection. E-kick scooters are equipped with robust braking systems, typically a combination of electronic (regen) brakes and mechanical disc brakes, to ensure reliable stopping power. LED lights are installed at the front and rear for visibility, along with reflectors to enhance safety during night-time rides. Additional safety measures include a sturdy kickstand and a non-slip deck surface.

Wheels and suspension play a vital role in ride comfort and stability. E-kick scooters are usually fitted with pneumatic tires to absorb shocks from uneven surfaces. Some models also include suspension systems, either front, rear, or both, to provide a smoother ride over rough terrain.

Case Study: Hamburg Demonstration Project

The SOLUTIONSplus project included a demonstration of e-kick scooters in Hamburg, aimed at assessing their potential to complement public transport systems in suburban areas. The public transport operator, HAMBURGER HOCHBAHN, subcontracted a shared e-scooter operator and provided seed funding to introduce shared scooters in two suburban demonstration areas.

Dedicated parking spaces were provided at four public transport stations in the demonstration areas. The shared scooter schemes were integrated into the public transport app to encourage intermodal travel. The demonstration activity revealed that approximately one-third of all scooter trips were part of intermodal travel chains, with 26% of scooter trips replacing car trips.

The results indicated that shared e-scooters could contribute to reducing transport-related carbon emissions when integrated with public transport. However, the overall impact on emissions depended on factors such as the number of additional e-scooters and the share of car trips replaced. The demonstration showed that e-scooters have the potential to improve accessibility in areas with less dense public transport, though they are not suitable for all users, such as the elderly or disabled.

The Hamburg demonstration highlighted several critical insights. The scooters used in the project had removable batteries, and service operations were conducted using electric vans, contributing to lower lifecycle emissions. This approach was part of a broader strategy to link public mobility with sharing and on-demand services, as outlined in Hamburg's ITS strategy and the European Mobility Framework.

E-VANS

https://emobility.tools/

DESCRIPTION

Coradir is company created in 1995, dedicated to the development of electronic and computer equipment, the production of electric vehicles, among others. Founded in the city of San Luis, it focuses on the public and corporate sectors. It works especially with the national government and the different provincial governments. The company produces and sells electric vehicles, and counts with different vehicle models to suit various mobility needs.

ACHIEVEMENTS

Two electric pick-ups trucks of the "Tita" model were manufactured and provided for a pilot of logistics operations for agricultural purposes, in the context of the SOLUTIONSplus project. The vehicle allows a 500kg load and has an autonomy of 100km. In a pilot led by Asociacion Sustentar and the collaboration of the Municipality of Escobar, the electric pick-ups were used for harvesting and transporting food in the municipal Agro-ecological Gardens, with the aim of improving the delivery frequency of agricultural products to the community and with potential for replication and scaling-up in other municipal programs.

INNOVATION

Coradir's has the capacity for mass production of six models of electric vehicles, as counts with five manufacturing plants, 3500 sqm of production space, 120 job positions. Their vehicles have an autonomy of around 100 and 300 km and a charging time of 6-8 hours.

E-MOTORBIKES

http://www.eve-move.com

DESCRIPTION

E-motorbikes have emerged as a powerful solution for shared mobility, providing a sustainable and efficient alternative to traditional fuel-powered motorcycles. These electric motorbikes are particularly advantageous in urban environments, catering specifically to motorbike taxis. This factsheet provides a detailed guide on the production and development of e-motorbike taxis, incorporating insights and examples from the SOLUTIONSplus project, with a specific focus on the innovative efforts of Ampersand in Rwanda.

Key Components of E-Motorbike Taxis

The production of e-motorbike taxis involves the meticulous selection and integration of several critical components, including the frame, electric motor and battery system, control and monitoring systems, safety features, and additional elements such as wheels and suspension.

The frame of an e-motorbike is typically constructed from lightweight yet robust materials like aluminum or steel. The design focuses on durability and stability to handle various urban conditions and loads, with an emphasis on ensuring rider comfort and ease of maneuverability. These ergonomic designs are essential for navigating congested city streets and providing a comfortable ride for both the driver and passenger.

