

A close-up photograph of a person's hand with light-colored nail polish gripping a green fabric strap hanging from a train. The person is wearing a dark brown leather jacket with a visible zipper. The background is a blurred view of a train window showing a cityscape with buildings and a blue circular sign. In the top right corner, there is a green square containing the white number 3, followed by a light green rectangular bar.

3

# (Vector 1). Intentional complementary development of electrified public transportation, micro-mobility and mobility-as-a-service (MaaS)

A potential outcome along this vector, circa 2040: Decision makers in the region have made deliberate and well-planned efforts to scale the build-out of electric-powered public transportation (buses, rail, other) – the “big end” of the e-mobility spectrum – in tandem with boosting the growth and usage of electric micro-mobility vehicles (scooters and other two- and three-wheelers) and the tech-enabled MaaS industry – the “small end” of that spectrum. These choices, expressed through policies, investments and other actions, have resulted in significant job creation, increased and easier access to job and other opportunities (especially for the least advantaged persons in countries throughout the region), population health improvements and other economic and social equity and wellness gains. Governments and other institutional actors have continued to promote consumer adoption of electric cars but have prioritized development of these “big” and “small” ends of the e-mobility spectrum as a symbiotic e-mobility model. This intentional strategy has had the expected result – advancement of each end of the spectrum helps boost the other, and both together boost societal benefits more than either could by itself.

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## A. Electric cars are only one element of the burgeoning e-mobility landscape in Arab countries and globally

The transition to an electric car future is incontestably gaining momentum. The amount of attention to electric cars in the media, policymaking bodies, and stock markets and board rooms is significant, and growing. It would be easy to think that four-wheeled personally owned electric cars are the only EVs proliferating around the world, and it is easy to understand why. The major global automakers are very public about commitments they are making to the transition to electric, and multi-billion dollar investments by multi-billion dollar companies command attention. BMW plans to increase its production and sales of e-cars by more than 50 per

cent by 2025, a tenfold rise over 2020. Over that same period General Motors is investing \$35 billion in electric car and autonomous vehicle product development, more than its investment in gas and diesel. Stellantis (the former Fiat Chrysler) plans the same level of investment over the same five-year period. A growing number of automaker OEMs have announced their cessation of manufacturing or selling ICE cars in favour of only electric ones, including Nissan, Audi, GM, Honda, Volvo, Ford and Mercedes-Benz.<sup>55</sup>

At the same time, but with much less recognition, adoption of other types of EVs is also increasing, and at significantly greater rates of growth. In 2021, e-scooters and other electric two- and three-wheelers were 42 per cent of EV sales, and electric buses represented 44 per cent, against 9 per cent for e-cars. There are 16 times as many electric two- and three-wheelers on roads in 2022 globally than there are electric cars. Electric cars, though increasing rapidly, as yet are only 1.6 per cent of total global cars, while e-buses make up 13 per cent of the global bus fleet.<sup>56</sup>

As the popularity of “micro-mobility” rises, the growing number of electric two- and three-wheelers are emerging as a pivotal element of another growing trend of MaaS. MaaS integrates a variety of modes of transport (scooters, bikes, car-sharing, ride-hailing) and transport-related services (for example, food or product delivery and other “quick-commerce” also known as “Q-commerce”) into a single, comprehensive, on-demand experience for users. Many aim to connect these individual mobility modes to public transit. Entrepreneurial companies emerging in the MaaS space generally manage both the customer experience and the coordination of connections between different mobility modes through an app that also serves as a single payment channel, obviating the need for multiple ticketing and payment operations.<sup>57</sup> The growth of electric two- and three-wheelers is seen as a key source and enabler of the growth of the MaaS model globally.

Growth of interest in and development of electric-powered public transportation, electric-powered micro-mobility and MaaS all are already happening in the Arab region. That growth is anticipated to continue over the next decade and beyond, and has the potential to scale. It also has great potential to integrate into a transformative e-mobility model.

## B. Public transportation systems in the Arab region are increasingly going electric

Millions rely on public transportation throughout the Arab region. Still, in many parts of the region public transport is underdeveloped, and benchmarking by the MENA Centre for Transport shows many Arab cities ranking low in metrics like transport supply (buses per million population) and ridership. In some cases, this is the result of what the World Bank calls the “underfunding trap”. They describe how “cities in developing countries require ambitious investments to expand and improve their urban transport system, but the total funds available are usually only a fraction of what is needed”. This is because “actual expenditures for maintenance of existing assets are insufficient”, precluding capacity expansion or for modernization such as transitioning to electric vehicles. While this is true in Arab countries, it is also true that investment in public transport is on the rise in the region, and the emphasis is on EVs and fully electrified systems.<sup>58</sup>

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## 1. Arab region electric public transit is in growth mode

While public transportation has not historically been a priority in the GCC countries, this is changing as the Arab region as a whole makes the transition to renewable energy. One element of the Dubai Green Mobility Initiative, adopted and launched in 2016, is to procure Euro VI fuel standard-compliant buses and over time increase the share of hybrid electric (HEV) and battery electric (BEV) taxis to 50 per cent. Dubai has been testing wireless dynamic charging for electric buses in preparation for future deployment of electric buses. The city's overarching aim announced in 2021 is to make public transport emissions free by 2050. In February 2021, electric buses were launched in Abu Dhabi powered by the fastest-charging lithium battery in the world (lithium-titanate-oxide), capable of charging in less than 20 minutes. The launch will be followed by a deployment of these buses in other Gulf Cooperation Council (GCC) countries. Abu Dhabi plans to deploy additional electric public buses in its transit system in preparation for the United Arab Emirates hosting COP28 in 2023. The United Arab Emirates is also investing in electric railway networks (Etihad Rail) with the potential to reduce greenhouse gas emissions by 70-80 per cent and displace hundreds of diesel trucks from the country's roads. Dubai's electric metro is also autonomous, the world's largest driverless metro system.<sup>69</sup>

