March 2021

Innovating for Clean Air: E-Mobility in Indonesia

CATAPULT Connected Places

Department for Business, Energy & Industrial Strategy

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Acknowledgments

The authors would like to thank the following individuals and organisations for their valuable contributions to this report (errors or omissions remain the responsibility of the authors):

Yanti Choesin Zen

Embassy of the United Kingdom in Jakarta

Dr Huw Davies, Coventry University

The Business of Cities

Abigail Matthews, Georgina Box, Alisdair Ritchie of Connected Places Catapult

Contents

Executive summary

This report was commissioned by the UK's Department for Business, Energy and Industrial Strategy to support UK's commitment to Indonesia. It aims to strengthen the two countries' relationship in the areas of science, innovation and technology to uncover how best to apply these areas to contribute towards the global net zero agenda.

This report is for the UK government, the Indonesian government - both national and local - as well as academic institutions and industry sectors associated with transport and mobility. It looks to further the understanding of the linkage between net zero commitments and the opportunity these present to drive forward the science and innovation agenda in Indonesia. The goal is to nurture on-the-ground collaborations between Indonesian and UK companies as well as academic institutions.

This report is split into five sections

Context on the net zero challenge at national and local level in Indonesia

How e-mobility can be part of the solution

How the UK can support Indonesia's e-mobility sector

The potential of e-mobility solutions at the local city level

Concluding summary and recommendations

These sections bring to life the interconnectedness of the net zero agenda with socioeconomic development. They show how what is often viewed as a challenge can actually be an opportunity to accelerate innovation and growth at local and national levels. New and emerging industries give rapidly-growing, developing markets the opportunity to take a giant leap forward in stimulating their science agenda and innovation ecosystem. The growth of the e-mobility sector presents Indonesia precisely with this chance.

Building on the ongoing collaborations that have taken place in three cities - Bandung, Denpasar and Surabaya - we look at ways to strengthen UK-Indonesia linkages and exchanges of information, technologies and know-how. We provide an overview of the current status of the still nascent e-mobility ecosystem in Indonesian cities, and we look for UK companies' capabilities that match current market gaps. We profile UK companies who have great potential to successfully enter this unsaturated and attractive, albeit not lacking in barriers to entry, market. We summarise the opportunities landscape and policy interventions to provide companies with an analysis of the possible areas to expand UK-Indonesia partnerships in e-mobility, which builds trust amidst a shared understanding in the region.

This report includes a guide to set up the necessary frameworks and structures to support UK companies to partner with local Indonesian counterparts through equitable partnerships. It urges them to build collaborative relationships to help stimulate the emerging e-mobility sector in Indonesia.

Key findings of the report show Indonesian cities as having a high potential to deploy and test innovative solutions in this area, to scale them nationally, regionally, and globally and in partnership with the UK. In the final recommendations section, we show that this global net zero challenge can be approached at a local level through structured programmes that will deliver real benefits to support decarbonisation of the city space. These programmes will in turn reduce air pollution, while at the same time nurture the growth of the start-up and SME innovation ecosystem, building the skills, jobs and companies of the future, and creating compelling investment opportunities for UK companies.

Foreword

Climate change is one of the most important challenges of our generation. This comes at a time when economies around the world are looking to diversify, to create the jobs, businesses and business opportunities of the future. Too often it can look like a choice between one challenge or the other. But this report shows that this is not the case. The net zero agenda is inextricably linked with innovation and socioeconomic development and growth. And rather than view it as a challenge, it can be seen as a great opportunity to provide focus and clarity to help guide policy and business decisions as governments and industry focus on solving the challenges of climate change through developing and deploying innovative solutions across different sectors of the economy.

This report looks at how e-mobility can not only contribute to the net zero and clean air agenda in the city space, but how it can provide Indonesia with the opportunity to move from a net importer of fossil fuels and e-mobility supply chain parts and solutions, to a leading hub of development and deployment, and then to a regional and global powerhouse of exports. To do this requires the collaboration and dedication of the government, both national and local, industry and academia. And through partnerships with countries like the UK, I know that we can see commitment and dedication translated into deployments in the cities of Indonesia that really make a difference.

The opportunity presented to Indonesia in this e-mobility space is something that both myself and colleagues here at Connected Places Catapult can commit our wealth of expertise to supporting. Over the last five years, Connected Places Catapult has undertaken more than 30 international projects across six continents.

Connected Places Catapult is the UK's innovation accelerator for cities, transport, and places. We provide impartial 'innovation as a service' for public bodies, businesses, and infrastructure providers to catalyse step-change improvements in the way people live, work and travel. We connect businesses and public sector leaders to cutting-edge research to spark innovation and grow new markets. We run technology demonstrators and SME accelerators to scale new solutions that drive growth, spread prosperity, and eliminate carbon.