The electric motor and battery system are central to the e-motorbike's performance. High-efficiency brushless DC motors provide a balance of power and low maintenance. These motors are integrated into the drivetrain to offer smooth and reliable performance. High-capacity lithium-ion batteries are favored for their energy density and long lifespan, providing ranges from 50 km to over 100 km on a single charge. Fast-charging capabilities are often included to minimize downtime, which is crucial for continuous use in motorbike taxi services.

Control and monitoring systems are designed to enhance user experience and operational efficiency. A handlebar-mounted digital display provides real-time information on speed, battery level, and diagnostics. Advanced e-motorbikes may also feature connectivity options like Bluetooth or IoT, allowing integration with mobile apps for navigation, fleet management, and ride analytics. These features are particularly valuable for fleet operators managing large numbers of e-motorbike taxis.

Safety features are paramount for e-motorbikes, especially given their use in urban environments. These include hydraulic or mechanical disc brakes for effective stopping power, LED lights for visibility, and additional elements like reflectors and turn signals to enhance safety during rides. The construction includes a sturdy kickstand, anti-theft mechanisms, and a non-slip seat for rider stability.

Wheels and suspension systems significantly impact ride comfort and handling. E-motorbikes are typically equipped with durable, high-grip tires suitable for various road conditions. Suspension systems, including front and rear shock absorbers, help to cushion impacts from uneven surfaces, ensuring a smooth ride even on bumpy urban roads.

Production Process

The production of e-motorbike taxis follows several essential stages: design and

prototyping, sourcing and manufacturing, assembly and integration, customization and final adjustments, and distribution and deployment.

Design and prototyping begin with comprehensive market research to understand user needs and preferences. Insights are gathered on urban mobility patterns and existing vehicle offerings to identify market gaps and innovation opportunities. Based on this research, initial design concepts are developed, focusing on functionality, aesthetics, and user ergonomics. Prototypes are then created and subjected to extensive testing under various conditions to ensure they meet high standards of performance, safety, and durability. Feedback from these tests is used to refine the design before moving to full-scale production.

Sourcing and manufacturing involve selecting high-quality materials and components from reliable suppliers to ensure the durability and performance of the e-motorbikes. This includes selecting robust frames, efficient motors, and high-capacity batteries. The manufacturing facility is equipped with advanced machinery and tools to facilitate precise production processes. Quality control measures are rigorously implemented throughout the manufacturing stages to maintain consistency and high standards.

Assembly and integration bring together the various components of the e-motorbike. The frame is assembled first, followed by the installation of the motor and battery system. Control systems, including the digital display and connectivity modules, are then integrated. Safety features such as brakes and lights are installed last. Each assembled e-motorbike undergoes comprehensive testing to ensure all components function seamlessly together and meet performance standards.

Customization and final adjustments allow for tailoring the e-motorbikes to meet specific market needs. This may include adjusting battery capacities for different ranges, modifying frame designs for ergonomic considerations, or incorporating branding elements for shared mobility services. Final adjustments are made based on customer feedback and specific requirements, ensuring that the e-motorbikes are optimally configured for their intended use.

Distribution and deployment involve planning the logistics for distributing the e-motorbikes to various locations. This includes setting up warehouses and distribution centers in strategic areas to ensure timely delivery and deployment. Once deployed, the e-motorbikes are monitored to assess their performance in real-world conditions. Ongoing support and maintenance services are provided to ensure optimal operation and user satisfaction.

Business Model and Market Strategies

The target market for e-motorbike taxis includes urban commuters and operators of motorbike taxi services. E-motorbikes offer a convenient and eco-friendly mode of transport, reducing traffic congestion and emissions. Motorbike taxi operators benefit from the lower operational costs and environmental advantages of e-motorbikes, providing a sustainable transport option for urban areas.

Revenue streams can be generated through direct sales to individuals and businesses, leasing options for companies, and subscription models that offer access to e-motorbikes on a monthly or annual basis. Shared mobility services, where users pay per ride or via a membership plan, are also significant revenue sources.

Effective marketing and promotion strategies are crucial for success. Developing a strong brand identity that emphasizes sustainability, efficiency, and innovation is essential. Digital marketing strategies, including social media campaigns, influencer partnerships, and content marketing, help raise awareness and attract users. Collaborating with local businesses, government agencies, and environmental organizations can also promote e-motorbike usage.

