Public Disclosure Authorized
Public Disclosure Authorized
Public Disclosure Authorized

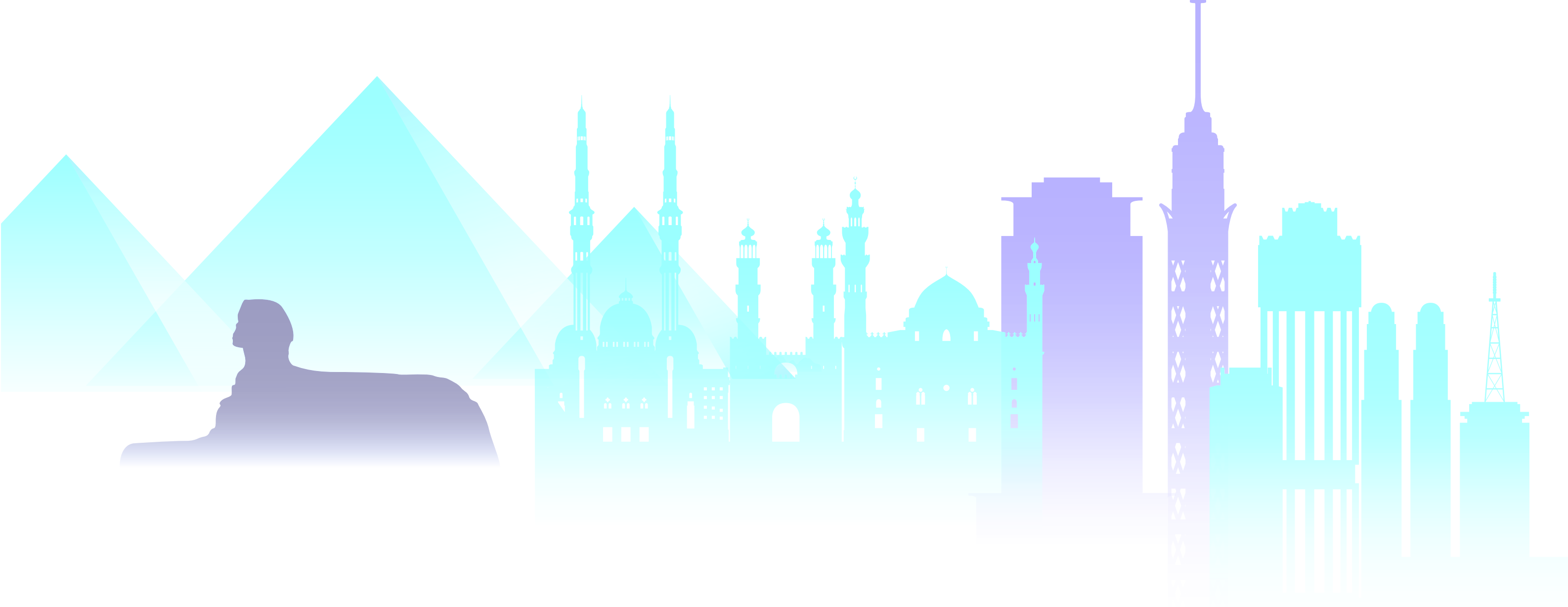
UNLOCKING ELECTRIC MOBILITY POTENTIAL IN MENA

Executive Summary – Egypt

WORLD BANK GROUP
INFRASTRUCTURE #BuildingBetterLives
ESMAP
MOLO eMobility
PPIAF Enabling Infrastructure Investment

1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

The Egypt Study has been led by Nobuhiko Daito, with contributions from Susan Lim, Salma Fattah, Yousra Assaker, Yanchao Li, Ashok Sarkar, Tarek Keskes, Kristin Panier, Maria Rodriguez De La Rubia Gassol and Yao Zhao. The analysis underpinning this Summary was commissioned by the World Bank and conducted by a consulting team comprising of Rebel Group, Siemens, Transport for Cairo (TfC), MRC and TRT.



Background and Motivation

Egypt is on a path toward greener, more resilient, and inclusive development, with high expectations for the electrification of transport, known as "electric mobility" (e-mobility), to play an important role. The Integrated Sustainable Energy Strategy ISES 2035 of Egypt sets the ambitious targets for both the integration of renewable energy and adoption of energy efficiency measures. Natural Gas and oil together represented about 92% of the total primary energy supply in 2019. Transitioning to a low carbon path could help Egypt prepare for an uncertain future by strengthening the competitiveness of Egyptian products. The recent National Climate Change Strategy 2050 articulates climate change mitigation and adaptation priorities that include scaling up domestic production, and adoption of electric vehicles (EVs), as well as green hydrogen. How this comes about is the subject of ongoing debate and covers deployment of EV-charging infrastructure and potential upgrades to utility distribution grid infrastructure, the need for new skills and jobs to cater to the growth of this industry, and ways to facilitate private investment (through policy and regulatory reforms, as well as institution building).

