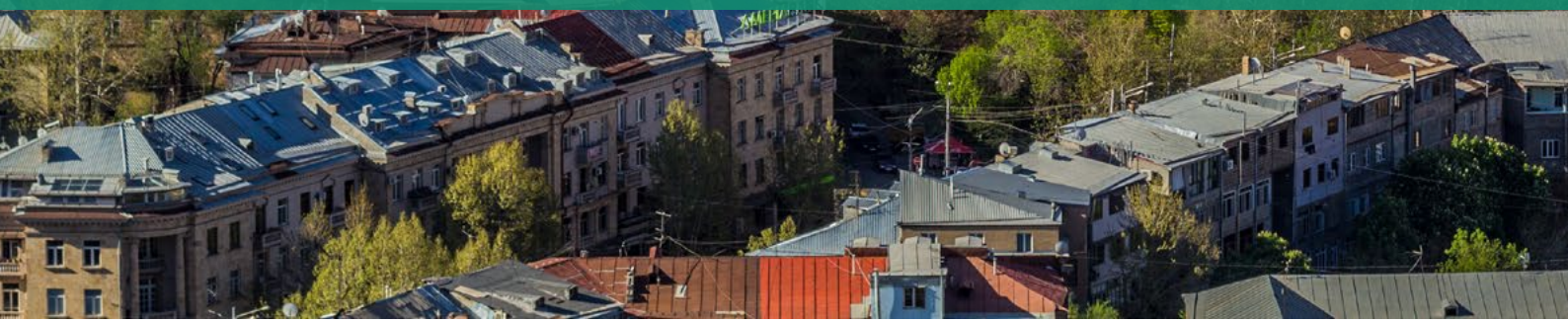
CITY ROADMAP FOR E-MOBILITY

ELECTRIC VEHICLE CHARGING IN YEREVAN



This project has received funding from the European Union Horizon 2020 research and innovation Programme under grant agreement no. 875041

PROJECT PARTNERS

ABOUT

To present a roadmap to upscale electric vehicle charging in Yerevan, Armania

TITLE

City Roadmap for Electric Vehicle charging in Yerevan

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DISCLAIMER

The views expressed in this publication are the sole responsibility of the authors named and do not necessarily reflect the views of the European Commission.

LAYOUT

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PICTURES

All the pictures are provided by the SOL+ partners

June, 2024

City Roadmap for E-mobility

Electric Vehicle charging in Yerevan

Yerevan, Armenia

July 2024

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Executive Summary

The transition to electric mobility is already gaining momentum in Yerevan. By the first half of 2023, a total of 7 688 of electric passenger light vehicles, representing roughly half a percent of the vehicle fleet, and 11 171 electric mopeds had been imported into Armenia. As the city of Yerevan hosts around a third of Armenia's population, a large proportion of these electric vehicles are circulating in Yerevan. Charging infrastructure is still in an early stage of development, there are no live statistics on the number of charging stations present, but estimations suggest there are at least 131 public charging stations in the whole of Armenia, 50 of which are in Yerevan. Of these 50 stations, 18 are fast charging stations. It is estimated that around 90% of charging takes place by private charging.

In contrast to these figures and in contrast to national policy efforts, EV policy development at city level in Yerevan is still nascent. Enhanced policy action is necessary not only to seize opportunities for societal cost savings and to reduce air pollution, but also to respond to increased pressure from major technology developments at the global level, clearly pointing towards increased electrification of road vehicles. Yerevan, with a young and educated population, has become a regional hub for tech companies, including several startups working in the e-mobility space, and is well placed to become a regional leader in the transition to e-mobility. Electrification of transport also reflects national interests, to reduce its dependency on fossil fuel imports and its associated price volatility. Therefore, in order to capitalize on the electrification trend that has already started within the city, and to guide it in the right direction, the city should take action to develop a supporting EV policy framework.

Though there are comprehensive national government regulations that promote the electrification of mobility in Armenia, affecting the car fleet in particular, there is not sufficient detail to support the roll-out of this new technology across all vehicle segments at the city level, and in particular the roll-out of the much-needed public charging infrastructure. The national EV policy framework has elaborate targets for vehicle electrification and charging infrastructure roll out, supported by financial support mechanisms as well as concrete fiscal and non-fiscal measures. The latter includes an obligation for economic entities operating existing public parking spaces to provide at least 10% of the total number of parking spaces with charging stations by January 1, 2025, which will directly affect the roll-out of charging infrastructure in Yerevan. At city level, the first EV policy measure of an exemption for parking fees for electric vehicles has already been implemented, but there is a need of a more robust EV policy framework.

The goal of this roadmap is to provide some recommendations to the City of Yerevan for the development of such an EV policy framework, but limited to four focus areas relevant to the SOLUTIONSplus project that are relevant to the city and could be considered as priorities. These focus areas are selected to complement the national EV strategy, including the electrification of highly utilized vehicles, supporting the integration of this new technology in society by increasing awareness and public acceptance and the availability of affordable EVs, and ensuring that the roll-out of charging infrastructure will be guided and supported by a comprehensive and well-planned roll-out strategy. The following four focus areas are proposed:

Focus area 1: Charging infrastructure. Given the long lead times for public charging infrastructure development and given its indispensability for the uptake of electric mobility, the development of an

EV charging infrastructure strategy is a key priority for Yerevan. Required actions are, amongst others: to set geospatial targets for charging infrastructure development, detailed for slow, fast and ultra-fast charging; a vision for the development of public-private partnerships; the organization of electricity supply and grid connections; and a management plan and a financial support plan.

Focus area 2: Availability and affordability of EVs. A key issue indicated by the City of Yerevan is the availability of affordable EVs. Addressing this requires incentivizing both the price of the vehicles as well as the affordability of capital, next to stimulating the import of affordable EV models. This is primarily a national policy focus, but given the important role that Yerevan plays in the country, and given the urgency of this issue, it is nonetheless selected as a key priority for this roadmap.

Focus area 3: Early transition of highly utilized vehicles. Buses and minibuses, freight delivery vehicles, and taxis are the vehicle segments where the most kilometres per vehicle are driven in Yerevan, and where the impact of electrification could therefore be the highest. Yerevan could prioritize setting electrification targets and requirements for these vehicles segments and the implementation of measures such as a zero-emission zone.

Focus area 4: Education and training. Public acceptance of EVs and awareness of the technology for consumers' first points of contact, such as car dealers and car repair shops, are essential. Additionally, skilled professionals are needed for the whole EV ecosystem, from government and policymaking, advisory, engineering, electricians to maintenance level work. The City of Yerevan could consider taking an active role in promoting this. It could make budget available to support information campaigns and training programs for the different technical areas and aimed at different local communities.

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List of Abbreviations

2w: Two-Wheelers

EV: Electric Vehicle

CBD: Central Business District

CNG: Compressed Natural Gas

CO_2: Carbon Dioxide

GCF: Green Climate Fund

GEF: Global Environment Facility

GHG: Greenhouse Gas

ICE: Internal Combustion Engine

LEZ: Low Emission Zone

MRV: Monitoring, Reporting, And Verification

PM: Particulate Matter

PTO: Public Transport Operator

SUMP: Sustainable Urban Mobility Plan

TCO: Total Cost f Ownership

ZEV: Zero Emission Vehicle

ZEZ: Zero Emission Zone

Acknowledgements

Coordination	UNEP
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ACKNOWLEDGEMENTS

This document is issued under the SOLUTIONSplus project, which is funded by the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 875041.

the SOLUTIONSplus Consortium Grant Agreement provisions.