Customer support and maintenance are vital for long-term success. Providing comprehensive support services, including user training, troubleshooting, and repair services, ensures high user satisfaction and retention. Regular maintenance plans help maintain the e-motorbikes in optimal condition, reducing downtime and extending their lifespan.

Case Study: Ampersand in Rwanda

Ampersand, a pioneering company in Rwanda, provides an exemplary case study of the successful production and deployment of e-motorbike taxis. Ampersand's mission is to deliver affordable and environmentally friendly transport solutions, focusing on the burgeoning market for motorbike taxis in East Africa.

Ampersand's electric motorbikes are designed to meet the specific needs of motorbike taxi operators. The vehicles feature high-capacity lithium-ion batteries, providing a range sufficient for a full day's work on a single charge. These batteries are designed for quick swapping, minimizing downtime and maximizing operational efficiency. This feature is particularly crucial for motorbike taxi services, where vehicle availability directly impacts income.

The e-motorbikes developed by Ampersand also include robust safety features, such as hydraulic disc brakes and LED lighting systems, ensuring safe operation in urban environments. The integration of IoT technology allows for real-time tracking and fleet management, enhancing operational efficiency and security. Ampersand's e-motorbikes have been rigorously tested to meet local regulatory standards, demonstrating reliable performance and safety.

Ampersand's business model includes both direct sales and leasing options, providing flexibility for motorbike taxi operators. The company has also implemented a battery swapping network, allowing riders to exchange depleted batteries for fully charged ones at designated stations. This network significantly reduces downtime and enhances the convenience of using electric motorbikes.

The success of Ampersand's e-motorbikes in Rwanda highlights the potential for innovation and impact in the e-mobility sector. By focusing on key components, adhering to a comprehensive production process, and implementing effective market strategies, Ampersand has developed successful e-motorbike solutions that address the unique challenges of urban transportation in East Africa.

The production of e-motorbike taxis tailored for shared mobility presents a significant opportunity for businesses to contribute to sustainable urban development. By focusing on key components, adhering to a comprehensive production process, and implementing effective market strategies, manufacturers can develop successful e-motorbike solutions. The example of Ampersand in Rwanda highlights the potential for innovation and impact, offering valuable lessons for new ventures in the e-mobility sector. Through careful planning and execution, e-motorbikes can play a crucial role in

enhancing urban mobility and reducing the environmental impact of transportation.

ELECTRIC MICRO-CARS

DESCRIPTION

Electric micro-vehicles are emerging as a versatile and eco-friendly solution for urban transportation, particularly well-suited for vehicle sharing programs. These compact vehicles offer an efficient alternative for short-distance travel, reducing traffic congestion and lowering emissions in city environments. This factsheet provides an in-depth guide on the production and development of electric micro-vehicles, with a focus on the exemplary work of GreenStar SRL in Uruguay.

Key Components of Electric Micro-Vehicles

The production of electric micro-vehicles involves the integration of several critical components, including the chassis, body, powertrain, control systems, and safety features.

The chassis of an electric micro-vehicle is typically constructed from steel, ensuring robustness and durability. The frame is designed to support the weight of the vehicle and its occupants while providing stability and safety. The use of steel also allows for a cost-effective manufacturing process while maintaining structural integrity.

The body of the micro-vehicle is often made from lightweight materials such as fiberglass. Fiberglass is chosen for its strength, lightweight properties, and resistance to corrosion, which enhances the vehicle's efficiency and longevity. The design of the body focuses on aerodynamics and user comfort, ensuring that the vehicle is suitable for urban environments. For instance, GreenStar's electric three-wheelers feature a fiberglass body that complements the steel chassis, providing a balance of durability and efficiency.

The powertrain is a crucial component of electric micro-vehicles, determining their performance and range. GreenStar initially sourced their powertrains from China, but later explored vehicle prototyping with powertrains provided by Valeo, a move that reflects their commitment to innovation and performance enhancement. The powertrain typically includes an electric motor, battery pack, and drivetrain components. High-efficiency electric motors are used for their reliability and low maintenance, while lithium-ion batteries are preferred for their high energy density and long cycle life. These batteries provide sufficient range for daily urban use, often exceeding 80 km on a single charge.