Qatar has been working toward a target of 25 per cent electric public transit bus in preparation for hosting the FIFA World Cup in November 2022. The final delivery of this e-bus fleet was completed in April 2022, and the buses will run on more than 50 public transport routes in the country by 2023. Qatar has announced plans for its entire public transport system to run 100 per cent on electric power by 2030. Saudi Arabia is investing \$25 billion in its electric railway infrastructure in three "mega-projects" totalling nearly 4000 km of track length. Riyadh and Jeddah have growth plans for over 300 km of new networks on their electric driverless metro lines. In March 2020, the country took delivery of 20 electric buses developed by Chinese company Zhuzhou CRRC Times Electric Company. These smart electric buses are especially developed for Saudi Arabia, with radiation-resistant and cooling effects customized for the extreme heat of the local operating environment.<sup>60</sup>

In Egypt, a new high-speed 1,800 km rail network with fully electrified main and freight rail lines will open in 2023. The estimated \$4.5 billion project will connect a port on the Red Sea to two ports on the Mediterranean Sea. As part of a six-year Greater Cairo Air Pollution Management and Climate Change Project with the World Bank announced in September

2020, Egypt is piloting electric buses in that city while assessing the technical and financial feasibility of scaling the bus fleet throughout the country. After a battery-electric bus (BEB) pilot in Alexandria, buses and charging infrastructure became operational in the city's transit system in May 2020. The European Bank for Reconstruction and Development's Green Cities programme is providing a €14.8 million loan to the city of Amman in Jordan for 15 electric buses and 136 Euro V fuel standard diesel buses. Electric public transit projects in Morocco include a solar plant-powered bus rapid transit (BRT) pilot in Marrakesh, with plans for 48 additional buses by 2030, supported with funding from the United Nations Development Programme (UNDP) and the Global Environment Facility. Another initiative in Morocco is an e-bus public-private partnership with Mercedes that will introduce a new "eCitaro" electric bus for a test period in the city of Rabat. The electric high-speed Al Boraq train line connects Casablanca and Tangier. Tunisia is also piloting electric BRT in its capital city and its local automotive industry plans to begin the manufacture of e-buses in the future.<sup>61</sup>

## 2. The need for increased clean public transportation in the Arab region is urgent

The need for increased public transportation in the Arab region is urgent for a number of reasons, and the importance of fuelling new public bus and rail options with clean energy is clear. Chief among the drivers for increasing clean public transport are population growth, traffic congestion, public health risks and equity.

The world's fastest-growing populations are in the Middle East and Africa (both North Africa and sub-Saharan Africa). By 2050, an estimated half of the countries in the Middle East and North Africa are projected to see their populations rise by 50 per cent or more from 2015 levels. Most of the growth will take place in cities – Cairo for example is expected to grow from 20 million to 30 million over the decade to 2030, and Riyadh from its current 7.5 million to more than 10 million by 2030. In addition to unemployment (mainly young people), potential unrest and other issues, these population rises will increase traffic, congestion and resultant CO<sub>2</sub> emissions in the absence of more public transportation that is powered not by diesel but by electricity.<sup>62</sup>

Traffic congestion caused by the very large numbers of personally owned cars and other ICE vehicles in large cities in the Arab region has material and measurable negative effects. Analysis by the World Bank in 2014 calculated the



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toll of projected traffic congestion in 2030 in Cairo alone on Egyptian GDP. Considering impacts including lost productive time, unreliability of timely arrival of workers and goods, safety (deaths and injuries in accidents) and damage to health and infrastructure from emissions, the assessed cost to the economy was nearly \$18 billion annually.<sup>63</sup> Comparable figures can be anticipated for other large densely populated cities in the Arab region. The opportunity cost of reduced attractiveness of these cities to new businesses must be considered as well. Attention to these effects is essential. The Sustainable Mobility for All (SuM4AllTM) Initiative assessed the lack of understanding of the short- and long-term negative economic and social impacts of the current mobility paradigm as one of the key barriers to the development of sustainable

electric mobility.<sup>64</sup>

Estimated health damages (globally) from transport tailpipe emissions reached a cumulative value in 2015 of approximately \$1 trillion by one 2019 analysis. In another study, adoption of progressive vehicle emission and fuel standards would reduce the number of premature fatalities in urban areas in 2030 by 33,000 in the Middle East and 25,000 in Africa. Electric and other clean-powered public transport can mitigate the health effects of transport-related pollution in the Arab region by reducing the need for cars and shifting car drivers to more efficient and non-carbon-producing buses, metros, trams, trolleys, etc. Analyses indicate that a daily 20-mile car trip shifted to public transportation can reduce CO<sub>2</sub> emissions by 4,800 pounds per year.<sup>65</sup>

## C. Arab region markets for electric micro-mobility and MaaS are also experiencing growth with high investment potential

As noted, the demand for e-micro-mobility is growing; as in other emerging markets, estimates of the scale and pace of that growth vary. McKinsey put the global market for electric two-wheelers and three-wheelers at \$97 billion in 2020, equivalent to 4 per cent of global automobile sales and projected to rise to \$150 billion in 2022. Other market forecasts are more modest, estimating \$41-44 billion in 2020 rising to \$198-215 billion in 2030, a compound annual growth rate of 17 per cent over the period. These EVs are most prolific in Asia – today China represents 30 per cent of the global market, and more than 80 per cent of scooters in China are electric. But e-two- and three-wheelers and MaaS are gaining in Europe, Latin America and the United States, and are just beginning to do so in the Arab region. By one estimate, the MaaS market is projected to grow from \$3 billion in 2021 to \$40 billion in 2030, a 32 per cent compound annual growth rate.