1. Background – Where are we now?

1.1. Urban mobility context in Yerevan

Armenia is a relatively small country in the Caucasus region with a population of around 3.2 million. Yerevan, the capital city, hosts a third of the country's inhabitants (1.1 million), meaning that city and national level interests are strongly linked. Armenia's economic growth is strong and steady, with an annual GDP growth of 5.8 in 2022 and 12.6 in 2023 (World Bank, 2024).

Armenia's economy is dominated by the services sector and the country is committed to economic reforms, as a result Yerevan is prioritizing innovation and developing rapidly. It has a young and educated population and as such Yerevan has become a regional hub for tech companies, including several startups working in the e-mobility space.

The transport sector of both Armenia and Yerevan is heavily focused on road transport, dominated by cars for passenger transport and the majority of freight transport is done by conventional trucks (Table 1). Motorized transport inside Yerevan is similarly mainly attributed to cars, buses and minibuses and freight delivery vehicles. The car fleet in Armenia is comprised of aged and inefficient vehicles that are largely imported from other countries (there is no domestic automotive manufacturing industry in Armenia). A significant portion of the car fleet is imported as a second-hand vehicle from other regions, and in 2018 90% of imported second-hand cars were older than 10 years (Chibukhchyan, 2019). Many of the cars have been converted to natural gas. Indeed, in the last two decades Armenia has successfully pursued to convert a significant portion of its vehicle fleet to natural gas, to match the strong investments in the natural gas sector over this period. In fact, Armenia is now one of the leading countries globally in the use of natural gas for the transport sector. In 2016, nearly 80% of its vehicles were running on natural gas, but according to more recent estimates this figure had reduced to somewhere between 27% and 53% in 2020 (Republic of Armenia, 2024). Natural gas is imported from Russia via pipeline through Georgia, but also from Iran through a barter agreement under which it exports electricity in exchange (International Energy Agency, 2023). Since the transport sector overall is heavily reliant on fossil fuel imports, it is exposed to price and demand fluctuation risks.

Vehicle segment	Number of vehicles registered in 2020
Cars	726.026
Trucks	88.097
Buses	11.450
Special purpose vehicles	5.964
Other vehicles	19.154
Total	850.691

Table 1: number of vehicles in registered in Armenia in 2020 (Republic of Armenia, 2024)

While official statistics on this do not exist, it is said that more than half of all cars in the country are concentrated in Yerevan (Chibukhchyan, 2019). The public transport system in Yerevan is outdated and less attractive for people to use, with inconsistent servicing and an ageing bus fleet. The minibus (10-13 person vans) is one of the most popular public transport modes in Yerevan, but larger buses do also operate in the city. A survey on Yerevan's public transport system, with 3000 respondents,

indicated that one-third of respondents is willing to pay more for improved public transport services (Transport for Armenia, 2019). 43% of respondents say that they use a private taxi a few times a week due to insufficient capacity of buses and minibuses. Yet the greatest issue recognized by 77% of respondents is the low capacity of vehicles. Yerevan also has a metro line with 10 stations, and in 2019 79 trolleybuses operated in the city (Chibukhchyan, 2019). While there is sufficient demand for a more extensive metro system in Yerevan, this is difficult to realize due to the exceptionally high costs for extending the metro system. This is attributable to the fact that Yerevan is located in mountainous terrain which requires metro lines to be built at very high depths below the ground, significantly adding to the investment costs needed for such a system.

In stark contrast with the transport sector, the electricity sector is already relatively advanced in terms of decarbonization, as 56% of the electricity supply comes from low-carbon sources. Armenia has one of the cleanest grids in the region. Almost one-third of the country's electricity generation is considered renewable energy, the majority of which comes from hydropower, supplemented by wind, solar and bioenergy. Nuclear energy accounts for 26% of Armenia's electricity mix and the remainder is supplied by natural gas (44%). The abundance of cheap and low-carbon electricity gives Armenia a competitive advantage when it comes to the transition to electric mobility. Also, the country has electricity infrastructure built out throughout the country and all citizens have access to the network.

Whilst the electricity sector is already relatively clean, the transportation sector, which is still fully relying on fossil fuel, is the country's largest contributor to GHG emissions. According to the IEA, transport accounts for 25% of energy-related CO2 emissions, followed by power generation (18%), the residential sector (18%), the commercial sector (8%), manufacturing (7%) and agriculture (1%) (International Energy Agency, 2023). There are also 23% fugitive emissions from natural gas, some of which are also attributable to the transport sector. GHG emissions from the transport sector are also growing rapidly, they increased by 63% between 2010 and 2019 (Republic of Armenia, 2024).

Electric mobility is slowly gaining traction in Armenia. While in 2017 only 29 cars were imported into the country, in the first half of 2023 this number had already grown to 2 604 (Figure 1), leading to a total of 7 688 of passenger light vehicles imported into the country. However, it is unclear if all of these imported vehicles are in circulation in Armenia. Indeed, according to official data from the Armenian national traffic police, in March 2023 3 427 electric light passenger vehicles were in operation (Table 2). It is possible some of the electric vehicles imported into Armenia were exported to other countries. As the overall car fleet in Armenia totals 726 000 vehicles (Table 1), this means that roughly less than half a percent of the car fleet is currently electrified. Next to the electric vehicles, also 11 171 electric mopeds had been imported into Armenia by the first semester of 2023 (Figure 1). While the share of electric vehicle imports is therefore still small, the growth witnessed to date holds promise for further development of the e-mobility sector, if supported by an enabling policy environment.

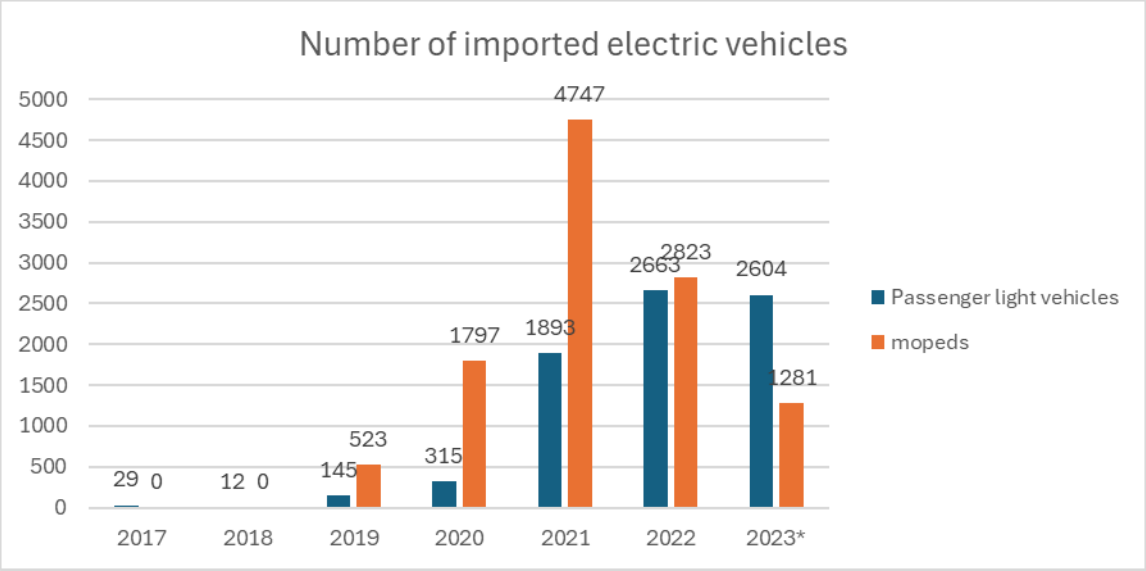

Figure 1: Number of imported electric vehicles in Armenia between 2017 and 2023. *2023 only includes the first half of the year. Source: (Republic of Armenia, 2024)*

Light passenger vehicle	3.427
Truck	11
Bus	13
Special	2
Other	1
Total	3.454

Table 2: number of registered electric vehicles in the Republic of Armenia in March 2023 according to the national traffic police. Source: (Republic of Armenia, 2024)

The City of Yerevan regards electrification of its bus fleet as a key pillar to promote its sustainable public transport agenda. There are currently 877 buses and 100 minibuses in Yerevan's bus fleet, of which 570-580 and 60-65 respectively are in circulation on a daily basis in Yerevan (Republic of Armenia, 2024). In Yerevan there are 56 electric trolleybuses, with 40-45 in operation daily, serving 7 routes. With funding from the European Bank for Reconstruction and Development, plans are underway to acquire 250 12-meter electric buses (Cities Development Initiative for Asia, 2024). According to the statistics, a total of 40 battery electric buses were imported into the country (in 2020) (Republic of Armenia, 2024), but according to statistics by the national traffic police only 13 of those were in circulation in March 2023 (Table 2).