Control systems are designed to enhance the driving experience and operational efficiency. These systems include a digital dashboard that displays real-time information such as speed, battery level, and diagnostics. Advanced micro-vehicles may also feature connectivity options like Bluetooth or IoT, allowing integration with mobile apps for navigation, ride statistics, and fleet management. This connectivity is particularly useful in vehicle sharing programs, where efficient management of the fleet is crucial.

Safety features are integral to the design of electric micro-vehicles. These include braking systems, typically a combination of regenerative and mechanical brakes, for effective stopping power. LED lights and reflective markings enhance visibility, while additional elements such as seat belts, roll bars, and robust frames ensure passenger safety. GreenStar's vehicles, for instance, have been tested to meet the safety and regulatory requirements for urban use, demonstrating reliable performance and safety standards.

Production Process

The production of electric micro-vehicles follows several essential stages: design and prototyping, sourcing and manufacturing, assembly and integration, customization and final adjustments, and distribution and deployment.

Design and prototyping begin with comprehensive market research to understand the specific needs of urban users and vehicle-sharing programs. Insights are gathered on user preferences, urban mobility patterns, and existing vehicle offerings to identify market gaps and innovation opportunities. Based on this research, initial design concepts are developed, focusing on functionality, ergonomics, and aesthetics. Prototypes are then created and subjected to extensive testing under various conditions to ensure they meet high standards of performance, safety, and durability. Feedback from these tests is used to refine the design before moving to full-scale production. For instance, GreenStar explored vehicle prototyping with Valeo powertrains, resulting in the successful development of a new four-wheeler prototype tested on a bench.

Sourcing and manufacturing involve selecting high-quality materials and components from reliable suppliers to ensure the durability and performance of the micro-vehicles. This includes sourcing robust steel frames, efficient motors, and high-capacity batteries. The manufacturing facility is equipped with advanced machinery and tools to facilitate precise production processes. Rigorous quality control measures are implemented throughout the manufacturing stages to maintain consistency and high standards.

Assembly and integration bring together the various components of the micro-vehicle. The steel chassis is assembled first, followed by the installation of the motor and battery system. Control systems, including the digital dashboard and connectivity modules, are then integrated. Safety features such as brakes and lights are installed last. Each assembled micro-vehicle undergoes comprehensive testing to ensure all components function seamlessly together and meet performance standards.

Customization and final adjustments allow for tailoring the micro-vehicles to meet specific market needs. This may include adjusting battery capacities for different ranges, modifying interior designs for ergonomic considerations, or incorporating branding elements for vehicle-sharing programs. Final adjustments are made based on customer feedback and specific requirements, ensuring that the micro-vehicles are optimally configured for their intended use.

Distribution and deployment involve planning the logistics for delivering the micro-vehicles to various locations. This includes setting up warehouses and distribution centers in strategic areas to ensure timely delivery and deployment. Once deployed, the micro-vehicles are monitored to assess their performance in real-world conditions. Ongoing support and maintenance services are provided to ensure optimal operation and user satisfaction.

Business Model and Market Strategies

The target market for electric micro-vehicles includes urban commuters, vehicle-sharing programs, and businesses requiring efficient transport solutions for goods and services. For urban commuters, micro-vehicles offer a convenient and eco-friendly mode of transport, reducing traffic congestion and emissions. Vehicle-sharing programs benefit from the flexibility and efficiency of micro-vehicles, providing an accessible transport option for short-distance travel. Businesses that require transport solutions for goods

and services can leverage micro-vehicles to enhance their operations.

Revenue streams can be generated through direct sales to individuals and businesses, leasing options for companies that prefer not to purchase outright, and subscription models that offer access to micro-vehicles on a monthly or annual basis. Shared mobility services, where users pay per ride or via a membership plan, are also significant revenue sources.

Effective marketing and promotion strategies are crucial for success. Developing a strong brand identity that emphasizes sustainability, efficiency, and innovation is essential. Digital marketing strategies, including social media campaigns, influencer partnerships, and content marketing, help raise awareness and attract users. Collaborating with local businesses, government agencies, and environmental organizations can also promote micro-vehicle usage.