The growth of the MaaS market is influenced by the growing number of smart city initiatives, buildout of 4G and 5G infrastructure and smartphone penetration among other factors – all of which are increasing in the Arab region.<sup>66</sup>

In the Arab world, e-micro-mobility and MaaS are to date taking off most and most quickly in the GCC, and especially the United Arab Emirates. The Dubai Roads and Transport Authority (RTA) in October 2020 announced an e-scooter trial project in five major zones of the city, as part of the United Arab Emirates Energy Strategy 2050. After obtaining customer satisfaction survey scores of over 80 per cent, the project expanded to 10 zones and is planned to expand further to 23 new districts. Another RTA project, with local micro-mobility and MaaS start-up Careem, is a bike rental (bike-share) service that recently entered a Phase 2 by adding 950 pedal-

assisted e-bikes and 95 pickup/drop-off stations. Plans are for 3,500 e-bikes and 350 stations in the future. In 2021, Dubai also unveiled its Bicycle-Friendly City Strategy 2025 with a total investment of 400 million AED and a 15-year contract with Careem.<sup>67</sup>

Established micro-mobility providers from the United States and Europe see the potential in the Arab region and are moving to accelerate it. Lime (US) launched an e-scooter fleet in the region in October 2020, as did TIER (Germany), the provider in the expanding Dubai RTA trial. TIER leveraged \$60 million from Goldman Sachs to fund this expansion. But the growth of this sector in Arab countries increasingly is organic. Dabeeb and Gazal are two EV-based micro-mobility start-ups in Saudi Arabia. Arnab, founded and based in the United Arab Emirates, describes itself as “a digital innovation company in the micro-mobility space which integrates global innovations in urban and personal mobility with light electric vehicles (LEVs)”. In a recent interview their CEO argued that micromobility devices can and will qualify as a mainstream type of transport in the Arab region over the next decade, and one that fuels economic development for individuals and businesses. Half of Arnab’s existing e-scooter fleet today is used for transporting people to and from their workplace. One Moto (United Arab Emirates) offers electric motorcycles, bikes and scooters including vehicles they designed and manufacture, and is expanding to serve Bahrain, Egypt, Jordan, Qatar and Saudi Arabia as well as countries outside the Arab region. They are focusing on the B2B segment, which accounts for 90 per cent of its operations. Fenix (United Arab Emirates) is operating in Bahrain and Qatar in addition to several Emirati cities.<sup>68</sup>

Outside the GCC, micro-mobility and MaaS are emerging more slowly, but are expected to expand in some of the larger, denser, more congested cities in a number of Arab countries. Several micro-mobility start-ups have been founded and begun operations in Egypt. One is RabbitMart, focused in addition to personal mobility on Q-commerce deliveries of food or other small consumer items from nearby fulfilment centres to homes in 20 minutes or less. The company’s founders are working to move beyond its initial limited scope in gated communities, “excited about a solution that will alleviate the pressure of the transportation scene and solve the short-distance commute problems” that plague large Egyptian cities. More than 40 per cent of Rabbit’s revenue is now from day rentals of its scooters in congested areas such as downtown Cairo and Zamalek. Another Egyptian start-up, Halan, began as a micro-mobility provider with electric two- and three-wheelers and ride-hailing and has since moved into the MaaS and “super app” space offering fintech services like bill payment, buy-now-pay-later (BNPL) e-commerce and micro and consumer loans.<sup>69</sup>

Car sharing is part of the MaaS equation in the Arab region as it is globally, and the cars increasingly are electric. Ekar, the region’s first and largest car-sharing platform, embarked on plans last year to more than double its workforce in Saudi Arabia after increasing demand grew the company’s revenue by 16 per cent in 2020. In late 2020 they began a new dimension of their business operations with Ekar Fleet, for car rental companies to upload their spare cars to the app. The company expected 400 per cent overall growth in 2021. Other car sharing start-ups in the region include Careem as well as Udrive, the first provider in the Middle East offering rental by



the minute. Capital is flowing into the Arab MaaS and e-micro-mobility sector, with significant (in some cases multi-million dollar) funding rounds in the last several years to Dubai- and Riyadh-based car subscription start-up Invygo, Riyadh-based car rental platform Telgani, United Arab Emirates-based Fenix's e-scooter sharing and super app company and others. Swvl, a ride-sharing company based in Cairo and Dubai, last

year went public in a merger with special purpose acquisition company Queen's Gambit Growth Capital in a deal that valued Swvl at \$1.5 billion. In July 2022, the Dubai Taxi Corporation added the Tesla Model 3 to its fleet in a new trial, following the introduction of earlier Tesla models in 2017 and with the aim of converting 90 per cent of the limousine fleet in Dubai into eco-friendly vehicles (hybrid/electric) by 2026.<sup>70</sup>

## **D. Electric public transit, e-micro-mobility and MaaS can have symbiotic impact through deliberate co-development**

Electric-powered public transportation has clear and significant potential to mitigate the negative health, economic, climate and other externalities of high numbers of ICE cars in Arab countries and the high volume of traffic they create on the region's roads. Electric-powered micro-mobility and the rapidly emerging MaaS ecosystem have great potential to empower residents of the region with access to goods and services, low-cost short-distance trips, employment opportunities and more. The additive and mutually reinforcing impact of each is projected to increase in a future in which the "big end" and "small end" of the e-mobility spectrum are developed in tandem as a deliberate objective.