Charging infrastructure is still limited in Yerevan, there are no official statistics on the number of charging stations present, but estimations suggest there are around 131 public charging stations in the whole of Armenia, 50 of which are in Yerevan (Republic of Armenia, 2024). Of these 50 stations, 18 are fast charging stations. It is estimated that around 90% of charging takes place by private charging.

Due to the large quantity of motorized vehicles running on fossil fuels, the city of Yerevan is currently dealing with severe air pollution, which poses a threat to its public health. The city is located in a

valley surrounded by mountains, which traps emissions and particulate matter inside the city, worsening the effect. Besides, leakage and unburned natural gas that comes from natural gas vehicles has a warming potential that is 20-30 higher than that of burned natural gas (taking the form of CO_2), adding to the climate budget of the city. Tackling emissions and air pollution is therefore a key driver of the city in their transport policy.

1.2. Current Policy Framework and Market Readiness for deployment of e- mobility

The Armenian government has recently given a lot of attention to the topic of electric mobility and developed comprehensive policies targeting this sector. At city level, policy development focused on promoting electric mobility is still more nascent in Yerevan. But the first step towards promoting electric mobility has been taken. The City of Yerevan currently has implemented discounted parking fees for electric vehicles (City of Yerevan, 2017).

Beyond this, the effects of the more comprehensive national EV policy framework will also be felt in the city. With its five-year activity plan for 2021-2026, the government has prioritized the development of electric mobility and the formation of a favorable ecosystem (Republic of Armenia, 2024). In this light, the Armenian government has recently adopted both the “Strategy for the Development of Electric Mobility in the Republic of Armenia" and the "Policy for the Development of Electric Mobility in the Republic of Armenia". This comprehensive EV policy framework was developed with support from UNEP through the GEF 7 program. It includes comprehensive targets (see list below), a set of financial and non-financial incentives to promote the uptake of electric vehicles and charging infrastructure.

To guide their EV policy framework, the government defined the following policy targets, to be reached by 2030 (Republic of Armenia, 2024):

1. Increase the number of electric cars to 50,000[1] units
2. Increase the number of high-speed charging stations installed along interstate highways up to 300 units
3. Promote the creation of at least 1 electric vehicle technical service center in each region
4. Promote the creation of at least 1 electric vehicle assembly plant
5. Promote the creation of at least 3 manufacturers for the production of chargers for electric vehicles
6. Replacement of at least 50% of the vehicle fleet of state and municipal services with electric vehicles
7. Promote the creation of at least 1 production facility for recycling electric vehicle batteries (electronic waste).

In order to support the targets, the following supportive measures, below, have been defined in the aforementioned Strategy and Policy for Armenia (Republic of Armenia, 2024). *(These measures have*

[1] Which is estimated to be about 12 percent of the total passenger cars

been translated by the roadmap authors from the Armenian language, and verified with in-country contacts where possible, but mistranslations or misinterpretations may still be present).

Fiscal incentives

- An EV purchase subsidy is provided for the purchase of new electric cars worth up to 10 million AMD.
- From 2035, car entry permits for each ICE vehicle will be 1 000 AMD.
- A full ban on ICE importation/registration will be implemented by 2040.
- For fast charging stations in remote areas, subsidies will be provided for investment costs, and they will benefit from a reduced electricity rate.

Promotion of favorable lending instruments

- At the expense of funds raised from multilateral development banks, climate funds, and donor organizations, to contribute to reducing interest on loans for the purchase of electric vehicles to 5% per annum.
- For companies engaged in investment activities in the field of electric mobility, subsidize credit interest (in the amount of 3% per annum) and allocate targeted grants for investment programs worth more than 2 billion AMD, which are aimed at creating a network of high-speed charging stations, as well as the production of electric vehicles and their components.

Non-fiscal incentives for EVs and charging infrastructure

- Minimum technical standards for EVs and for EV charging infrastructure will be introduced.
- A requirement for the projects of new buildings is set to provide at least 10% of the total number of parking lots for electric vehicles.
- Economic entities operating existing public parking spaces (including those adjacent to administrative and office buildings, public buildings and retail facilities) are obliged to provide at least 10% of the total number of parking spaces with charging stations by January 1, 2025.
- EVs will receive exemptions from parking fees.

In addition, stemming from an earlier policy initiative, on March 17, 2022, a customs benefit was established for the import of electric vehicles into the territory of Armenia without paying import duties and VAT, which is valid until December 31, 2023 inclusive . And from 2023, this benefit was extended until 1 January 2025 (Republic of Armenia, 2023). Electric vehicles are also exempt from the environmental tax (Republic of Armenia, 2024).

The Republic of Armenia, in cooperation with the Global Environmental Facility and the UN Environment Programme, is currently implementing the project titled "*Transition towards electric mobility in Armenia*", which runs between mid-2021 and mid-2024. The project is being executed by the Environmental Project Implementation Unit (EPIU) within the Ministry of Environment of the Republic of Armenia. The project has been designed to achieve its stated objective by addressing prevailing barriers to the development of e-mobility sector through three inter-linked components, namely:

- Component 1: Institutionalization and strategic planning for low-carbon e-mobility
- Component 2: Short term barrier removal through low-carbon e-mobility demonstrations
- Component 3: Policy development for scale-up and replication of low-carbon

There are also several other international initiatives that focus on supporting the e-mobility transition in Armenia. Since January 2022, the Green Climate Fund (GCF) has initiated a grant program titled *Technical Advisory Support to Armenia on Enabling the Uptake of Electric Vehicle Mobility*. This program encompasses four key components: 1) Assisting the Ministry in formulating policies to encourage electric vehicle adoption and legislative regulation. 2) Creating a plan for the establishment of electric vehicle charging stations and related infrastructure 3) Providing methodological consultations to the private sector for the development and implementation of innovative financial instruments and market models and 4) Launching an awareness campaign aimed at promoting electric vehicles within the country (Green Climate Fund, 2021).

A further GCF project, titled *E-Mobility Program*, implemented by the Asian Development Bank, was approved in March 2024 and covers seven countries, including Armenia. The project focuses on creating low carbon and climate resilient urban mobility systems through four components: 1) Increase the climate resilience of urban transport infrastructure through (i) a climate risk assessment, (ii) flood adaptation measures, and (iii) urban heat adaptation measures; 2) Deploy Public transport and NMT measures through (i) cycle lanes, (ii) pedestrianization, and (iii) bus lanes and route restructuring; 3) Deploy electric bus fleets through (i) buying 860 e-buses, (ii) designing charging infrastructure, and (iii) exploring innovative business models; and 4) Technical assistance through (i) a climate resilient e-mobility ecosystem.