As part of the World Bank's regional analytics and advisory support on e-mobility in the Middle East and North Africa (MENA), the present report addresses key challenges and proposes actions to accelerate e-mobility adoption in Egypt. With appropriate interventions and initiatives, e-mobility presents opportunities to transform the energy and transport sectors, creating social, environmental, and economic opportunities, including jobs. The unique operational environments of the MENA region, and of Egypt in particular, also reveal an inherent concern that impacts EV operation in hot climates: the mobile cooling needs of the EV fleet, including mobile air conditioning (MAC), transport refrigerated units (TRUs), and batteries and power electronics.

Public transport is a suitable sector to consider electrifying from climate transition and development perspectives, yet the sector faces challenges to enable a transition. Public transport provides affordable means for the Egyptians to access economic opportunities and services, building resilience to vulnerable groups with limited means to adapt and respond to climate and other risks. High mileage of public transport fleet particularly suits well to mitigate carbon emission and air pollution, through electrifying, as compared to private vehicles. As such, the Egypt analysis focuses on exploring opportunities to electrify public transport services in Greater Cairo context.

Country Overview

While advancing with converting motor vehicle fleet to CNG as a transitional measure to green transport, Egypt aspires to play a key role in the e-mobility to keep pace with global electrification trends. Several developing countries began their e-mobility journey around a decade ago, yet the market is still young and open for new entrants to become key players in the e-mobility market. Egypt expects to do just this, given the government's political drive to deepen local manufacturing of EVs (figure ES.1).

Egypt's e-mobility strategy, launched in 2019, is in line with the United Nations Sustainable Development Goals and in accordance with the Sustainable Development Strategy of Egypt's Vision 2030. The strategy focuses on three goals: (1) strengthening local manufacturing, (2) setting up charging infrastructure, and (3) refurbishing the existing fleet. The strategy is to be implemented in three phases, each focusing on a set of objectives that build on one another:

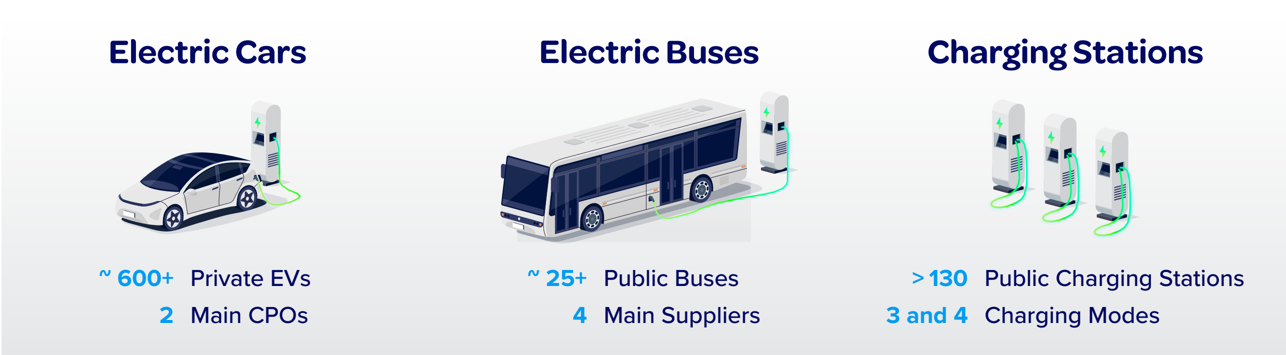
- **Phase 1 (2019–24)** will promote the advancement of EV use, local production, and related research and development.
- **Phase 2 (2025–30)** will expand the role of local manufacturing and strengthen research and development.
- **Phase 3 (2030–40)** will master all technical aspects of EV manufacturing and expand the export market with superb output quality.

The strategy sets quantifiable targets to achieve these objectives, including:

- A **65 percent** industrialization share in the EV manufacturing value chain by 2030.
- Increases in the market share of private EVs in Egypt to **14 percent** by 2025, **36 percent** by 2030, and **50 percent** by 2040.
- An increase in the share of industrial production in GDP to **5 percent**.
- A **90 percent** reduction in the burden on the state budget resulting from importing fossil fuels for vehicles by 2040.