Customer support and maintenance are vital for long-term success. Providing comprehensive support services, including user training, troubleshooting, and repair services, ensures high user satisfaction and retention. Regular maintenance plans help maintain the micro-vehicles in optimal condition, reducing downtime and extending their lifespan.

Case Study: GreenStar in Uruguay

GreenStar SRL, a small and medium-sized enterprise (SME) in Uruguay, provides an exemplary case study of the successful production and deployment of electric micro-vehicles. GreenStar produces electric three-wheelers with a steel-framed chassis and a fiberglass body. Initially, the powertrain components were acquired from China, but the company later explored vehicle prototyping with Valeo powertrains as part of the SOLUTIONSplus project.

GreenStar's electric three-wheelers have demonstrated significant achievements in urban environments. The vehicles offer more than 80 km of autonomy on a single charge, making them suitable for daily use. They are well adapted to urban settings, responding effectively to acceleration demands and meeting safety and regulatory requirements. However, the lack of lateral windows and glass presents a challenge during rainy conditions, a point of feedback that GreenStar is addressing to improve the vehicle's all-weather usability.

The vehicles' load capacity is another notable advantage, accommodating two passengers and more than 200 kg of cargo, with a volume of 250 liters. This capacity surpasses that of many similar urban vehicles available in Montevideo. The ease of entry and exit, straightforward driving experience, and convenient parking, loading, and unloading make GreenStar's micro-vehicles highly practical for urban logistics and vehicle-sharing programs.

GreenStar's innovation in prototyping with Valeo powertrains has led to the development of a new four-wheeler vehicle, which has been successfully tested on a bench. This ongoing commitment to innovation and improvement positions GreenStar as a leader in the electric micro-vehicle market, ready to expand into new markets, including the USA.

The production of electric micro-vehicles tailored for urban logistics and vehicle sharing presents a significant opportunity for businesses to contribute to sustainable urban development. By focusing on key components, adhering to a comprehensive production

process, and implementing effective market strategies, manufacturers can develop successful micro-vehicle solutions. The example of GreenStar in Uruguay highlights the potential for innovation and impact, offering valuable lessons for new ventures in the e-mobility sector. Through careful planning and execution, electric micro-vehicles can play a crucial role in enhancing urban mobility and reducing the environmental impact of transportation.

E-BUSES

DESCRIPTION

Electric buses (e-buses) offer a sustainable and efficient solution for urban transportation, significantly reducing greenhouse gas emissions and air pollution compared to traditional diesel-powered buses. This factsheet provides a detailed guide on the production and development of e-buses, incorporating insights and examples from the SOLUTIONSplus project, focusing on the bus conversion demonstration in Kathmandu and the electric buses operated by BasiGo in Kigali.

Key Components of Electric Buses

The production of electric buses involves the integration of several critical components, including the chassis, electric motor and battery system, control and monitoring systems, safety features, and additional elements such as wheels and suspension. The chassis of an e-bus is typically constructed from high-strength steel or aluminum alloys, ensuring robustness and durability. The design focuses on providing a stable platform capable of supporting the heavy batteries and electric motor while maintaining passenger comfort. The structural integrity of the chassis is crucial for ensuring safety and longevity under the rigorous demands of urban transit.

The electric motor and battery system are central to the e-bus's performance. High-efficiency electric motors are chosen for their reliability and low maintenance requirements. These motors are usually integrated into the drivetrain, providing smooth and powerful acceleration suitable for stop-and-go urban traffic. Lithium-ion batteries are preferred for their high energy density and long lifespan, with capacities sufficient to provide ranges from 100 km to over 300 km on a single charge. Fast-charging capabilities are essential for maintaining operational efficiency, especially for buses that need to be in service throughout the day. Control and monitoring systems enhance the operational efficiency and driver experience. A dashboard-mounted digital display provides real-time information on speed, battery level, route navigation, and diagnostic alerts. Advanced e-buses often feature connectivity options such as GPS tracking and IoT integration, allowing for fleet management and route optimization. These systems enable transit operators to monitor vehicle performance and optimize routes and schedules. Safety features are paramount for e-buses, given their role in public transportation. These include advanced braking systems, such as regenerative braking combined with mechanical brakes, for effective stopping power. LED lights and reflective markings enhance visibility, while additional elements such as passenger seat belts, emergency exits, and reinforced body structures ensure safety. E-buses are also equipped with modern safety systems like collision avoidance and electronic stability control.