1.3. SOLUTIONSplus replication project

The Armenian, Yerevan-based startup EVAN LLC successfully participated in the SOLUTIONSplus project under the scope of WP4 - Comparative Demonstration actions. The project, titled "Transition Towards Electric Mobility in Armenia", was a part of the Global Environment Facility (GEF) initiative aimed at demonstrating innovative e-mobility solutions.

Project Overview

- Project Title: SOLUTIONSplus
- Project Start Date: 1st July 2023
- Project End Date: 31st June 2024
- Project Manager: Hripsime Gevorgyan

Objectives and Activities

EVAN LLC was tasked with installing and maintaining 30 electric vehicle (EV) charging stations in Armenia. The primary objectives were to:

- Demonstrate the technical, financial, and environmental feasibility of electric mobility charging infrastructure.

- Support the GEF project's EV pilot by ensuring the operational efficiency of the charging infrastructure.

The project activities were executed in three phases:

1. Project preparation and set up

- Project Team Formation: A dedicated project team was established.
- Documentation System: A shared online folder for project documentation was created.
- Component Assembly: Components for the 30 charging stations were assembled in Armenia.
- KPIs Definition: Key Performance Indicators (KPIs) were defined

2. Project implementation and monitoring

- Kick-Off Workshop: A successful kick-off workshop was organized with all partners.
- Location Selection: Close collaboration with EPIU ensured optimal locations for the charging stations.
- Charging Stations Installation: 30 interoperable charging stations were produced and installed.
- Operational Monitoring: The operation of the charging stations was monitored via an intelligent internet platform.
- Customer Support and Maintenance: Continuous customer support and operational maintenance were provided.
- Monthly Updates: Regular monthly update calls were conducted to ensure alignment and address any emerging issues. You can also see the photos of the installed chargers at the end of this document.

3. Project evaluation and dissemination

- KPI Evaluation: KPIs were systematically analyzed to measure project success.
- Closing Workshop: A closing workshop was organized to share outcomes and insights.
- Reports Production: Mid-term reports were produced summarizing the project's progress, as well as monthly meetings were organized for project status updates.

4. Lessons Learned

The implementation of the SOLUTIONSplus project provided valuable insights that can inform future e-mobility initiatives:

- **Stakeholder Engagement is Crucial**: Close collaboration with local authorities, such as the EPIU, and other stakeholders ensured that the project was aligned with local needs and regulations, facilitating smoother implementation.
- **Location Selection is Key**: The strategic placement of charging stations significantly impacted their utilization rates. Locations with high visibility and accessibility were preferred by users, leading to higher adoption rates.
- **Technology Integration**: Ensuring interoperability of charging stations with all EV models was crucial for user satisfaction. Compatibility issues can deter potential users, highlighting the importance of standardization.

- **Customer Support Enhances User Experience**: Providing robust customer support and timely maintenance services was critical in maintaining high uptime and user satisfaction. Proactive support systems can prevent minor issues from escalating.
- **Data-Driven Decision Making**: Continuous monitoring and evaluation of KPIs allowed for real-time adjustments and improvements. Data analytics played a crucial role in understanding usage patterns and optimizing operations.
- **Public Awareness and Education**: Raising awareness about the benefits of e-mobility and educating the public on using the charging infrastructure contributed to higher adoption rates. Effective communication strategies are essential for the success of such initiatives.
- **Scalability and Replicability**: Documenting the project's processes, challenges, and successes provided a valuable framework for replicating similar projects in other regions. Scalability considerations should be integrated from the outset.

Conclusion

The collaboration between UITP, UNEP, and EVAN LLC under the SOLUTIONSplus project was a resounding success. The project not only met but exceeded its objectives, providing a scalable model for e-mobility charging infrastructure roll-out in Armenia. The successful installation and management of EV charging infrastructure showcased the feasibility and benefits of electric mobility, as well as the potential for local manufacturing and job creation. The insights and data collected during the project will serve as a valuable resource for future e-mobility initiatives, contributing to sustainable urban transport development globally.

2. Approach – Methodology

This roadmap addresses the electric mobility sector in Yerevan, Armenia, and was prepared based on four main sources of information:

Firstly, numerous reports, policies, legislative documents, news reports, and various other secondary sources were reviewed, several of which have been referenced in this roadmap and can be found in the References section. In particular, government reports examining the charging infrastructure requirements of electric transport in Yerevan were explored. This information was also used to corroborate and contextualize claims from the other three sources.

Secondly, information was sourced from the Armenian government, through their GEF-funded e-mobility project, for which the SOLUTIONSplus activities were designed to complement. Regular communication with the Environmental Project Implementation Unit (EPIU) within the Ministry of Environment of the Republic of Armenia, the Executing Entity of the project, has enriched this roadmap immeasurably.

Thirdly, information was sourced from the partner implementing the SOLUTIONSplus replication project in Armenia, the charging infrastructure provider EVAN LLC. As described in section 1.3, EVAN has been an exemplary partner, with a deep knowledge and understating of the Armenian transport sector, as well as a keen insight into the evolution of the electric vehicle industry in the country.

A site visit and fact-finding mission was conducted by UNEP to Yerevan in August 2023. The aim of the mission was to better understand the Armenian e-mobility context, to inspect EVAN LLC's manufacturing facility, to assess their progress in delivering the number of chargers stipulated in the financing agreement, and to observe the use of the chargers by members of the public. Despite an in-depth desk study being performed by UNEP for the GEF and SOLUTIONSplus projects, an in-person site visit was critical to understanding the nuance of the Armenian e-mobility context. This mission was of considerable value to this roadmap and to the SOLUTIONSplus replication project in the country.

3. The roadmap – Where are we going?

3.1. Vision

The City of Yerevan has the ambition to fully electrify transportation in the city, in due time, and to eliminate the use of fossil fuels, hand-in-hand with an improved and more highly utilized electric public transport network. This is important for the city to reduce air pollution, which poses a risk for the health of its citizens, to contribute to the country's energy security and independence from fossil fuels, and to contribute to its climate goals and decarbonization strategy.

As discussed above, Yerevan has not yet had the opportunity to develop an all-round EV policy framework but will draw guidance from the recently published national e-mobility policy and strategy. The purpose of this document is to provide the City of Yerevan some targeted policy recommendations based on the SOLUTIONSplus project for when they decide to develop such a framework. Therefore, the focus of this roadmap is just on four areas from the SOLUTIONSplus project, set out below, that are particularly relevant to the Armenia context, rather than a comprehensive EV policy framework.

3.2. Objectives

To underpin the city's ambitions regarding electric mobility, setting a concrete target will be useful. Indeed, if the city will pursue the development of a comprehensive EV strategy, such a target is essential to guide the direction of this strategy. The strategy and target development process could entail four distinct steps:

1. The Vision - Developed through a comprehensive consensus building process across the relevant city departments (e.g. urban planning, real estate and energy/electricity supply) and local stakeholders.
2. The Context - An evaluation of the status quo that would cover the Strengths, Weaknesses, Opportunities, and Threats of the Yerevan transport sector for the EV transition. But should also include an assessment of global and local trends, the policy landscape, the actors within the transport sector, critical uncertainties, key assumptions, existing shifts and stresses.
3. The Strategy - Often with a 3 time horizon format (short, medium, long) for targets and mechanisms, the implementation framework, a plan for implementing in different contexts, and a framework for prioritizing actions.
4. The Programme - Detailed overviews of actions and commitments, whose responsibility those actions relate to, and the indicators to track the programmes.