At Connected Places Catapult, we have experience in nurturing future-facing place leaders to seed and stimulate innovation economies in the UK and worldwide. From steering elements of the Belfast City Region Deal to supporting Smart Dubai, we have partnered with places all over the world to unlock economic and environmental benefits through the adoption of new technologies, city leader upskilling programs, making connections to the UK's world-leading innovation ecosystem and designing and delivering innovative approaches to all aspects of a truly smart city for all.

Tackling climate change and the path to net zero can certainly be seen as a challenge. But challenges can bring the best out of us. With vision and purpose, coupled with a clear plan of action and a steadfast determination, no challenge should be insurmountable.

Nicola Yates OBE
Chief Executive Officer, Connected Places Catapult

Opinion piece

It has never been a more exciting time for cooperation between the UK and our Asia-Pacific partners. This region contains the world's fastest growing economies. Indonesia, the tenth largest globally, offers enormous potential for trade, investment, partnership and mutually beneficial learning. Even as governments work to tackle Covid-19, we are determined that the global economic slowdown must not halt progress in bilateral collaboration.

Cities around the world face twin challenges around urban air pollution and congestion, leading to an increasing number of governments committing to sustainable mobility targets. In Indonesia, the world's largest bus rapid transit system, TransJakarta, has committed to converting its fleet of 14,000 buses to electric power by 2030. This will be the largest electrified bus fleet to date - and a monumental example for other cities in Indonesia, the region and globally to follow.

Real progress is now being made on emissions. In 2010, DKI Jakarta government made a non-binding commitment to reduce greenhouse gas emissions by 30% below the baseline level of 2005 by 2030. This year, Jakarta plans to issue an updated Climate Action Plan with the support from the C40 Cities Climate Leadership Group.

The UK is working to support these moves. The C40 Finance Facility, partly funded by the UK government, supported TransJakarta on the technical and financing feasibility of the first 100 e-buses operating in Jakarta throughout this year. Another UK government funded programme, UKPACT, will support Indonesia's capital on scaling up this pilot through an implementation plan for TransJakarta's e-bus roll out until 2030. It will also support a viability study to convert motorcycles in Jakarta to electric power, in collaboration with local ride-hailing companies.

Momentum is building across Indonesia. Following DKI Jakarta ambition, Bandung, Surabaya, and Denpasar cities as well as their respective provinces are delivering their low carbon commitments. E-mobility and zero emission urban development will spread across metropolitan cities in Indonesia. UK prosperity programmes such as our Global Future Cities Programme are working with these municipalities to ensure that planning for future cities include planning for e-mobility and energy efficient neighbourhood.

But there is still much further to go. Global emissions from road transport are rising more rapidly than any other sector, and the UK is going further and faster than ever to decarbonise transport, harnessing the power of clean green technology to end the UK's contribution to climate change by 2050.

So I was delighted to learn that Connected Places Catapult, alongside the UK government and British Embassy, have undertaken this important piece of work to understand the drivers, barriers and opportunities for progressing the ambitious commitment to e-mobility by the Indonesian government - and to help foster cooperation between our two countries in this sector. There are undeniable combined benefits of undertaking sustainable mobility options in Indonesia - cleaner air, healthier lifestyle, economic prosperity, jobs growth, catalysing local innovation and entrepreneurship - and all of these can be realised alongside a great partner to learn from and with - like the UK. If we work together, we can access all these benefits sooner. By sending a strong policy signal to the global industry, we can scale up investment faster, increase economies of scale, and accelerate cost reduction.

The COP26 summit in Glasgow this November will be a perfect opportunity to bring parties together to accelerate action towards the goals of the Paris Agreement and the UN Framework Convention on Climate Change. The UK's COP26 Presidency falls during the first significant test of the Paris Agreement - where countries are expected to reassess their national commitments against the overall temperature goal of 1.5oC. 2020 saw considerable progress on climate, culminating in 75 leaders making ambitious commitments at the Climate Ambition Summit on 12 December. The UK has four main goals for making COP26 a success.

Firstly, we call on all countries to set net zero emissions targets - which governments responsible for two-thirds of global emissions have already done - and set targets for emissions cuts by 2030. Our second goal is for every country to have a credible plan for managing the unpredictable and often damaging weather pattern that are the result of climate change. We are bringing nations together to share solutions, through the new Adaptation Action Coalition, which countries around the world are now joining.