Egypt already has active value chains for both passenger EVs and electric buses. A stakeholder mapping exercised identified the following energy sector authorities being part of the EV value chain:

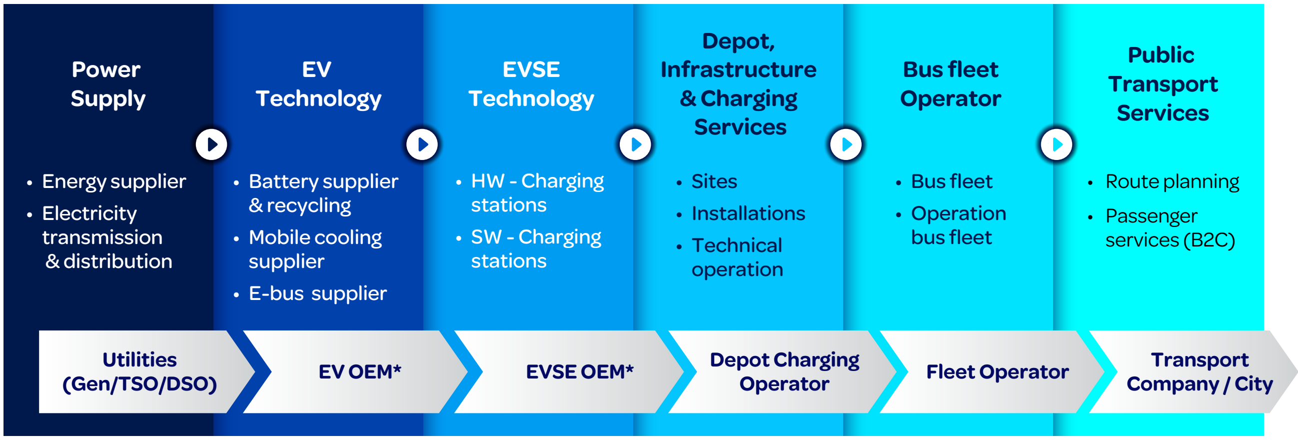
FIGURE ES.1. • Electric Vehicle Stock in Egypt in 2022



Source: Original compilation.
Note: EVs = electric vehicles; CPOs = charge point operators.

Ministry of Energy and Renewable Energy (MoERE), New and Renewable Energy Authority (NREA), Egptian Electric Utility and Consumer Protection Regulatory Authority (EgyptERA), and Egptian Electricity Holding Company (EEHC). In the transport sector, governorates and respective transport authorities (e.g., Cairo Governorate and Cairo Transport Authority as well as their equivalent in Alexandria), National Authority for Tunnels and Land Transport Regulatory Authority would be part of the EV value chain. Stakeholders also include power supply companies (handling generation, transmission, and distribution), charge point operators, as well as e-mobility providers and mobility service providers with various vertical integration models (figure ES.2). Aligned with the 2019 Egypt e-mobility strategy, local EV/e-bus makers and supply equipment manufacturers began production of electric fleet. The energy sector stakeholders remain the same in both value chains, while the transport sector stakeholders differ between the two, given that most buses are state-owned.

FIGURE ES.2. • Egypt's E-Bus Value Chain



Source: Siemens AG

Note: TSO = transmission system operator; DSO = distribution system operator; OEM = original equipment manufacturer; EVSE = electric vehicle supply equipment.

Technical Analysis of Opportunities for E-Bus Operations in Greater Cairo

The study assesses the technical feasibility of e-bus deployment in Greater Cairo, focusing on representative corridors in which the Cairo Transport Authority (CTA) operates large buses running on diesel or compressed natural gas (CNG). Based on the operational parameters of the incumbent services, the analysis considers overnight depot charging, opportunity charging at terminals, and a combination of the two technologies. The assumption is that the MCV e-bus (Seti bus),[1] with a battery capacity of 315 kilowatt-hours, is a likely candidate for deployment on Egyptian roads. The

1 MCV = manufacturing commercial vehicle; the Egyptian e-bus is called the Seti bus.

analysis reveals the following.

Scaling up the e-bus transition requires a comprehensive package, including charging and power infrastructure. Information and communication technologies will need to be integrated into operations, and operational requirements unique to the electric fleet into service planning. Formalizing an infrastructure plan that covers charging infrastructure and mechanisms, as well as an appropriate operational plan, is critical. Thus, we first considered (1) potential charging strategies; (2) relevant charging hardware; and (3) information technology (IT) backend solutions that can be used to create a seamless e-bus cyber-physical system. Finally, we (4) analyzed nine routes operated by CTA and evaluated their potential for electrification.

A hybrid charging strategy based on a combination of depot and opportunity charging, with the chargers located at depots, origin stops, and destination stops, is the only suitable choice for Egypt. This strategy relies on full overnight charging at the depot, filling the battery 100 percent. The bus then leaves the depot and begins operations, charging only at the original stop and the final bus stop (terminus). Depot charging alone does not allow sufficient range for a full day's operation. The shortest, mid-length, and longest routes in each corridors were considered, with estimated daily total driving distances ranging from 210.9 kilometers (km) to 507.4 km. CTA routes are exceptionally long, and electrification should be viewed as an opportunity to reorganize and improve the operational plan of CTA bus services.