It is also important to choose targets that are specific, measurable, achievable, relevant, and time-bound. An example of such a target is that the City of Yerevan could pursue partial electrification of its transportation sector by 2030 (e.g. 10% of its vehicle fleet), in line with Armenia's national target, and 100% by 2050. Separate targets could be set for the bus fleet, freight delivery fleet, and passenger light vehicle fleet. The target of 30% of its public transport trips to be on electric vehicles by 2030 and 100% by 2040 is ambitious but achievable. To bring this all together, it could declare a full zero-emission zone in the city for all vehicle segments by 2040.

4. Implementation plan – How do we get there?

4.1. Focus area 1: Charging infrastructure

The availability of a comprehensive public charging network is essential for the development of e-mobility in Yerevan. The development of charging infrastructure is often seen as a chicken-and-egg problem. I.e., *should there first be a large number of EVs to enable an increase of the number of charging points or should more charging points be installed to encourage consumers to purchase EVs?* The answer is that one cannot happen without the other, and they need to be stimulated simultaneously. Range anxiety, which is the fear that an EV will not have sufficient battery to get from A to B due to a lack of opportunities to charge, is considered one of the main barriers for consumers to switch from fossil cars to electric cars. Yet, in an e-mobility strategy, charging infrastructure is often overlooked. The development phase of a charging network, or even one charging station, can take several years from the initial planning phase to final realization. It's therefore important to start this process early to avoid setbacks.

Charger types

A comprehensive charging network consists of a combination of different types of charging, to ensure the maximum comfort level for consumers and to reduce range anxiety. The following types of charging are needed in a city to offer options for all use cases, and ensure the charging network is truly comprehensive:

- **Private charging (home and workplace):** these chargers are generally installed by consumers and businesses at their own initiative, and generally not regulated or subsidized. It is nonetheless relevant to update building codes so that all new buildings with parking spaces or garages have electricity infrastructure in place suitable to connect EV chargers.
- **Public slow charging (3.7-11 kW, 5-10 hours charging):** on-street chargers next to parking spots, or in parking lots.
- **Public fast charging (50 kW, 45-60 min charging)**: chargers in parking lots next to shopping malls, supermarkets, health centers, or other areas where people tend to park their car for a shorter while (around one hour).
- **Public ultra-fast charging (>300 kW, 10-20 min charging):** larger charging hubs with 4-20 chargers inside the city where that can service hundreds of cars per day. This is an essential service to complement slow charging for citizens who don't have the time to wait for 8-10 hours of charging. Taxis tend to use charging hubs frequently. It is important for a city government to appoint land for this purpose and ensure they are spread out throughout the city. As land in cities is often scarce, and such a charging hub requires generally at least 1000m2 of space, it could be an idea to repurpose the land of existing petrol stations and replace this with a fast-charging station (through a public private partnership, see section below).

Elements of a comprehensive EV charging roll-out strategy

Without the presence of a comprehensive charging network, it is not possible to scale e-mobility efficiently. Since the first movers, the first consumers switching to EVs, are often based in cities, cities have an important responsibility when it comes to taking the first steps of developing a strategy to

roll-out a comprehensive EV charging network. While several regulations needed for charging infrastructure, such as charging standards and data sharing regulations, are organized at the national level, the role of cities is also very relevant, if not more important. Indeed, cities are responsible for making sure that charging infrastructure is actually rolled out, and that they are in the right locations accessible to the EV driver. Making an EV charging roll-out strategy at city level is therefore recommended, also in the case of Yerevan. In general terms, an EV charging infrastructure strategy at city level should contain the following elements:

- The first step when designing an EV infrastructure strategy is to undertake **in-depth analysis** to inform the decision-making process. A technical/economic analysis to understand what type of vehicles are to be charged, the time available for charging and what mix of charging types is most suitable, where it is to be installed and the space needed for the infrastructure, whether and where sufficient grid capacity is available, training needs both for policy maker and the technical workforce, and finally the budget available to the investment. In parallel, it would be useful to organize a **stakeholder dialogue**, in particular with local companies, to understand their willingness to implement the plan, the barriers they foresee, and what they need from the government to make this happen. See the section The charging ecosystem below with further details on the type of players that can be expected in a charging ecosystem.
- A **vision** and **targets**, specifying the goals and targeted number of chargers, per type of charging (public slow, public fast and public ultra-fast), to have been rolled out by a certain year. Especially given the close connection between the national interests of Armenia and those of Yerevan (hosting one-third of the country's population), it makes sense to align the city targets with national plans. Targets for charging infrastructure are commonly either formulated in terms of number of chargers, in terms of capacity (kW or MW installed capacity), linked to the number of EVs circulating (kW installed capacity/EV in circulation), or distance based (kW or MW installed capacity e.g. every 60 km, which is relevant for long-distance road networks). The first one is more simplistic and easier to implement, as it requires less planning and analysis, but is also less comprehensive. The target following the number of EVs in circulation is the most comprehensive, best matching the actual uptake of EVs, but is also more complicated in terms of implementation. As a reference point, the EU has adopted a target of 1.3 kW/Battery electric vehicle in circulation to give a rough idea of what is an appropriate level.
- A description of the **roll-out approach** of the charging network. In cities, commonly there are two approaches to roll-out charging infrastructure, either commissions or tenders are given out for a set number of chargers to be rolled out in a certain area (e.g. across specific neighborhoods or specific parking lots) for slow chargers, and for charging hubs (fast and ultra-fast charging) specific plots of land are allocated for a specified number of chargers. A second approach for the roll out of slow charging, which is applied in a lot of European cities, is the demand-based approach. This means that when a consumer buys an EV, they can request a charger to be constructed near their home. This approach is generally applied in the early phase of EV uptake and the advantage of this approach is cost-effectiveness and more effectively reducing the range anxiety barrier. Both approaches generally take place through public-private partnerships, outsourcing the construction and operation of the charging infrastructure to one or more companies (see next bullet point).
- Plans for **public-private partnerships** (e.g. a tender) that gives Charge Point Operators (CPOs) the right to operate chargers on public land for a certain period of time, e.g. next to

parking spaces, in parking lots, repurposing of the land of petrol stations. This is probably the most delicate and important element of the charging infrastructure strategy, that actually ensures the roll-out of charging infrastructure will be implemented. Since there are a lot of risk elements, a separate section is dedicated to this topic (below).

- A **plan** describing how **electricity supply** for EV charging will be organized. It is important to align the roll-out of charging infrastructure with local grid maps, to ensure that sufficient grid capacity is available at the intended locations. This plan should therefore detail the expected electricity demand from charging and required grid capacity, both in terms of volume and specific locations, and it is important to check whether the intended locations of charging infrastructure match with the geographic set up of the grid. It is important to coordinate with local grid companies to ensure they are included and involved in the plans and if needed will undertake grid upgrades to ensure the availability of sufficient grid capacity. Counterintuitively, while it is often thought that charging hubs with ultra-fast chargers, often requiring a grid connection of a few MWs, has a bigger impact on the grid that a more decentralized slow charging networks with much lower grid connections, this is not the case. Indeed, the big difference is that bigger charging hubs can often be directly connected to the medium voltage grid, and one such connection can service hundreds of cars per day, while a slow charging network has numerous smaller grid connections that each have to be connected to the local low voltage network with a capacity to charge only 1-4 cars per day. In most cities the main network congestion issues take place in the lower voltage network. As such, if Yerevan is encountering congestion issues in the lower voltage network, it could be a reason to steer more charging demand to larger charging hubs. Furthermore, the charging curves are quite different for fast charging and slow charging. While the peak of slow chargers tends to be towards the end of the day when people come home from work, coinciding with the peak-hours of residential electricity demand, the peak of fast chargers tend to be centered around the middle of the day, mostly outside of peak hours, which also coincides with the time when renewable electricity (solar and wind energy) is most abundant.
- An execution and **management plan**. This details who is going to be responsible for each of the required actions to implement the overall strategy. Which city department is going to execute and dedicate staff time to the charging infrastructure plan, and are there other departments who should also be involved? For example, the urban planning department, the department in charge of property and land rights, the energy department and/or local grid operator, local consumer associations. Also, how does this strategy fit into already existing regulatory frameworks of the city? Furthermore, it should detail the budget available for the overall execution of the plan and how the budget will be spent. Lastly, it should detail a monitoring, reporting and verification framework (MRV) for tracking progress towards the set goals and targets, and whether concession holders meet their obligations.
- A **financial support plan**. This plan should detail the business case for the different charging infrastructure types is, including how these are expected to be financed. Consultation with the private sector through a stakeholder dialogue could be useful input here. If needed and possible, the city could consider a subsidy programme to contribute to a positive business case and increase the willingness of the private sector to invest. It must be noted that this is not always necessary, since companies can adjust their price levels to meet business case requirements, a positive business case should therefore be possible once EV numbers are growing. If this city does consider a subsidy scheme, it is also important to design it in such a