The suspension system significantly impacts ride comfort and handling. E-buses are typically equipped with advanced suspension systems, including air suspension, which can be adjusted for different loads and road conditions. This ensures a smooth and comfortable ride for passengers, even on uneven urban roads.

Production Process

The production of electric buses follows several essential stages: design and prototyping, sourcing and manufacturing, assembly and integration, customization and final adjustments, and distribution and deployment.

Design and Prototyping: The process begins with comprehensive market research to

understand user needs and preferences. Insights are gathered on urban mobility patterns and existing vehicle offerings to identify market gaps and innovation opportunities. Based on this research, initial design concepts are developed, focusing on functionality, ergonomics, and aesthetics. Prototypes are then created and subjected to extensive testing under various conditions to ensure they meet high standards of performance, safety, and durability. Feedback from these tests is used to refine the design before moving to full-scale production.

Sourcing and Manufacturing: High-quality materials and components are sourced from reliable suppliers to ensure the durability and performance of the e-buses. This includes sourcing robust chassis, efficient motors, and high-capacity batteries. The manufacturing facility is equipped with advanced machinery and tools to facilitate precise production processes. Rigorous quality control measures are implemented throughout the manufacturing stages to maintain consistency and high standards.

Assembly and Integration: The assembly process involves bringing together the various components of the e-bus. The chassis is assembled first, followed by the installation of the motor and battery system. Control systems, including the digital display and connectivity modules, are then integrated. Safety features such as brakes and lights are installed last. Each assembled e-bus undergoes comprehensive testing to ensure all components function seamlessly together and meet performance standards.

Customization and Final Adjustments: Customization options allow for tailoring the e-buses to meet specific market needs. This may include adjusting battery capacities for different ranges, modifying interior designs for ergonomic considerations, or incorporating branding elements for transit operators. Final adjustments are made based on customer feedback and specific requirements, ensuring that the e-buses are optimally configured for their intended use.

Distribution and Deployment: This stage involves planning the logistics for distributing the e-buses to various locations. This includes setting up warehouses and distribution centers in strategic areas to ensure timely delivery and deployment. Once deployed, the e-buses are monitored to assess their performance in real-world conditions. Ongoing support and maintenance services are provided to ensure optimal operation and user satisfaction.

Business Model and Market Strategies

The target market for e-buses includes urban public transportation systems, private transit operators, and businesses requiring efficient transport solutions for large groups. E-buses offer a reliable and eco-friendly mode of transport, reducing operational costs and emissions. Public transit operators benefit from the lower maintenance costs and environmental advantages of e-buses, providing a sustainable transport option for urban areas.

Revenue streams can be generated through direct sales to transit authorities and private operators, leasing options for companies that prefer not to purchase outright, and subscription models that offer access to e-buses on a monthly or annual basis. Effective marketing and promotion strategies are crucial for success. Developing a strong brand identity that emphasizes sustainability, efficiency, and innovation is essential. Digital marketing strategies, including social media campaigns, influencer partnerships, and content marketing, help raise awareness and attract users. Collaborating with local governments, environmental organizations, and businesses can also promote e-bus

usage.

Customer support and maintenance are vital for long-term success. Providing comprehensive support services, including driver training, troubleshooting, and repair services, ensures high user satisfaction and retention. Regular maintenance plans help maintain the e-buses in optimal condition, reducing downtime and extending their lifespan.

Case Study: Kathmandu Demonstration and BasiGo in Kigali

The SOLUTIONSplus project's demonstration in Kathmandu involved the conversion of an old diesel mini-bus into an e-bus. This conversion primarily focused on replacing the drive system components, such as the motor, transmission, and rear axle, with imported components, while assembly took place locally. The project aimed to showcase the financial and technical feasibility of converting existing diesel buses to electric, thus reducing the capital cost of e-mobility in this sector. The converted bus demonstrated significant emission reductions and operational cost savings, validating the approach of retrofitting older buses to meet modern e-mobility standards.