The third goal is on finance: sufficient funds are vital to tackling the climate crisis. In the UK we have committed £11.6 billion over the next five years in climate finance and we are pushing others to follow our lead. Finally, we aim to make the COP26 negotiations in Glasgow a success.

But we need to see a further step-change in ambition and action from all countries if we are to avoid unleashing catastrophic impacts on generations to come. As countries emerge from the current pandemic, there is an unprecedented opportunity to reboot global economies in a manner that builds more sustainable, inclusive and resilient societies. We would like to use the UK's Presidency of COP26 to bring countries, states, industry and businesses together to achieve this goal.

One key example is that as governments support the recovery of the auto sector following Covid-19, we must ensure we support the transition to zero emission vehicles, and do not set it back. COP26 is a unique opportunity to advance this initiative, but this is part of a longer-term and broader effort to ensure electrification rollout continues so that 100% of global car and van sales are zero emission.

I look forward to working together with our friends in Indonesia as net zero partners to tackle climate change ahead of COP26, and beyond.

Ken O'Flaherty
COP26 Regional Ambassador to Asia-Pacific and South Asia

"Liverpool's award-winning international relationships with key thriving and distinctive places have certainly helped identify growth potential - particularly around a net zero economy and becoming a national leader in clean growth, e-mobility and green infrastructure. Together with our strategic partners and Sister City Surabaya in Indonesia we are helping develop a dynamic business environment through cooperation. This teamwork is translating ideas into innovation that impacts upon and helps connect our many diverse communities. I very much believe that with the help of Connected Places Catapult, trusted evidence-based research and local engagement we can certainly support the creation of more inclusive, exciting opportunities and healthier, forward-thinking places at home and overseas."

Gary Millar, Deputy Mayor, Councillor for Liverpool City Council

Definitions and Acronyms

ADB: Asian Development Bank
AKDP: Provincial Intercity Transportation
AQI: Air Quality Index
ASEAN: Association of Southeast Asian Nations
BAU: Business-as-usual
BLU: Public Service Agency
BPDLH: Environmental Fund Management Agency
BPEV: Battery powered electric vehicles
BRT: Bus rapid transit
BPPT: Agency for the Assessment and Application of Technology
CapEx: Capital expenditure
CMMAI: Coordinating Ministry of Maritime and Investment
CO2: Carbon dioxide
EV: Electric vehicle
FDI: Foreign direct investment
GHG: Greenhouse gas
GDP: Gross domestic product
GFCP: Global Future Cities Programme
ITDP: Institute for Transportation and Development Policy
ITS: Intelligent Transport System
MOTI: Ministry of Trade and Industry
MoU: Memorandum of understanding
NDC: Nationally Determined Contributions
NOx: Nitrogen oxides
OECD: Organisation for Economic Cooperation and Development
OPEC: Organization of the Petroleum Exporting Countries
OpEx: Operating expenditure
PLN: PT Perusahaan Listrik Negara (State-owned electric company of Indonesia)
PM: Particulate matter
PTIS: Public Transportation Information System
RISTEK-BRIN: Ministry of Research and Technology of the Republic of Indonesia
SME: Small and medium-sized enterprise
SOx: Sulfur oxides
SPBKLU: Public Electric Vehicle Battery Exchange Station
SPKLU: Construction of Public Electric Vehicle Charging Stations
TKDN: Level of Domestic Components
WEF: World Economic Forum

Note about the Methodology

Connected Places Catapult conducted both primary (industry interviews) and secondary research (desk-based evidence) from the 13th of January until the 12th of March 2021, to understand and evaluate the market opportunity for UK e-mobility suppliers to enter the Indonesia market in support of Indonesia's commitment to decarbonisation. Conducting a needs analysis, gap identification and mapping of UK-Indonesia collaboration opportunities are outcomes of the research and interview process.

Market intelligence is generated by research and analysis, internal expert evaluation, and interviews with key regional stakeholders as follows:

- Desk research spanning academic journal articles, national government briefings and reports, annual reports of companies and research institutes, Non-governmental organisations (NGOs) and development bank-sponsored analyses, and local news stories.
- Interviews with experts from NGOs and thinktanks, local businesses, government departments, consulting firms with specialist knowledge in Indonesian e-mobility and global and regional development banks.

A list of the organisations, who kindly participated in the research process, is included below. We thank them for speaking with us.

In addition to this, a list of research sources has been included in our report. Any errors are the sole responsibility of the authors. However, we cannot take responsibility of any updates which have been done to public information included in this version, since the time in which we carried out our research.