way to avoid market imbalances. For example, if one form of charging (e.g. on-street slow charging) is subsidized and not another form of charging (e.g. fast charging by shopping malls), it could create a market imbalance and unfair competition, and should therefore be avoided. A way to avoid this is to design an application process for which all types of public chargers are applicable, and that offers a subsidy per kW installed capacity (to ensure coherence across the different charging segments).

Public-private partnerships

If Yerevan wishes to outsource the construction, operation and maintenance of its EV charging network to local businesses, the best way to organize this is through a public-private partnership. Through such a public-private partnership it could offer permits to selected Charge Point Operators (CPOs) to operate charging infrastructure on public land belonging to the city. An example of this is a concession, a contractual arrangement which grants the concession holder the right to construct and operate charging infrastructure in a given area/location and for a specified number of years (e.g. 15 years). A market party can obtain a concession, bears risk and costs for construction, operation and maintenance, and in exchange can earn an income by selling electricity (usually a price is set per kWh). Since range anxiety is one of the main barriers for consumers to switch to electric driving, the quality (e.g. service and uptime) of a charging network is very important, it can make or break a successful transition to electric driving, especially in the first and most vulnerable phase of this transition. The first public-private partnerships, and in particular the quality of the bidding process and conditions prescribed, will shape this network and doing it right from the beginning is therefore key. In order to increase the chance of a successful public-private partnership, and in particular the roll-out of a charging network that is fully functional and offers high quality and competitive pricing, the following elements can be considered:

- **Ensuring a fair and competitive bidding process will lead to higher quality charging infrastructure**. It is recommended to exercise concessions for charging infrastructure through a public bidding process (e.g. a tender), rather than giving the right to operate a charging network directly to an operator without giving the chance to other companies to compete for these rights. Competition encourages a greater quality of charging infrastructure and more competitive pricing, by widening the pool of potential operators and encouraging them to make an attractive offer, which is to the advantage of consumers and their willingness to switch to electric mobility. This public bidding process should be open to all parties who are interested to participate, and have a transparent selection process and selection criteria (e.g. scores). In an earlier phase it may be more advantageous to base the selection of the operators/concession holder on qualitative criteria, such as the level of service and customer support, the level of maintenance and uptime, sustainability, provision of access for disabled people, etc. This is because ensuring a high-quality network that is fully operational all the time and offers good customer service is essential in the early phase to earn the trust of citizens regarding switching to electric vehicles. Once this trust is broken, it is more difficult to repair. In a later phase, or perhaps as only a partial contribution to the selection process, one could also include a financial selection criterion, for example by the price/kWh asked to customers by the concession holder.
- **Separating slow charging and fast charging concessions will widen the pool of candidate CPOs**. The business case and business operation of a slow charging and fast charging network is inherently different, which has also led some CPOs to specialize in

specific charging segments, and only do one or the other. In order to create as large as possible pools of candidate applicants for the bidding process, which ensures the best quality charging network, it is therefore recommended to separate the concessions and bidding processes for fast and slow charging.

- **Setting a minimum duration of 10-15 years will widen the pool of candidates and guarantee better quality proposals**. This is generally considered an appropriate time of operation over which a company can earn back the initial capital investment for the development of charging stations and grid connections. This is especially important, since in the first few years the income for CPOs tends to be lower while the number of EVs in circulation is still lower. A shorter period could be possible (e.g. 7 years) if Yerevan for example wishes to reduce the risk and lock-in of a system that may not be working according to its wishes when the city does not yet have experience with this. However, in that case it is recommended that a subsidy scheme is part of the arrangement as otherwise it will likely be more challenging for the operator to earn back the investment and come to a positive business case, reducing the pool of high-quality operators.
- **Embedding conditions guaranteeing quality of infrastructure in the public private partnership will make a big difference.** Consider including requirements on the charging standard that needs to be available (e.g. CCS, CHAdeMO and Type 2 connectors), payment methods required, accessibility for disabled citizens, safety standards, customer service, maintenance and uptime. Indeed, the obligation of proper maintenance in the concession agreement is essential, for example by requiring a minimum uptime of >95%. One of the key failures in cities and countries who were early movers in the transition to electric mobility was that regularly charging infrastructure that was build was not functioning properly or out of order, which led to significant discouragement for consumers to switch to electric mobility. However, this could relatively easily be solved by including these conditions in the public-private partnership or concession agreement.
- **Ensuring that multiple CPOs are offering their services within the city will lead to better quality charging infrastructure.** Avoiding monopolization, or the availability of only one CPO that offers charging services is detrimental to the quality of a charging network, as the consumer does not have a choice between operators it reduces the pressure on the CPO to do a good job in terms of service and offer competitive pricing. The city can play an essential role in ensuring that the EV driver will be able to choose between multiple operators. This could be done by designing a public-private partnership in such a way that it prescribes a minimum number of CPOs to be operational. For example, the locations and sites appointed for charging (both fast and slow) could be bundled into multiple batches of locations for which CPOs need to make individual bids. Ideally in such a way that there will be multiple batches of locations for slow charging and multiple batches of sites for charging hubs for fast charging. It would be helpful if the batches were compiled so that it generates an even (geographic) spread across the city, so that in the case of a different CPOs per batch, EV drivers will have a range of options near their place or destination. The city could announce beforehand that it is planning to select a minimum number of CPOs (e.g. 2 per category such as fast or slow) to win to guarantee this diversity.
- **Check whether the concession agreement and public bidding process is in line with local competition and public procurement rules and legislation**. Something often seen in European cities who started with their first public-private partnerships for EV charging, is

that the policy officers designing the public-private partnership arrangements were working for the transport department or urban planning department and did not have knowledge of competition and public procurement legislation, which has led to court cases in some cases. Therefore, in order to avoid (legal) issues later on, it is important to check whether the design of the public-private partnership is in line with these laws.

- **It is recommended not to encourage co-locating (fast) charging hubs with petrol and CNG refueling.** Co-locating fast charging and fossil refueling (petrol, CNG) for example on a petrol station site does not work well for a number of reasons. 1) The demand for (fast) charging is growing too fast to justify transitional solutions as placing a few chargers next to a petrol station. Since land in cities is scarce, and developing a charging station from a to z takes several years, sites that are made available for charging should be fully dedicated to charging right from the start to meet the growing demand. 2) giving out permits for charging to existing petrol station operators based on public land is often not in line with competition laws, which requires all services on public sites to be offered through a public bidding process. 3) When offering of charging services is a side-business rather than the primary service of a provider, there tends to be lower quality of service offer compared with operators that are fully dedicated to offering charging services. All in all, it therefore makes more sense to repurpose sites of petrol stations entirely to fast charging sites (for example when their permit runs out it could not be renewed), instead of co-locating, which could be done gradually with the petrol stations in Yerevan over time and following the decline of the petrol and CNG vehicle fleet (once the fleet is fully electrified there is no more need of petrol stations).
- **Include a guarantee and safety mechanism in the contract.** For example, a condition that if the city can prove that the above standards and requirements are not met, the city government has the right to withdraw the contract and organize a new bidding process to select a new operator.