In Kigali, BasiGo has successfully deployed electric buses for urban transit. These buses feature advanced motor systems, high-capacity batteries, and comprehensive safety features. BasiGo's e-buses are designed for efficient urban transit, providing reliable service with lower operational costs and environmental benefits. The buses are equipped with IoT connectivity for real-time monitoring and fleet management, ensuring optimal performance and route optimization. BasiGo's business model includes leasing options and subscription services, making electric buses accessible to a broader range of operators. The successful deployment of BasiGo's e-buses in Kigali highlights the potential for electric buses to transform urban transit systems, offering significant benefits in terms of sustainability, efficiency, and cost-effectiveness.

The production of electric buses tailored for urban transit presents a significant opportunity for businesses to contribute to sustainable urban development. By focusing on key components, adhering to a comprehensive production process, and implementing effective market strategies, manufacturers can develop successful e-bus solutions. The examples from the SOLUTIONSplus project in Kathmandu and BasiGo in Kigali highlight the potential for innovation and impact, offering valuable lessons for new ventures in the e-mobility sector. Through careful planning and execution, electric buses can play a crucial role in enhancing urban mobility and reducing the environmental impact of transportation.

E-TUK-TUKS

DESCRIPTION

Electric three-wheelers, commonly known as tuk-tuks, offer a versatile and sustainable solution for urban mobility, particularly in densely populated areas. These vehicles are ideal for a variety of applications, including passenger taxis, on-demand delivery services, garbage collection, and more. This factsheet provides a detailed guide on the production and development of electric three-wheelers, incorporating insights and examples from the SOLUTIONSplus project, with a specific focus on EKOglobe's initiatives in Tanzania.

Key Components of Electric Three-Wheelers

The production of electric three-wheelers involves the integration of several critical components, including the chassis, electric motor and battery system, control and monitoring systems, safety features, and additional elements such as cargo handling equipment and suspension systems. The chassis of an electric three-wheeler is typically constructed from high-strength steel to ensure durability and the ability to handle various loads. The design focuses on providing a stable platform that can support the weight of the vehicle, passengers, or cargo while maintaining maneuverability. This robust structure is essential for ensuring safety and longevity in urban environments where vehicles are subject to frequent starts and stops.

The electric motor and battery system are central to the vehicle's performance. EKOglobe utilizes high-efficiency electric motors known for their reliability and low maintenance requirements. These motors are integrated into the drivetrain, providing smooth and powerful acceleration suitable for urban traffic. Lithium-ion batteries are preferred for their high energy density and long lifespan, with capacities sufficient to provide a range of 50 km to over 100 km on a single charge. Fast-charging capabilities are essential for maintaining operational efficiency, especially for vehicles that need to be in service throughout the day. Control and monitoring systems enhance operational efficiency and user experience. A handlebar-mounted digital display provides real-time information on speed, battery level, route navigation, and diagnostic alerts. Advanced three-wheelers may also feature connectivity options such as GPS tracking and IoT integration, allowing for fleet management and route optimization. These systems enable operators to monitor vehicle performance and optimize operations effectively.

Safety features are paramount for electric three-wheelers, given their role in public and commercial transportation. These include advanced braking systems, such as regenerative braking combined with mechanical brakes, for effective stopping power. LED lights and reflective markings enhance visibility, while additional elements such as seat belts, emergency exits, and reinforced body structures ensure passenger safety. EKOglobe's vehicles are designed to meet safety and regulatory requirements, ensuring reliable performance in urban environments. The suspension system significantly impacts ride comfort and handling. Electric three-wheelers are typically equipped with advanced suspension systems that can handle the additional weight of the batteries and the cargo, ensuring durability and comfort even on uneven urban roads.

Production Process

The production of electric three-wheelers follows several essential stages: design and prototyping, sourcing and manufacturing, assembly and integration, customization and final adjustments, and distribution and deployment.

Design and Prototyping: The process begins with comprehensive market research to

understand user needs and preferences. Insights are gathered on urban mobility patterns and existing vehicle offerings to identify market gaps and innovation opportunities. Based on this research, initial design concepts are developed, focusing on functionality, ergonomics, and aesthetics. Prototypes are then created and subjected to extensive testing under various conditions to ensure they meet high standards of performance, safety, and durability. Feedback from these tests is used to refine the design before moving to full-scale production.