The analysis recommends that buses be able to recharge at the maximum possible charging power at origin and destination stops. Buses typically spend a short time in a destination terminal before embarking on their return service. Thus, it is important to maximize the use of limited time to meet the operational requirements of each route.

Mitigating technical risks is at the core of determining specifications and charging strategies. The analysis shows that many CTA bus routes are extensive, often beyond the battery range of the electric fleet. The technical risks are high in light of the lack of dedicated bus lanes, congested traffic flows wherein large buses cannot compete with smaller motor vehicles, and high temperatures and the need for mobile air conditioning. Another concern is the risk of vandalism and theft of charging equipment in public streets.

Successful operations based on the proposed hybrid strategy depend on a fixed trip duration with reliable arrival and departure times. Deploying an e-bus fleet on CTA routes will be an opportunity to formalize and transform scheduled operations. Egyptian bus operators (such as Mwalsat Misr) have been known to take "shortcuts" to stay on schedule, by, for example, (1) skipping a trip to save operational costs; (2) resetting the clock; and (3) increasing terminal wait times. These actions in effect decrease the hours spent carrying paying passengers and increase the number of buses on the road. Adopting congestion protection through dedicated bus lanes and by giving buses priority at intersections is a profitable complement to electrification, as is "formalizing" CTA operations to increase service quality (Hegazy 2021a).

Successful e-bus systems rely on IT backend solutions with effective computational capabilities to manage the integration of EV charging infrastructure with the grid. Smart (controlled) charging functionality is necessary to be able to react to possible grid constraints (for instance, in power transmission, distribution, or local grids) and on energy demand and response commands that require integration with an e-bus management application. Based on the overnight plug-in charging systems, and combined with smart charging software, all the charging operations will be intelligently optimized in order to minimize the overall energy consumption and peak loads of the depot. By providing highly efficient infrastructure designed to be future-proofed against rapid advances in battery technology, the power range of the charging station should support bus operators with optimal flexibility when planning e-bus depots.

International and local IT standards need to be considered to avoid "stranded assets." The existing ICT infrastructure that public transport operators use suggests significant upgrade would be necessary to successfully materialize the benefit of electrification. Enhancing the ICT of public transport also aligns with the GOE's digital development initiatives such as government digital transformation plan[2]. The following IT functions are recommended for e-bus charging infrastructure:

- Remote monitoring and control to automatically start and stop the charging session
- An ability to forward the in-process charging status to the IT backend charging application
- A display of the details of each charging session (showing charging time and charged kWh)
- An ability to control the charging session to react to grid demand requirements

The technical operations of charging infrastructure (including monitoring and remote control of charging stations) and financial and business-to-consumer transactions (including contracts, radio-frequency identity management, and billing) should be considered.

In the initial phase of e-bus implementation, the focus should be on technical operations. In particular, adequate charging stations are key to upscaling the e-mobility market in Egypt (see annex). This includes (1) general selection criteria and requirements for the charging hardware infrastructure and (2) requirements and necessary IT functionalities of charging infrastructure.

Mobile cooling is a key aspect of achieving operational and energy efficiency gains. Technical interventions (figure ES.3) include more efficient subcomponents and materials for a vapor compression cycle (VCC) MAC, load reduction technologies, as well as deployment of sensors, automation, and intelligence. Alternative technologies include cooling systems that do not rely on vapor compression cycles, with the potential to eliminate the global warming potential of conventional refrigerants in a VCC MAC. Nontechnical measures include changes in consumption patterns and utilization processes to manage MAC load demand.

A total cost of ownership (TCO) analysis finds that, in the Egyptian context, e-buses are not yet attractive to operators from a financial perspective and will require sensibly designed interventions to unlock the potential. This is primarily due to the abundance and local production of fossil fuels, making diesel and compressed natural gas (CNG) fueled vehicles appear to be more efficient options. From an economic perspective, the case for e-buses is stronger but not as clear-cut as CNG vehicles, when considering additional nonquantified factors, such as additional grid connection and reinforcement costs, the greater complexity of implementation, and the reduced operational flexibility of e-buses. Cost signal will continue to be a motivation: for higher

2 https://mcit.gov.eg/en/ICT_Strategy

penetration of EVs, demonstration of technology robustness[3], reliability and service efficiency, and effectiveness of EV supply equipment will play important roles. A longer-term consideration will include raising the awareness among the general public and stimulating behavioral change towards greener and environment-friendly choices including local air quality.

Therefore, even though the transition to e-mobility is unlikely to occur overnight, it would be useful for Egyptian stakeholders to prepare for this transition and gain some experience with e-buses. To make it attractive for operators to launch trial projects, we assessed possible measures that the Egyptian government could consider to incentivize the adoption of EVs over nonelectric vehicles. These measures, if adopted, would help narrow the gap in financial costs for operators willing to experiment with newer technologies.