Steps toward transit-oriented development (TOD) are being taken in countries around the world including in the Arab region. The World Bank describes TOD as a "planning and design strategy that consists of promoting urban development that is compact, mixed-use, pedestrian- and bicycle-friendly and closely integrated with mass transit by clustering jobs, housing, services and amenities around public transport stations".<sup>71</sup> Benefits include increased job density, increased economic productivity by collocating jobs with means of accessing them for residents at all income levels, increased real estate value through improved access to TOD neighbourhoods, reduced carbon footprint and more. Dubai began transit-oriented development initiatives nearly a decade ago with projects replanning districts around metro stations. The Union Square Project was described by RTA executive director at the time as the first TOD destination in the Arab region. In 2016 the RTA identified additional locations for transit-oriented development along the Dubai Metro Route, and in 2018 the Saudi Ministry of Transport (MOT) was evaluating TOD projects potentially related to the Riyadh metro and public-private partnership projects in Mecca, Jeddah, Medina and Dammam.<sup>72</sup>

Electric micro-mobility and MaaS have the potential to help make TOD more effective and solve many of the transport-related problems that cities in the Arab region face. The most important benefit lies in improving access to public transport

by solving the first- and last-mile problem through micro-mobility and MaaS. More reliable and flexible scooter, bike, ride-sharing and other e-mobility options and availability can facilitate the use of public transportation in place of personal cars. In the Arab cities that have micro-mobility and MaaS, they are not yet optimally connected to public transit systems in ways that maximize the potential of the entire multimodal transport ecosystem. Additionally, throughout the region, infrastructure to accommodate and enable micro-mobility, such as dedicated bike lanes for e-scooters and e-bikes, is largely absent. Abduljabbar Mohammed, a retired Arab municipality assistant engineer, noted in a recent interview that "our streets are designed for the easy movement of cars ... the urban designs were not dedicated to accommodate pedestrians or bikers".<sup>73</sup>

As micro-mobility and MaaS spread in the region, alongside public transport systems expanding and modernizing with EVs, proactive design of these interconnections and enabling infrastructure has the potential to increase the benefits of investment in all modes beyond the benefits they could provide individually. The Institute for Transportation and Development Policy shows that integration of micro-mobility options and MaaS coordination mechanisms into public transit systems and infrastructure "improves the reliability, affordability, and flexibility of multimodal trips; increases ridership across modes; and expands the population within an accessible distance to transport stations". One key to successful integration creating symbiotic effects are strong working relationships between private sector entrepreneurial operators and public system officials. Another step would be shifting the focus of regulation on micro-mobility to foster its potential to fill in gaps in public transit systems. Physical infrastructure modifications like linking cycle lanes to transit stations and building micro-mobility pickup/drop-off and charging docks at the stations also will be important.<sup>74</sup>

In the Arab region as elsewhere, public transport operators and their governing authorities, along with operators and providers in the e-micro-mobility and MaaS sectors,

are recognizing and acting on shared interests in creating integrated mobility ecosystems. The companies are building their businesses around social good objectives. Fenix describes its mission as helping residents in the region “Reach Your Potential”, enabling “faster, more affordable, and better connected journeys so you are empowered to do what you’re meant to”. Swvl’s founder and CEO Mostafa Kandil describes “mobility and the empowerment that comes with it” as “a fundamental right for all”. The foundation of the MaaS business model is to design software interfaces to link mobility providers who have infrastructure in place, including public transport providers. Micro-mobility providers also see it as part of their purpose to “play a significant role in addressing the challenges of first- and last-mile connectivity in accessing public transport” according to Zaid Al Mufraih, co-founder of Gazal. He adds that “Gazal’s goal is to contribute to creating an integrated transport system”.<sup>75</sup>

Deliberate development of e-micro-mobility, MaaS and electric public transportation as complements to one another represents an opportunity not only to provide more seamless travel experiences and advance climate change adaptation in the Arab region. It also supports broader social good and development outcomes like access to opportunity and social inclusion. It will require entities in all three sectors to work together to “understand the challenges and opportunities of multimodal integration in an increasingly data- and technology-driven mobility market, and co-create a governance and regulatory framework for how the transport system should evolve to support broader social, environmental, and economic goals”.<sup>76</sup>

### Battery cost

and supply is the single greatest factor in pricing



**EVs**, and global battery production increased in 2020 by **33 per cent** from 2019 as the average cost of batteries **declined 13 per cent** in the same period.