The charging ecosystem

The charging infrastructure strategy is generally the component of an EV policy framework that is the most complicated in terms of alignment with other stakeholders. It has the largest and most diverse stakeholder group, and is the most decentralized. Since a charging network should be connected to the national network and even beyond national borders, in order to ensure EV drivers will be able to have comfortable driving experience, alignment is needed with national, regional and city government levels. Beyond that, there is alignment needed with many other stakeholders, ranging from companies to consumer associations and grid operators. It is therefore important for Yerevan to have a clear picture of its charging ecosystem.

Indeed, in order to make it a seamless experience for the consumer, alignment with cooperation with stakeholders beyond the city level is therefore needed. The goal of a charging ecosystem should be to optimize the EV user experience during charging and ensure interoperability in the system. To achieve this, all stakeholders must work together, but the government has a key role to play in this alignment, making sure that the development of the public charging network is driven by policies through standardization, regulation and the organization of public-private partnerships. Alignment with stakeholders on the design of these, through stakeholder dialogues, will ensure that they are effective, and help to solve barriers which stakeholders face in their operations and development.

Figure 2 is an example of an EV charging ecosystem, portraying the actors that play a role in the operation of the network. The payment system deserves some extra explanation. In numerous countries, a system has developed where charging infrastructure doesn't have hardware in place allowing to pay through physical means (card or cash). Instead, Charge Point Operators (CPOs) only offer digital means, such as a QR code, an app, a RFID card (which is a tag or card that customers swipe on the charger to start a session, and which is directly linked to the owners credit card), or a plug and pay system (when a customer connects the charger to the car, it will automatically recognize the customer and link to its credit card, billing occurs automatically). Yet in order to 'run' such digitalized payment methods, CPOs often make use of the services of other companies, such as Mobility Service Providers (MSPs, essentially payment service providers) and roaming platforms. These companies ensure interoperability, so that for example one RFID card gives the customer access to chargers from different CPOs, often across different countries, which increases the user friendliness for consumers since they do not have to download individual apps and make accounts for each different CPO.

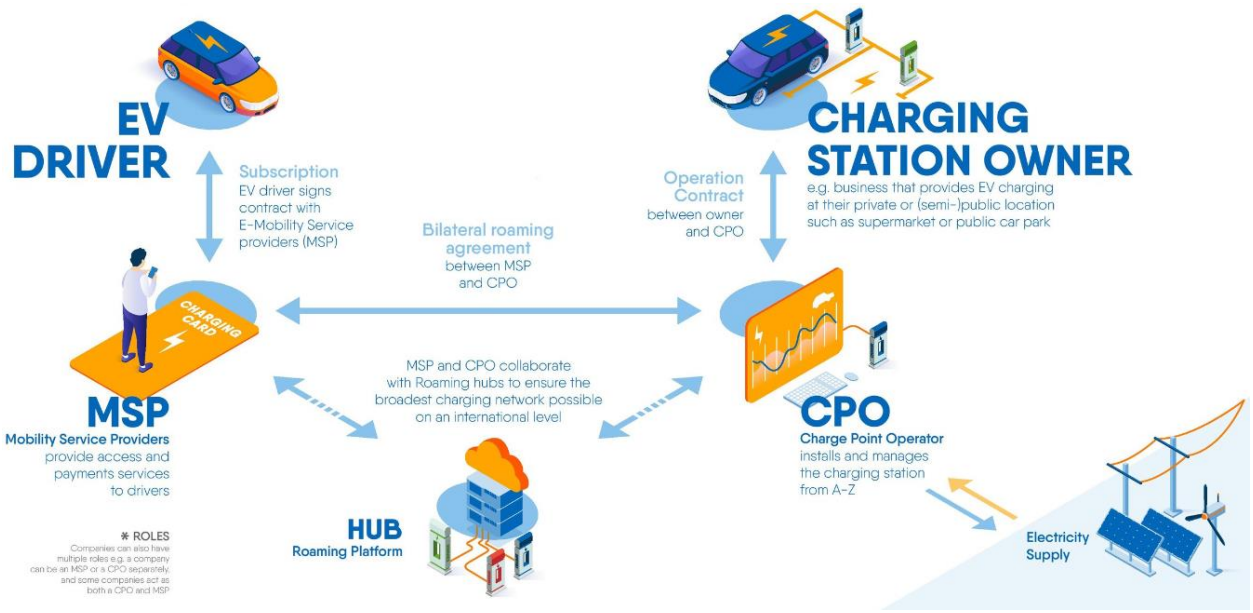

Figure 2: EV charging ecosystem players. Source: ChargeUp Europe

4.2. Focus Area 2: Availability and affordability of EVs

One of the issues indicated by the City of Yerevan is that consumers who are interested in electric cars have difficulty finding one. Most electric cars entering Armenia today are coming through a handful of import companies or privately imported and overall availability of electric cars is still limited, both new and second hand. While, according to the latest known statistics, 2823 electric vehicles were imported into Armenia in 2022, as shown in Figure 1, demand for electric cars exceeds

availability. The availability of affordable EVs is therefore a key issue to resolve to be able to take the next step in the transition to electric mobility.

Affordability depends both on the price of the vehicles, as well as on the cost of capital. With regards to the latter, interest rates for loans for EVs are high in Armenia. Because EVs technology is still new and unknown to many and banks do not have a lot of experience with this yet, the risk involved in a loan for purchasing an EV is perceived to be higher. Addressing these high interest rates for EVs is therefore one way to improve the affordability of EVs for Yerevan's citizens and avoiding too high a reliance on fiscal incentives.

When aiming to encourage import of both new and second hand (affordable) vehicles through policy, this is most relevant to address at national rather than city level. Yet, because of the close connection between Yerevan and the national government of Armenia, it is still relevant to mention here. The following suggestions could help to promote the import of more affordable EVs:

- The most effective measure in this area, temporarily reducing or eliminating import and VAT taxes for EVs, is already in place. Currently, this incentive is in force until 1 January 2025. As success of this measure is already visible in the EV import statistics, and Armenia has set the ambitious target to reach a 10% EV share by 2030, it is recommended to extend this measure beyond 2025. Effectiveness of this measure could be enhanced by extending it for a longer period at once (e.g. until 2030), to provide long-term stability and certainty for the private sector, which increases the attractiveness of Armenia as an export destination for EVs.
- An information campaign and training program targeting car dealers and repair shops could help to engage these important stakeholders, to prepare and motivate them to play a part in the e-mobility transition. In and around Yerevan, car dealers, repair shops and car importers have, due to a lack of training and exposure to EVs, limited knowledge of EVs. This may make it more difficult for them to take steps to pursue this business, or to recommend EVs to their customers. Indeed, these companies are key to support the switch to electric driving on a larger scale. Dedicated information and training programs specifically organized for this audience could therefore be of great benefit.
- One way to increase the affordability of electric cars in Armenia is to stimulate a better cost of capital. The government could consider providing assurances, and work directly with (development) banks to create programs to provide more affordable loans for purchasing EVs.
- If there are city taxes or levers for cars, such as a circulation tax or toll, reducing these could also help with the affordability of EVs in the early stages of the transition to electric driving. The city has already taken steps to reduce the parking tariffs for electric cars, which is a great measure to take. Beyond this, other types of charges, such as registration or circulation taxes could also be a subject of discussion for reduced tariffs for EVs to stimulate affordability. This in turn will help make Yerevan a more attractive export destination for EVs and will indirectly stimulate the availability of EVs.