For further information or questions about this report, please contact us on the following email: global@cp.catapult.org.uk

List of Interviewed Organisations

Asian Development Bank

BAPPEDA - Regional Development Planning Agency

BAPPENAS - Ministry of National Development Planning of the Republic of Indonesia

Bandung Transportation Agency

Bali Government, Energy and Mineral Resources Department

British Chamber of Commerce in Indonesia

Coventry University, UK and Indonesia

Denpasar City Government

Denpasar Transportation Agency

East Java Provincial Government

Gesits (PT WIKA)

Grütter Consulting

Institute for Essential Services Reform (IESR)

Institut Teknologi Bandung (ITB)

Institute for Transportation and Development Policy (ITDP)

Institut Technologi Sepuloh Nopember, Surabaya (ITS)

KADIN - The Indonesian Chamber of Commerce and Industry

Liverpool Mayor's Office

Microcab (UK SME)

Mott MacDonald

PricewaterhouseCoopers (PwC)

Regional Secretariat Cooperation of Denpasar

The Business of Cities

The Society of Motor Manufacturers and Traders Ltd (SMMT)

Transportation Agency Bandung

Udayana University (CORE)

UK-Indonesia Consortium for Interdisciplinary Sciences (UKICIS)

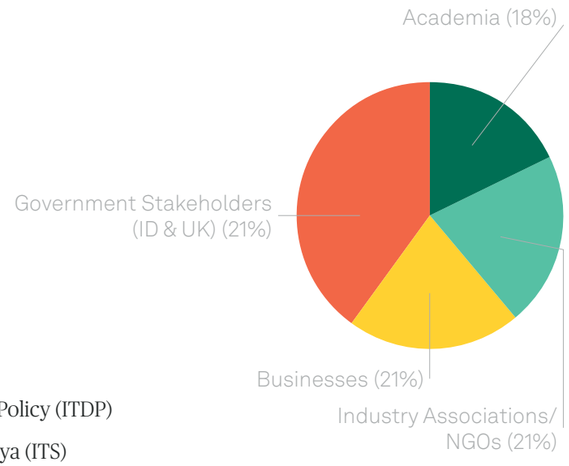
UK Department for International Trade (DIT)

Universitas Indonesia

Universitas Padjadjaran

West Java Department of Energy and Natural Resources

West Java Regional Transportation Agency



1 Introduction

Now that over half of the world's population lives in cities, the urban way of life has brought many socioeconomic advantages, but also a number of challenges, particularly related to the environment. One of the most common sources of health and environmental issues in urban areas globally is road transport, which remains the main contributor to atmospheric air pollution in the urban environment. In turn, through greenhouse gas (GHG) emissions road vehicles also contribute to the global climate crisis, which significantly increases the risks of extreme weather events and natural disasters such as floods, typhoons and earthquakes. In a country like Indonesia, consisting of large islands and archipelagos already prone to devastating natural disasters, a world rapidly warming up will bring higher sea levels, higher temperatures and tropical storm surges.

Exacerbating the above negative aspects of transport, an expanding middle class has led to higher levels of consumption of goods, amongst them a higher adoption rate of private vehicles, with the associated increase in pollutants negatively impacting on air quality and health. As rapid urbanisation continues to shape economies, national and local governments must find ways to balance and provide infrastructure, public services and sustainable growth.

Through the Innovating for Clean Air (IfCA) programme, Connected Places Catapult and the British Embassy team in Indonesia are supporting the world's 10th, and Southeast Asia's largest, economy in its aspirations to address these challenges through the adoption of e-mobility solutions and supportive policy interventions.

At present most vehicles run on petrol and diesel, and as the number of road vehicles increase, so does the consumption of these fuels, placing pressure on the global supply chain, leading to fluctuating prices and uncertain access to supplies. Indonesia is a member of Organization of the Petroleum Exporting Countries (OPEC), however, due to its high levels of demand, is also an oil importer. A factor in the country's aspiration to move towards renewable energy sources is the need to decrease capital spent on imports to meet the growing domestic demand.

At the same time, Indonesia has committed to reducing GHG emissions in line with its membership in the 2015 Paris Agreement. Its reduction targets make e-mobility a strategic necessity if the country is to meet the timescales of reduction of emissions. In order to comprehensively address the requirements of the Paris Agreement, Indonesia seeks to transform its transport sector through the National Action Plan for GHG Reduction (RAN-GRK). Such a transformation would only be possible through the collaborative efforts of coordinated policy makers on all levels and the private sector, unified into an overall strategic approach. In fact, recent efforts have been applauded by the international community as Jakarta received the prestigious Sustainable Transport Award in early 2021[1] for the local administration's integration of transport modes connecting the capital and satellite cities, operating electric bus fleet as well as promotion of active travel.