From a technical point of view, scaling up e-bus adoption in the Greater Cairo Region (GCR) requires reimagining public bus service provision and taking a holistic view of the entire bus system. The same findings apply to Alexandria and other cities in Egypt. In Cairo, electric buses will require the companies serving as public bus operators to have the required capacity and resources (which currently do not exist outside Cairo and Alexandria) that can meet the necessary operational constraints imposed by modern technology.

FIGURE ES.3. • Interventions and Measures for Mobile Air Conditioning

TI	Technical Interventions (TI)	1	Windows glazing	7	Refrigerant leakage prevention
		2	Zonal cooling	8	Solar reflecting paint
		3	Seat cooling	9	Default recirculation controls
		4	Heat exchanges	10	Condenser subcooling
		5	Product temperature simulant	11	Secondary loop + R152a refrigerant
		6	Demand controlled optimization		
AIT	Alternative & Innovative Technologies (AIT)	1	Magnetocaloric air conditioning		
		2	Thermoacoustic air conditioning		
		3	Vacuum-cooled water refrigeration		
NTM	Non-technical Measures (NTM)	1	Preconditioning		
		2	Shaded Parking / Charging		
		3	Ride sharing		

Source: Siemens AG.

Egypt Financial TCO Comparison for E-Buses

Scenario	Diesel	Diesel Hybrid	CNG	Battery Electric
Base case fuel—Differential useful life	0.40	0.41	0.40	0.46
Base case fuel—Equal useful life	0.40	0.41	0.40	0.53
Higher fuel case—Differential useful life	0.43	0.43	0.40	0.46
Higher fuel case—Equal useful life	0.43	0.43	0.40	0.53

Source: Original compilation.

3 The World Bank-financed Greater Cairo Air Pollution Management and Climate Change Project supports demonstration of electric buses for Cairo Transport Authority operation.

Egypt Economic TCO Comparison for E-Buses

Scenario	Diesel	Diesel Hybrid	CNG	Battery Electric
Base case fuel—Differential useful life	0.53	0.52	0.44	0.43
Base case fuel—Equal useful life	0.53	0.52	0.44	0.47
Higher fuel case—Differential useful life	0.57	0.55	0.44	0.43
Higher fuel case—Equal useful life	0.57	0.55	0.44	0.47

Source: Original compilation.

Business Model Considerations to Mobilize Private Capital

The study explores commercial options for mobilizing private investment in the operation of public transport electric fleets. The magnitude of needed investments in electrifying public transport fleet, along with infrastructure upgrades (e.g., charging equipment, electricity supply) is considerable. Cairo Transport Authority (CTA) alone has 3,000 strong large diesel buses, whose operational requirements suggests investments far greater than the capacity of the GOE to fund or finance. Therefore, consideration of a mechanism to mobilize private investment would be essential toward a scale-up. Two broad approaches can be employed in deploying public transport e-buses in Greater Cairo (and also across Egypt).

1. A **"quick delivery"** method where the goal is to achieve electrification in the shortest time possible.
    - This approach leverages the existing institutional landscape to accelerate electrification.
    - As the primary public transport operator in the GCR, the CTA is the central player in this approach. The CTA would be in charge of procuring assets and establishing contracts with the original equipment manufacturers and financiers.
2. A longer-term approach that envisions electrification as part of a **broader public transport overhaul and reform program**; this approach involves licensing routes to the private sector.
    - In this scenario, the Land Transport Regulatory Authority (LTRA) would regulate issuing tenders for the operation of certain routes. E-buses and charging infrastructure would be included as part of the tender requirements.
    - The tenders would be issued by different entities operating under the umbrella of the Ministry of Transport.
    - The variety of contractual arrangements may result in a longer implementation time but may have long-term benefits.

The results of the TCO analysis suggest that the second approach may be the most appropriate for the GCR because the financial and economic case for e-buses in Egypt is not clear-cut under prevailing conditions in the local transport and energy markets. The analysis supporting this conclusion is explained in the following sections. However, it should be noted that the choice of the preferred approach ultimately remains a policy decision of the Egyptian Cabinet.

Approach 2: Electrification as part of the overall public transport reform program. The Egyptian transport sector, as a whole, needs to be reformed to meet the region's future needs. If the goal is to improve the transport sector first, then the LTRA and the CTA (under the GCR governorates) **can start rationalizing and concessioning routes to private operators.** The concession tenders would require private operators to acquire e-buses. Presently in the GCR, separate concessions are granted to third parties in the New Urban Communities (NUCs). This process can be rolled out in the GCR and include requirements for electrification. Until e-buses become more commercially attractive, the Government of Egypt can gradually incorporate electrification in transport sector reform via pilot projects.