4.3. Focus Area 3: Early transition of highly utilized vehicles

A focus on the early transition of highly utilized vehicles is important for the cost-effective deployment of e-mobility in Yerevan. Especially with currently high oil prices and the low electricity prices in Armenia, vehicles that travel a lot of kilometers per day will make the largest cost savings at an operational level and are therefore suitable for an early transition. In Yerevan, highly utilized vehicles are mainly buses and minibuses, taxis, and urban delivery vehicles. Some suggestions for measures to promote these vehicle segments are listed below.

Buses and minibuses

- Yerevan could consider setting targets for electrification of its bus and minibus fleet. It would be useful to perform a market analysis and organize stakeholder dialogue sessions with bus and minibus operators in the city to understand the age and expected retirement age of the current bus fleet and TCO analysis to establish, in cooperation with the industry, what could be a reasonable phase-in target. For example, targeting 50% of the buses and minibuses to be electric by 2030 and 100% by 2040.
- Establish a licensing requirement for new routes that these can only be operated using electric buses.
- During tenders for licenses and public routes, preference could be given to electric buses.
- Pursue climate finance opportunities, such as the *E-Mobility Program* mentioned in section 1.2, funded by the GCF and implemented by ADB, which includes support for procuring electric buses.

Freight delivery vehicles

- To stimulate zero emission freight transport, a lot of cities in other countries have chosen to implement a zero-emission zone for deliveries. Zero-emission zones have proven effective measures to stimulate electric freight transport and have a significant impact on air quality in the city. Yerevan could consider implementing such a zone in the city centre by a certain year (e.g. 2028) to stimulate the transition to electric freight vehicles.
- Complementary with such a mandate, it is important that Yerevan considers the development of high-speed charging stations for trucks and other delivery vehicles at convenient locations. Charging hubs could be realized on public land on the edges of the city, ideally on or near Yerevan's arterial roads. It is important to note that technical requirements for fast charging stations are not the same for cars and trucks. The height of the chargers, carrying capacity of the flooring, and turning angle are different for trucks than for cars. Also, while most electric trucks today charge at a maximum speed of 350-400 kW, similar to cars, it is expected that the next generation electric trucks will be using Megawatt chargers, which is not expected for cars. Therefore, while it is technically possible to combine, generally charging stations are either designed for trucks or cars. Yerevan should therefore make the choice if it prefers to have combined charging hubs for both cars and freight vehicles, or separate hubs. It could be useful to ask for input from operators and the private sector to understand what they would find most convenient.
- Most electric delivery vehicles will also frequently be using depot and destination charging. However, as these are usually not developed on public land the City of Yerevan has a limited mandate in this area. Nevertheless, stakeholder dialogue sessions with site owners could be useful to understand from these players if the city could be of support in any way to realizing charging infrastructure on these sites. For example, a struggle often seen in other cities by

depot owners is that it is difficult to obtain the relatively large grid connections required for these sites, where the city could perhaps assist to speed up these processes.

- Cooperate with the national government to investigate the possibility of a purchase subsidy for electric delivery vehicles. The Total Cost of Ownership (TCO) gap between electric and ICE vehicles is generally larger for freight delivery vehicles than for buses, a purchase subsidy could therefore be an important mechanism to stimulate businesses to switch to electric delivery vehicles.

Taxis

- Taxis tend to be frequent users of fast charging hubs. The city could reduce barriers for taxi drivers for switching to electric vehicles by ensuring the availability of high-speed charging hubs (>300 kW chargers) in convenient locations. Suitable locations are sites with space for at least 4-20 chargers near the airport and near the main roads.
- Consider a zero-emission zone for taxis, and possibly also other cars and vehicles, in conjunction with a zero-emission zone for freight delivery vehicles.
- Give priority to electric vehicles when issuing new taxi licenses.
- Consider reducing taxes and the price of operating licenses for taxis when taxi drivers use an electric vehicle.
- Consider organizing information and training sessions and test drives in electric cars for taxi drivers to increase their exposure, awareness and understanding of EVs.

4.4. Focus Area 4: Education and training

Education and training are an essential part of advancing the transition to electric mobility in Yerevan, and Armenia more broadly. Skilled professionals are needed for the whole EV ecosystem, from government and policy making, advisory, engineering, electricians to maintenance level work. As the EV and charging technologies are relatively new, there are not many local experts in the field who can guide and support the transition to e-mobility. As in other countries, the main training needs to develop e-mobility in Armenia are therefore in charging infrastructure technologies and installation, battery disposal, policymaking, finance and fiscal schemes, and mobility and integrated planning.

The City of Yerevan could consider taking an active role in promoting this. It could make budget available to support training programs for the different technical areas and targeted at the different professionals. In order to achieve this, it could seek cooperation with universities, community colleges, and technical schools, or with private training institutions. The municipality could support these institutions by organizing public information campaigns convincing young students and other relevant citizens to specialize in this field and follow these trainings. Capacity building for its own public policy officials is also essential for those who will be designing and implementing Yerevan's e-mobility programs. Training and field trips to other cities working on electric mobility could be a useful component of the education program of public policy officials.

There is also a limited number of mechanical workshops familiar with EV maintenance to meet the current and projected demand for the next few years. Thus, it is necessary to create technical training programs to train technicians capable of repairing and maintaining EVs. Technical careers could, for

example, be based on a dual system of learning, in which a part of the knowledge is incorporated theoretically in the classroom and another part is learned practically in a workshop, applying the theoretical knowledge. Similarly, car dealers are often most familiar with traditional ICE technologies and have limited knowledge and experience with EV technologies. Some of them may also be influenced by misinformation or find EVs daunting. Car dealers play a pivotal role in advising consumers about EVs and being a focal point for consumers considering switching to electric driving. Therefore, organized training sessions and exposure programs (e.g., test drives) targeted at car dealers could make a big difference.

5. Conclusion and next steps – what do we need?

Good progress is being made in Armenia and Yerevan with regards to the transition to electric mobility. EV numbers are rising, a comprehensive national EV strategy is adopted, and the City of Yerevan has already introduced an incentive for EVs through their parking tariffs. Additionally, there are several new international donor projects starting in the coming years focusing on electric mobility in Yerevan or Armenia. There are also startups in the e-mobility space eager to grow their services and offerings in Yerevan. Since there are numerous projects and initiatives ongoing in the e-mobility space, the city could be adding a lot of value by bringing this all together in the development of a comprehensive EV strategy and EV policy framework for the city. This will help to consolidate the efforts of the different initiatives, will provide a direction, stability and certainty for the private sector and other stakeholders, and most importantly, can be a great opportunity to address roadblocks and barriers that are currently experiences by the parties tasked with implementing the transition to electric mobility.

The most important next step for the City of Yerevan would therefore be to start the development of a comprehensive and overarching EV strategy, focusing on all relevant areas, including the electrification of different vehicle segments (cars, buses and trucks) but also focusing on charging infrastructure and the underlying electricity supply. The strategy should include a vision, targets, analysis of the context, strategy for intervention, and programme of measures. In order to do this effectively, training of knowledge and capacity building of policymakers and relevant official within the municipality of Yerevan is essential. But close cooperation with other city departments (urban planning, public transport, energy/electricity supply, and real estate) is also critical. An extensive stakeholder dialogue or public consultation taking place in the development stage of the EV strategy could inform the city of the roadblocks experienced by different stakeholders, after which measures can be taken to address these roadblocks. An exchange program with other cities who are taking steps in this area could also be useful to learn from other experiences.

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