## E. As e-car growth becomes self-sustaining, Governments can focus their support on e-public transit, e-micro-mobility and MaaS

Prioritizing the “big” and “small” ends of the e-mobility spectrum will require Governments in the Arab region to devote significant financial and other resources. In the region as in the rest of the world, much of the promotion of EVs has involved incentives to consumers to purchase cars, in the form of tax credits, waivers of import and customs duties and other monetary measures. Today the most developed EV markets – China, elsewhere in Asia, Europe, the United States – have gotten there in part through such costly subsidies.<sup>77</sup> Some countries in the Arab region have followed in that path. Authorities in the United Arab Emirates have provided incentives for electric car purchases including free charging, bonus warranty for EVs, discounted car registration and renewal, free parking in certain areas and toll exemptions, with overall savings of around \$6,000 for owners. The lead by Jordan over other countries in the region in total EVs in operation is due in part to tax exemptions and custom duties. The Egyptian Government has pledged to subsidize the costs of the first 100,000 locally produced electric cars, albeit to boost in-country manufacturing as well as EV adoption itself.<sup>78</sup>

But in today’s most successfully growing EV markets, sales are rising rapidly due to a variety of factors, and growth in demand is becoming self-sustaining irrespective of subsidies. The Arab region (and other developing EV markets) are anticipated to benefit from this effect. This can free resources for electric public transport projects and to support the e-micro-mobility and MaaS sectors.

What are the factors making market dynamics overtake incentives to consumers as the accelerant of EV adoption? EVs are projected to reach price parity – in any and every global market – by 2028 even in Bloomberg NEF’s more pessimistic scenario assessment. Battery cost and supply is the single greatest factor in pricing EVs, and global battery production increased in 2020 by 33 per cent from 2019 as the average cost of batteries declined 13 per cent in the same period. Lithium-ion batteries are now 30 times less expensive than 30 years ago, and the cost is projected to fall below \$100 per kilowatt-hour by 2023. The trend in battery price will continue driving down EV prices to the consumer with the potential to make subsidies unnecessary in a few years in the Arab region. Morgan Stanley analysts in 2021 told investors “we would not be at all surprised to see the prices of many EVs eventually fall to below \$5,000 per unit”. There are already some ultra-low-priced EVs for sale in China (the \$4,500 Hong Guang Mini from SAIC Motor) and Europe (the \$6,600 Citroën Ami) that could find markets in Arab countries.<sup>79</sup>

Arab region Governments can and should continue promoting the purchase of personally owned electric cars. But they can do so through policies and other actions that do not require

financial resources that could go instead to electric public transit and promoting micro-mobility and MaaS.

The carbon reduction pledges most Arab countries have already made in the COP context are part of that menu of policy options, as the transport sector will be compelled to reduce its share of emissions. There are other non-fiscal measures Arab Governments can take to promote consumer EV adoption while preserving resources to support a complementary e-public transit, e-micro-mobility and MaaS electric mobility ecosystem. Options include zero-emission vehicle mandates, vehicle miles travelled targets, stringent fuel economy standards on ICE vehicles and bans on the sale or import of ICE vehicles (including used vehicles). Fuel quality regulation in the region is driven to a degree by export market requirements, creating a self-interest in adopting European fuel specifications that would push car owners toward EVs. It is anticipated that most countries in the Middle East region will revise fuel economy standards in the near future. To date no Arab country has joined the 25 countries that have set ICE vehicle phase-out target dates, but this could be another measure in support of the objective of prioritizing government e-mobility financial support on the “big and small ends” of the spectrum.<sup>80</sup>

## **F. An intentional complementary “big end, small end” focus has a prospect of creating a virtuous circle of social good**

As electric-powered micro-mobility and MaaS help boost usage of electric-powered public transportation in the Arab region, greater ridership can be anticipated to increase the return on investment in transit systems. Public

transportation expansion will similarly fuel the growth of micro-mobility and MaaS. Intentional integrated development of these two ends of the e-mobility spectrum can be expected to additively increase each end’s benefits for Arab



populations, in the form of greater economic opportunity, equity and inclusiveness and public health.

World Bank analysis projects nearly 140,000 direct and 440,000 induced jobs and an additional 0.48 per cent GDP growth in the Arab region for each billion dollars of public infrastructure investment. As a growing number of public transportation infrastructure development projects are anticipated to deploy e-bus fleets and electric rail and light rail systems, the transition to e-mobility in this sector will increase employment in the region. As an e-micro-mobility and MaaS ecosystem grows in the region integrated with public transit, it will be easier and less time consuming for workers to get to these and other jobs. A survey by Lime in Washington, D.C. revealed that 44 per cent of their riders used the shared e-scooter to go to their current job, a usage that can be anticipated in Arab countries and elsewhere as e-micro-mobility expands. And the sector is already creating and will create new jobs of its own, in Q-commerce delivery, other e-scooter- and e-bike-enabled services, maintenance of micro-vehicle fleets and charging infrastructure and more. While the scale of job creation in the Arab region would be well less by comparison, a study that extrapolated micro-mobility behaviour across more than 100 cities, synthesized with other scenarios and projections, estimated the deployment of the technology could create up to a million jobs in Europe by 2030.<sup>81</sup>