Sourcing and Manufacturing: High-quality materials and components are sourced from reliable suppliers to ensure the durability and performance of the three-wheelers. This includes sourcing robust chassis, efficient motors, and high-capacity batteries. The manufacturing facility is equipped with advanced machinery and tools to facilitate precise production processes. Rigorous quality control measures are implemented throughout the manufacturing stages to maintain consistency and high standards. In the case of EKOglobe, some components are manufactured locally while others are imported.

Assembly and Integration: The assembly process involves bringing together the various components of the three-wheeler. The chassis is assembled first, followed by the installation of the motor and battery system. Control systems, including the digital display and connectivity modules, are then integrated. Safety features such as brakes and lights are installed last. Each assembled three-wheeler undergoes comprehensive testing to ensure all components function seamlessly together and meet performance standards.

Customization and Final Adjustments: Customization options allow for tailoring the three-wheelers to meet specific market needs. This may include adjusting battery capacities for different ranges, modifying interior designs for ergonomic considerations, or incorporating branding elements for commercial services. Final adjustments are made based on customer feedback and specific requirements, ensuring that the three-wheelers are optimally configured for their intended use.

Distribution and Deployment: This stage involves planning the logistics for distributing the three-wheelers to various locations. This includes setting up warehouses and distribution centers in strategic areas to ensure timely delivery and deployment. Once deployed, the three-wheelers are monitored to assess their performance in real-world conditions. Ongoing support and maintenance services are provided to ensure optimal operation and user satisfaction.

Business Model and Market Strategies

The target market for electric three-wheelers includes urban commuters, delivery services, and operators of motorbike taxis. EKOglobe's business model includes leasing options and direct sales, providing flexibility for operators. Revenue streams can be generated through direct sales to individuals and businesses, leasing options for companies, and subscription models that offer access to three-wheelers on a monthly or annual basis. Shared mobility services, where users pay per ride or via a membership plan, are also significant revenue sources. Effective marketing and promotion strategies are crucial for success. Developing a strong brand identity that emphasizes sustainability, efficiency, and innovation is essential. Digital marketing strategies, including social media campaigns, influencer partnerships, and content marketing, help raise awareness and attract users. Collaborating with local businesses, government agencies, and environmental organizations can also promote the use of electric three-wheelers.

Customer support and maintenance are vital for long-term success. Providing comprehensive support services, including driver training, troubleshooting, and repair services, ensures high user satisfaction and retention. Regular maintenance plans help maintain the three-wheelers in optimal condition, reducing downtime and extending their lifespan.

Case Study: EKOglobe in Tanzania

EKOglobe, a cleantech company operating at the intersection of green mobility, solar rooftop installations, and capacity building, provides an exemplary case study of the successful production and deployment of electric three-wheelers in Tanzania. Operating in Dar es Salaam, Dodoma, and Iringa, EKOglobe designs and assembles electric three-wheelers for various applications, including passenger taxis, deliveries, on-demand delivery services, garbage collection, mobile solar water pumps, and milk chilling, all powered by 100% green energy.

EKOglobe embarked on electric mobility projects in 2022 by testing electric tricycles mounted with solar refrigerators and studying the market for taxi services with three-wheelers (bajajs). By January 2023, the company began manufacturing some components locally while importing others. They assembled and tested a total of 10 units, demonstrating their capability in producing reliable electric three-wheelers. As part of the SOLUTIONSplus project, EKOglobe assembled 12 electric three-wheelers for passenger services and trained 12 drivers. These vehicles were dispatched to 10 drivers offering taxi services on a lease-to-own basis with daily mobile money payments and battery exchange fees. This model ensures accessibility and affordability for drivers while promoting sustainable urban mobility. EKOglobe has also innovated in the area of battery recharging solutions. By using two three-wheelers as mobile battery dispatching units, EKOglobe tests an innovative recharging solution previously tested in India but not yet in East Africa. The technical specifications and routes for the pilot are based on the 2023 SOLUTIONSplus feasibility study to electrify existing three-wheelers near BRT stations.