Regarding delivery options, the study recommends an operator delivery model through a competitive tender process to achieve better operational performance across the GCR. The main delivery options include (1) operator led, (2) public sector led through an AssetCo (the asset holding entity), and (3) third-party leasing. These structures are summarized in table ES.1, along with an assessment of their advantages and disadvantages. The operator model can be applied in the NUCs where the concessions are granted to third parties. This practice can be continued for the deployment of e-buses and related charging equipment.

With respect to financing, it is recommended that the government considers contributing partially to the fleet and charging infrastructure investment. The government can seek a loan from international finance institutions to refinance this payment obligation to the operator. A differentiation must be made between responsibilities for procurement

TABLE ES.1. • Delivery Options for Approach

Options	Operator	Public AssetCo	Third-Party Leasing
Explanation	• The operator purchases the e-buses and charging infrastructure. • The operator is responsible for maintenance and operations.	• The government procures the assets and secures the financing. • The assets are held and/or managed by AssetCo, with the government remaining the ultimate legal owner. • Operators lease the assets from AssetCo and are contractually bound to pay lease fees to AssetCo.	• A third party (e.g., a utility, manufacturer, or financial services company) purchases the buses and charging equipment. • Components are leased to the transport operator.
Benefits	• Life-cycle cost optimization between capital costs and operational costs becomes possible. • This is the most common model for e-bus systems worldwide and will be understood by the market (UITP 2021).	• Cheaper financing. • The government retains control of a key public service delivery asset, making it easier to switch operators. • With greater control over assets, the government retains greater flexibility and the ability to scale.	• Investment risks are shared among the parties. • Maintenance and operating costs may be reduced. • Life-cycle cost optimization between capital costs and operational costs becomes possible.
Drawbacks	• Since not all operators will have the necessary design and operational expertise for the charging infrastructure, competition may be affected.	• The public sector will have to fund the construction of the infrastructure (UITP 2021). • Limited experience in separating ownership and operation.	• It can cause a barrier to entry as it may result in infrastructure optimized for one manufacturer's equipment (UITP 2021).

Source: Original compilation.

in financing the fleet, and charging infrastructure investments.

- The financing of the assets to be acquired does not need to be organized by the same entity responsible for the procurement of those assets, and even in cases where the e-buses are privately procured and owned, they do not have to be (fully) financed by private capital.
- Options for financing private e-buses through public capital exist, for instance, in the form of an upfront capital subsidy or milestone payment under a public-private partnership (PPP) contract, and the initial upfront investment can either be made from public budgets or refinanced through (concessional) public borrowing. Some of these approaches may be blended.

Asset financing analysis, including advantages and disadvantages of public and private financing, is presented in table ES.2.

The deployment of e-buses can start in the NUCs. The governorate can issue tenders to hire operators on a PPP basis, and the PPP contracts are recommended to include initial government subsidies refinanced at concessional terms to reduce capital costs (figure ES.4).