Investment in public transit will also boost women's participation in the Arab region's labour force. More than 40 per cent of women surveyed in Jordan are reported to have turned down employment opportunities for lack of access to viable transport. Safety and economic concerns of women throughout the Arab region clash with the reality of often

expensive, inadequate and unreliable public transport systems to commute to work. Public transportation improvements, whether electric powered or not, would mitigate these challenges, but most new projects in the region are anticipated to be for e-buses and electric rail and light rail. IMF estimates a 20-40 per cent gain in per capita GDP across the Arab region if women were able to participate fully in economic activities. Development and deployment of e-scooter, e-bike, car-sharing and other options will contribute to the increased access to employment opportunities by women and other less advantaged communities, and even more so when they are integrated with public transport.<sup>82</sup>

As noted, accelerated adoption of clean vehicle and fuel policies would also reduce early deaths by 80 per cent in the grouped Middle East, Africa and smaller Asian-Pacific markets by 2030. Electric buses and rail will substantially reduce economic costs stemming from traffic congestion and resultant air pollution to which ICE cars substantially contribute. Globally, investment in urban public transport is estimated to be able to reduce the sector's emissions by more than half by 2030. Expansion of electric-powered and other clean public transportation would reduce the health risk to the population across the entire Arab region, virtually all of whom are exposed to pollution levels that are deemed unsafe according to World Bank data. In 2019, exposure to excessive PM2.5 levels was associated with almost 300,000 deaths in the region. A significant portion of these emissions was generated by cars and other vehicles on the roads. Over a lifetime in the region, these pollutants at these levels are estimated to be the cause of 70 sick days. They also entail large economic costs for the region, totalling more than \$140 billion in 2013, around 2 per cent of its GDP. An e-mobility



ecosystem centred on integrated public transit, micro-mobility and MaaS could have unique impacts on reducing

these and other public health risks in the Arab region.<sup>83</sup>

## G. Key challenges in pursuing this e-mobility pathway

Progression on this pathway to an Arab region e-mobility future faces some key challenges that are foreshadowed in the preceding narrative.

### 1. Financing of public transportation and urban redevelopment projects

Building public transportation infrastructure is costly in the Arab region as it is in other parts of the world. It is promising to see the level of commitment to such projects in many countries of the region. Saudi Arabia, the United Arab Emirates and Iraq each have project pipelines of between \$50 billion and \$60 billion. There is a total of more than \$50 billion in high-speed rail projects across the region as a whole.<sup>84</sup> As described above (and in other sections of this report), the majority of ongoing and planned projects are for electric-powered public transport. While it will be easier to devote funding to such projects in the GCC countries, other countries in the region face financial difficulties in building what is needed to move to an e-mobility public transit future. As Abduljabbar Mohammed notes, “streets can be re-imagined and humanized to accommodate micro-mobility devices. However, this needs a national strategy and a lot of money to be invested”.<sup>85</sup> Sources of funding will need to be explored including private sector investment, and funding support from multilateral development banks, other international development and climate finance institutions. Projects that focus on integrating public transportation options with micro-mobility and MaaS as described above will not necessarily be more costly than projects that do not, but the increased number of interests and parties involved could be complicating factors in securing and overseeing funding.

### 2. Adapting and integrating the informal public transportation sector

In many Arab region cities, informal transport is the most common and widely used form of urban transit. Where regular public transport is inadequate or limited or both, small-scale operators, in some contexts legally and others illegally, enter the market to fill these gaps with passenger vans, minibuses, etc. The vehicles serving this “transit gap” largely run on

diesel and lack emission control technologies and filters, generating very large CO<sub>2</sub> emissions and other pollutants. The informal transport providers are an extant hybrid form of micro-mobility and public transport in the Arab region, but one that will be difficult to integrate into the e-mobility pathway outlined here. The nature of their independent single-operator business model does not benefit from economies of scale and does not generate enough revenue to invest in innovation like purchasing new EVs. Additionally, informal transport operators represent a significant share of the workforce in a number of Arab countries. Attempts to limit them through stricter regulations or competition from subsidized clean-power modes risks implementing this e-mobility model at the expense of the social good of those making a living in this sector. Innovative financial incentives and other measures will be important to integrate the current informal sector into a “small end, big end” e-mobility future.

### 3. Feasibility of these mobility modes in rural and peri-urban areas

Rural areas in the Arab region have long experienced mobility deficits. They largely lack public transport networks, have less funding than urban areas to devote to providing mobility to the population, and have less robust governance and institutional capacity to oversee service provision. Comprising approximately a quarter of the population, rural areas are at the centre of mobility equity concerns in the region. As the International Association of Public Transport notes, solving for rural mobility could “unlock equity potential – good rural road infrastructure and services drive agriculture, commerce, trade, industry, and allow populations to access opportunities such as education, jobs, health, culture and social activities. It is no wonder that rural transport plays a critical role in achieving no less than half of the SDGs”.<sup>86</sup> But the traditional models of urban public transport do not transfer to rural settings – for example, it is uneconomical to run regular bus routes through areas where demand is low and route timing is difficult to match to population needs. The e-micro-mobility and MaaS models as they are being developed for urban settings will need adaptation to rural areas, given for example much lower 4G network coverage for coordinating rides. Electricity in these areas also poses a challenge to any form of e-mobility.

## 4. Impact of the importation of used ICE vehicles to the region

The global export of used ICE cars and other light duty vehicles (vans, pickup trucks, SUVs) has risen significantly over the last decade – from 3.4 million in 2015 to nearly 5 million in 2019. Between 2015 and 2020, a total of 23 million used cars were exported, overwhelmingly ICE vehicles. And this continues to rise as EV take-up rises around the world. Two thirds of used car exports go to the developing world, including to the Arab region. Estimates range between 25 and 40 per cent go to countries in Africa (considering both North and sub-Saharan Africa), and the Middle East represents about 10 per cent. Within the Middle

East part of the Arab region, the United Arab Emirates is the main importer with almost 70 per cent (many for re-export, largely to other Arab countries). On the one hand, the easy availability of generally very low-cost used ICE cars hinders market growth for EVs in the region and strongly disincentivizes greater use of public transport, micro-mobility and MaaS. From an equity standpoint, the cost of purchasing electric two- and three-wheelers can be comparable to or cost less than used ICE cars (and use of them on a rental or share basis in MaaS models is even more economical). But promoting the “big end, small end” e-mobility pathway over the purchase of used cars will require greater public awareness and government policy actions potentially including ICE car import limits or bans and micro-mobility purchase incentives.<sup>87</sup>

Recommendations for intentional development of an e-mobility priority model of complementary electrified public transportation, e-micro-mobility and electric-based mobility-as-a-service (MaaS)

Based on our research and analysis, the following recommendations individually and collectively have potential to advance and accelerate the movement of the Arab region on this pathway for an e-mobility future. In some cases they are adapted and customized for the Arab region from recommendations developed in other analyses that focus on electrification of public transportation, promotion of electric micro-mobility and MaaS or integration of electrified public transit systems and electric micro-mobility and MaaS ecosystems in the Arab region and in other parts of the world.



### **Develop a national sustainable urban mobility policy in each country of the region, with capacity-building support as needed, to shift car drivers to more efficient and non-carbon producing forms of transportation**

Several models have been developed, and implemented around the world, for national frameworks of integrated policies to promote and scale sustainable urban mobility. Decision makers of the transport, energy, environment and planning ministries of Arab countries should review these models, confer with peers in countries that have employed them and create a national sustainable urban mobility policy (NUMP/SUMP) for their country. Such plans are developed by national Governments to enhance the technical, financial, regulatory and other capabilities of cities to plan, finance and create integrated sustainable mobility systems. They generally focus as an early priority on infrastructure development required for EVs and other sustainable mobility modes, before creating incentives for EVs. This is important because overcoming the largest barriers to EV adoption first is essential. One of the NUMP/SUMP models available for Arab country decision makers to consider is a set of principles and a structured four-phase,

fifteen-step process developed by the MobiliseYourCity Partnership, an international transport initiative under the United Nations Marrakech Partnership

for Global Climate Action, launched at COP21 in Paris in 2015. This model has been adopted and implemented in more than 15 countries in Europe, North and South America and Asia. Another model has been developed by the United Nations Human Settlements Programme (UN-Habitat) in Kosovo, and another developed with the support of UNDP and implemented in Georgia. The plans that Arab countries develop should be underpinned, as the MobiliseYourCity model emphasizes, by a principle of “national appropriateness”, i.e. recognizing that conditions differ across the four country groupings and ensuring that each plan is tailor-made to circumstances in that country. NUMP/SUMP planning in the Arab region should consider encompassing the regulation and enablement of all land mobility modes, services and providers, including all public transport systems and MaaS providers in a city, under a single ministerial or departmental entity. Attention should be given in this sustainable urban land mobility planning to the potential for integrating other modes of transport in the future, such as river and marine transport, aerial drones and air taxis, etc.



### **Set national targets for procuring electric buses by 2025 and 2030**

Arab countries including Bahrain, Saudi Arabia, and the United Arab Emirates have formal targets for net-zero carbon emissions. Almost every country in the region has specific renewable energy targets and emissions reductions targets, for example Emirati pledges for 50 per cent clean energy in its total energy mix and a 70 per cent reduction in CO<sub>2</sub> emissions, both by 2050. Few have declared targets specifically for e-mobility. An important place to start is targets for electric buses. Setting targets to have minimum numbers of e-buses in countries' public transportation systems, or to procure only e-buses after certain dates, will be important demand signals to suppliers, operators and capital providers. This will spur investment by e-bus manufacturers and accelerate e-bus cost competitiveness against ICE buses.



### **Establish policies or legislation that enable transport systems at state and municipal levels to use innovative procurement models for e-buses and rail**

Traditional procurement models in public transportation systems make the higher upfront cost of electric buses a barrier to adoption. A variety of new procurement models for e-buses have emerged that are based on total cost of ownership (TCO) over time and on innovative partnerships between cities and bus suppliers. One example is separating ownership of buses from their operation and maintenance to help offload capital expenditure from the public to the private sector. Leasing contracts help secure the buses in the system until the financial obligations are paid, which helps reduce payment risks and lower credit rates and funding costs. Santiago, Chile has had success with this model, leveraging procurement regulations that allowed it.<sup>88</sup> Other examples of innovative e-bus procurement models to build into policy include environmental costs in tender evaluations, and upfront bus purchase with batteries leased out of operational funds. In countries where national level regulations forbid or complicate such models, these regulations should be removed. Procurement models and regulations for public rail transportation systems should also be examined for how they might complicate or bias against deployment of electric-powered systems and revised accordingly.