TABLE ES.2. • Asset Financing: Private versus Public

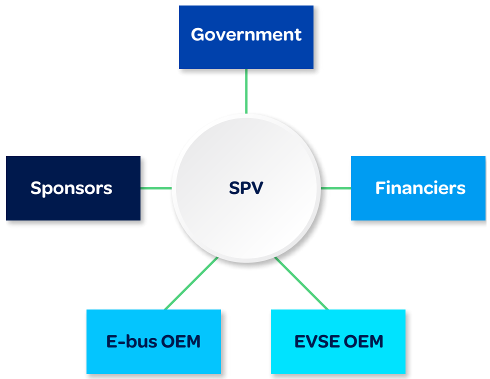
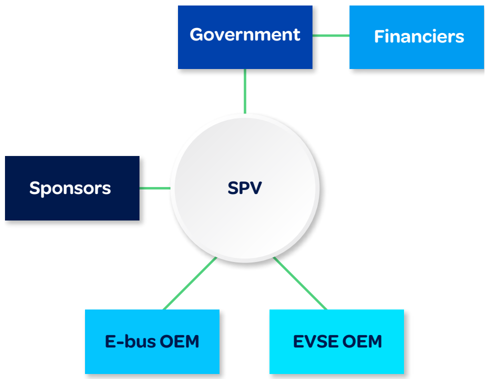
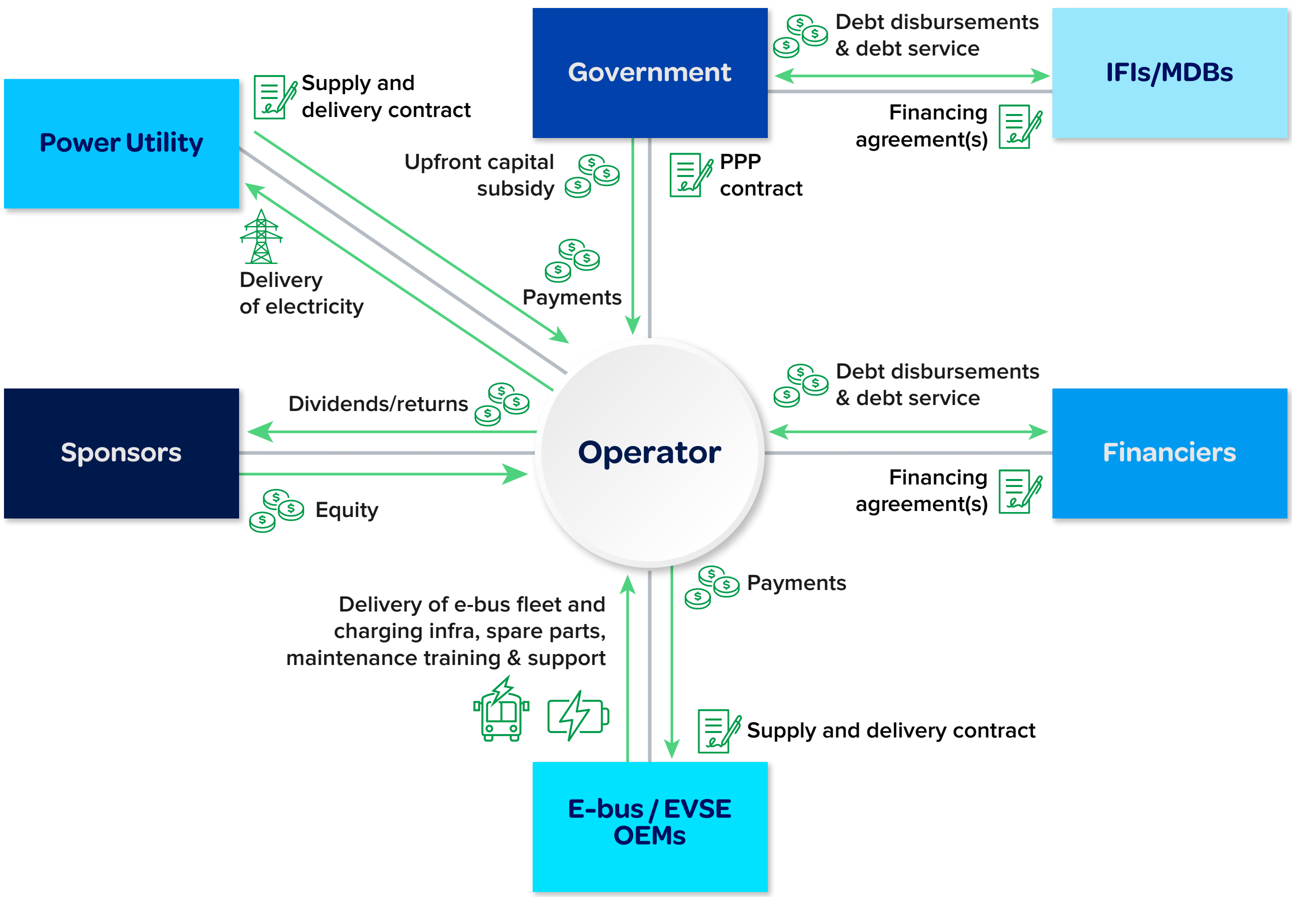
Options	Private Financing / Public-Private Partnership	Public Financing
Structure		
Explanation	A public-private partnership (PPP) is set up through a special purpose vehicle (SPV).	• The government arranges financing through a multilateral development bank, national bank, or other partner. • The government then passes the financing through to the SPV.
Benefits	Allows for a **more optimal risk allocation** between the public and private sectors and, thus, better risk management.	• Typically **comes with a government guarantee** or other credit enhancement support to mitigate any credit risk. • **A simpler contract structure for the government to manage.** • Provides more **flexibility and scalability** due to greater public sector control over assets and the decoupling of funding sources and asset procurement.

Table continues on next page

Options	Private Financing / Public-Private Partnership	Public Financing
Drawbacks	• Setting up a PPP has **higher transaction costs.** • The contracts are **more complex** due to transfer of risk to the private player(s) and long-term commitments. • Typically established through a competitive process, leading to a longer procurement period. • Requires **close monitoring** to verify compliance with contract terms and conditions. • Financiers will most likely **require a government guarantee** if the SPV defaults on its financing obligations, increasing the government's condition liability.	• No supervision from third-party lenders. • It is **public money**, so the government is stuck with the assets even if they are not of the expected quality. • Longer approval process, especially for concessional loans from development partners. • **The borrower must meet more constraints and conditions in** reporting, environmental and social standards, etc.

Source: Original compilation.

FIGURE ES.4. • Recommended Contractual Structure of the Operating Model



Source: Original compilation.

Note: EVSE = electric vehicle supply equipment; IFIs = international financial institutions; MDBs = multilateral development banks; OEMs = original equipment manufacturers; SPV = special purpose vehicle.