### **Provide grants, loans and/or subsidies from appropriate levels of government and aid agencies, and explore multilateral development bank funding, for urban redevelopment projects and other projects that purposefully integrate public transportation, electric micro-mobility and MaaS**

Depending on the country, urban redevelopment planning, financing and project implementation is conducted at the national, sub-region or city level. At whatever level these decisions are made, new forms of finance and funding should be made available on a prioritized basis for projects that are purposefully designed to integrate the “big end” (e-buses and electric rail systems) and “small end” (e-micro-mobility and MaaS using EVs). Such infrastructure development and use-of-space redesign projects would prioritize objectives like: parking and charging for e-bikes and e-scooters (owned and shared) at transportation hubs such as train or bus stations and stops; street and road space reclamation to prioritize bikes, scooters and walking, especially near public transit hubs; locating bikes and scooters in underserved areas of cities; transit-oriented development that places housing, commerce, employment opportunities and services around public transportation hubs; and two- and three-wheel-only infrastructure that allows electric micro-mobility vehicles easier access to public transportation hubs by bypassing congested or dangerous intersections and enables other transit-to-destination shortcuts. Financing support should especially prioritize: cities that are suffering the greatest harmful effects on public health and economic growth from air quality and congestion; cities structuring joint e-bus purchasing arrangements with other cities to increase economies of scale and reduce upfront costs; and cities seeking to make full fleet replacements of ICE buses with e-buses.



### **Establish national and regional standards requiring interoperability in charging infrastructure, especially for charging points deployed for public transit systems**

Building out charging stations for EVs of all types will be a priority in the Arab region as it is globally, and interoperable (versus proprietary) systems will be an important contributor to promoting EV adoption. Mandating interoperability for the infrastructure powering EVs in Arab countries will be essential to scaling the adoption of e-mobility. Ideally, common standards for interoperable charging should be adopted region wide, enabling individual EV owners and long-distance public transportation systems to cross borders without concern about power availability

or trip range limitations. This will also be important when electric medium-duty and heavy-duty cargo trucks become more a part of the e-mobility picture in the region. In prioritizing e-mobility in public transportation, it will be especially important to mandate common/interoperable charging technology for e-buses in cities' transit system fleets. The ability to accommodate multiple plug interfaces and charging technologies will protect public transit systems from becoming locked into any single manufacturer; reduce financial and technological risk for cities; and ensure maximum flexibility and competitiveness in procurements for future subsequent fleet additions or upgrades.



### **Set ICE vehicle phaseout deadline mandates that cover all buses and other vehicles in the public transportation sector**

To date, 17 countries around the world as well as several provincial and state governments have set ICE vehicle phase-out target dates, but no Arab country has. Of those which have declared their ICE phase-out targets, only a few have included vehicle segments such as vans, light commercial trucks and medium- and heavy-duty vehicles, and only the Netherlands, Hainan province (China) and Cape Verde have specifically included buses. Arab countries should establish their target dates and define the scope of the future bans to include all public transportation vehicles and medium- and heavy-duty cargo trucks. These bans will accelerate the market viability of such heavy vehicles by stimulating manufacturer demand to develop them sooner. Where possible, financial and other incentives should be employed to encourage owners to accelerate the replacement of their ICE vehicles and get the legacy stock off the country's roads. This should prioritize public transport vehicles, but also include owners of cargo fleets, corporate fleets and personal vehicles. In setting these targets, countries in the region should also develop plans to manage the elimination of ICE vehicles that are put out of service in an efficient and optimal manner, within the context of the "circular economy", focusing on reducing waste to a minimum and making optimal use of recyclables. In addition to the environmental benefits, doing so can create new employment, manufacturing and other opportunities in the ICE vehicle recycling sphere.



### **Implement vehicle tax and vehicle insurance rationalization to promote electric two- and three-wheel vehicle sales and usage**

Countries in the Arab region could adapt models employed in other countries for using tax rates to influence the share

of two-wheel and three-wheel EVs in the mobility mix. Importation duties, sales or excise taxes, annual licensing and registration fees and other taxes and fees could be raised on ICE cars, and reduced to very low rates on smaller, lighter, efficient sustainable micro-mobility modes like two- and three-wheel EVs. In a similar manner, vehicle insurance rates could be adjusted to favour these lighter, lower-speed EVs on the basis of their lower negative externalities (risk of damage to other vehicles and people, CO<sub>2</sub> emissions, other air pollution, etc.). Governments might consider covering universal basic insurance for two- and three-wheel EVs from surplus revenue generated from the higher tax levies on ICE vehicles of all types.



### **Develop national governance and policy frameworks for MaaS that regulators at lower levels can align with for uniformity**

A common regulatory framework at the national level in each Arab country, and ideally across all the countries of the region, could create stable, competitively level market growth environments for current and future MaaS providers, while mandating their alignment with public good objectives that Governments establish related to sustainable mobility. Such frameworks could establish broad parameters applicable to all MaaS modes that lower-level regulators could work within for permitting, pricing mechanisms, use of public space, data security and privacy, requirements for integration of public transit systems into MaaS providers' apps and more.



### **Provide financial and other support to impel informal transport sector operators to adopt electric vehicles and integrate with public transit MaaS systems**

Options could encompass loans to buy new electric vans or minibuses or retrofit ICE vehicles with battery power; subsidized or no-cost provision of electric two- and three-wheelers; provision of the information technology required for operating within MaaS networks; new forms of income enabled by MaaS operators' non-mobility revenue streams; pension plans or other forms of long-term income security; non-financial incentives like health or social insurance; and others. Incentivizing informal sector operators to integrate with electric-powered public transit, e-micro-mobility and MaaS ecosystems could also contribute to addressing mobility deficits in rural and peri-urban areas by expanding the potential for more demand-driven service.