TABLE ES.3. • Priority Policy Actions

Pillar	Policy / Action	Type	Led by	Horizon	Description
Local Manufacturing	**Policy 1-1a:** Training programs	Capacity building	MoPBS and MoHE	Short term	Training programs for technical institutions and curriculum for BSc programs at public universities.
	Policy 1-2: EV manufacturing/ assembly lines	Government funding	MoMP and MoPBS	Short term	Announce competitive tendering to ensure fair competition and allow market players to showcase their offers.
	Policy 2-2a: Reduce electricity prices	Financial incentives	MoERE	Short term	Introduce a predictable tariff scheme for charging e-buses for depot overnight charging and opportunity charging at bus stops.
	Policy 2-2b: Increase diesel / natural gas		MoPMR	Medium term	Gradually increase diesel and natural gas prices.
	Policy 2-4a: Import tariff on e-buses		MoTI	Short term	Abolish the 40% import tariff applied on e-buses, similar to passenger vehicles, in accordance with presidential decree no. 419 / 2018.
	Policy 2-4b: Import tariff on ICE fleet		MoTI and MoE	Medium term	Increase the import tariff on CNG and diesel buses based on their emission levels set by MoE.
	Policy 2-5: Toll exemptions	Nonfinancial incentives	Cairo Governorate and NCRCD	Short term	Exempt e-buses from paying tolls.
	Policy 2-6: LEZ exemptions		MoE and Governorate	Short term	Define LEZs through MoE while exempting e-buses.
	Policy 2-7: Parking slots at terminal buses	Regulation	Cairo Governorate	Short term	Dedicate exclusive parking space for e-buses for opportunity charging at terminal stops.
	Policy 2-9: Emissions standards		MoTI and MoE	Medium term	Introduce clear and ambitious emission targets for manufacturers and dealerships aiming to sell their vehicles in Egypt, similar to those in leading countries.
Charging Infrastructure	**Policy 3-1a:** Train DisCos on grid planning	Capacity building	MoERE	Short term	Provide capacity building for DisCo engineers on grid planning concepts and tools, e.g., Siemens PSS®/E and PowerFactory.
	Policy 3-7: Charging permits	Regulations	MoERE and MoHUD	Short term	Develop building codes for charging stations.
	Policy 3-8b: Charging tariff		MoERE (EgyptERA)	Medium term	Offer a competitive and flexible tariff structure, e.g., ToUs and real-time pricing.
	Policy 3-9: Charging standard		MoERE (EgyptERA)	Short term	Ensure a unified national standard is in place for both charging stations OEMs and vehicle OEMs.
	Policy 3-10: CPO competition		MoERE and ECA	Medium term	Ensure regulations are in place to guarantee fair competition and prevent monopolistic practices.
	Policy 3-11: Interoperability		MoTC	Medium term	Ensure interoperability between different CPOs to allow operators to charge from any charging point.
	Policy 3-12: Re-introduce net metering		MoERE and EgyptERA	Short term	Introduce mechanisms, e.g., Fit, net-metering for RE with generous tariffs to attract local developers.
	Policy 3-13: Introduce a GoO certification scheme			Short term	Develop GoO scheme to allow electronic trading in the voluntary market for RE certificates.

Source: Rebel.

Note: Short term, 2022–25; medium term, 2026–35; long term, 2036–40.

CPO = charge point operator; DisCo = distribution company; ICE = internal combustion engine; LEZ = low emission zone; OEM = original equipment manufacturer; RE = renewable energy; ToUs = times of use.

Recommendations

The study recommends the following policy options, classified under three pillars: (1) localize EV technology and deepen local manufacturing; (2) scale up e-buses; and (3) enable the charging infrastructure and synergize with renewable energy sources (table ES.3).

Recommendations for each pillar include:

- **Regulations:** Essential to upscale the market in its early phases. As witnessed in Egypt, a lack of proper regulations can prevent consumers from buying EVs. There were no technical specifications at the Ministry of Interior to register passenger EVs, typically registered for internal combustion engine vehicles based on their cubic capacity.
- **Capacity building:** Develop the local workforce by specifically minimizing reliance on external experts as sources of knowledge, resources, and solutions to e-mobility issues.
- **Nonfinancial incentives:** These complement financial incentives by providing practical reasons and benefits for using EVs over internal combustion engine vehicles. They may take the form of nonmonetary benefits, such as toll exemptions and priority to drive in low-emission zones.
- **Financial incentives:** These offer a good way of encouraging the purchase of EVs, whose price is considered one of the top deterrents for customers. Financial incentives are mostly at an early stage, given the different adoption barriers.

WORLD BANK GROUP

INFRASTRUCTURE
#BuildingBetterLives

ESMAP

MOLO
eMobility

PPIAF
Enabling Infrastructure Investment