1 https://www.itdp.org/event/2021-sustainable-transport-award-ceremony/

Yet the decarbonisation agenda of urban mobility should not be viewed in isolation as a national commitment to a global challenge of reducing global warming. It is a socioeconomic opportunity for the nation. This is a chance to focus research and industry to a fast-growing global industry, and to support new job creation, new business growth and economic development. This report also looks at this opportunity through the lens of collaboration with UK companies. By partnering with Indonesian academic institutions, industry and government to enter this unsaturated market, UK businesses join in the efforts to stimulate and speed up the development of Indonesia's vibrant innovation ecosystem.

This report looks at the Indonesian market for electric powered mobility as well as the current conditions that underpin the Indonesian electric vehicle (EV) ecosystem. It highlights the barriers and opportunities in this space, particularly with reference to approaches to collaboration between Indonesian national and local governments, and businesses and their UK counterparts.

Recent Indonesian government efforts in policy decrees, setting EV targets and public transport pilot programmes, combined with local business forays in this sector, have grown both the market opportunity and drawn the interest of foreign investors looking to engage with this nascent but growing market. In the following sections of the report, Connected Places Catapult outlines the approaches to engagement that are most likely to lead to successful outcomes in urban air pollution reduction, e-mobility uptake, innovation and job creation growth for the local economy.

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Connected Places Catapult

Connected Places Catapult connects businesses and public sector leaders to cutting-edge research. We help develop, implement and commercialise the latest technology and innovation for existing markets, as well as create demand and grow new markets globally. With transport and the built environment sectors contributing the majority of worldwide emissions, we are prioritising innovations that tackle carbon in the ways we travel and manage buildings.

If you would like to learn more about what we do or the opportunity which Indonesia represents, please get in touch at **global@cp.catapult.org.uk**.

2 Defining the Challenges

A combination of geography, demographic changes, and economic turbulence has shaped Indonesia's current status as one of the strongest Southeast Asian economies and, at the same time, one of the region's largest contributors to GHG and air pollution. Against a complex backdrop of social, economic and governance challenges, Indonesia has nevertheless committed to reducing emissions by 41% by 2030. Under the Global Development Agenda, Indonesia has undertaken to deliver sustainable growth, increase green financing projects and reduce the destruction of biodiverse ecologies. Through the 2018 Green Economy and Low Carbon Development Framework, the country's leaders laid out an ambitious plan to tackle climate and air quality issues within three broad areas of focus: energy, forest and land-based mitigation, and special economic zones, making clean, low-carbon growth a critical part of Indonesia's urbanisation journey.

2.1 Energy Generation

Indonesia's Nationally Determined Contributions (NDC) outline the country's transition to a low carbon and climate resilience future. The NDC describes the enhanced actions and the necessary enabling environment during the 2015-2019 period that would lay the foundation for more ambitious goals beyond 2020, contributing to the concerted effort to limit the temperature increase to 1.5ºC above pre-industrial levels to 2030. For 2020 and beyond, Indonesia envisions achieving archipelagic climate resilience as a result of comprehensive adaptation and mitigation programmes and disaster risk reduction strategies. Indonesia has set ambitious goals for sustainability related to production and consumption of food, water, and energy. These goals are set to be achieved by supporting empowerment and capacity building, improved provision of basic services in health and education, technological innovation, and sustainable natural resource management, in compliance with principles of good governance.

Without a strong commitment to energy grid decarbonisation and limiting fossil fuel subsidies in the transport sector, however, the impact of Indonesia's efforts on GHG emissions reduction is likely to be limited. Moreover, the higher carbon intensity of Indonesia's electricity system means that there are higher marginal abatement costs (i.e. costs of reducing environmental negatives such as pollution). According to the Bandung Institute of Technology (ITB), without any further government interventions, approximately 60% of Indonesia's electricity in 2025 would still be supported by fossil fuel, particularly by coal and diesel. The Asian Development Bank (ADB) also observes that "in countries such as Indonesia [...] greening the grid should be the first priority".[I]

In recent months, following the outbreak of Covid-19, support for fossil fuels in Indonesia has gained traction. In January 2020, progress in the country's journey to renewables has been hindered as it capped the price of domestic coal at $US20 per tonne below market value to boost consumption. The country plans to subsidise fuel for industries and businesses by using around 15% of the budget reserved for the National Economic Recovery Plan's rollout. In addition, the Plan makes provision for supporting coal powered electricity companies with earmarked funds.[II]

The government has strongly endorsed 'B30' biodiesel, a 30% palm-based fuel, with the view of lowering fuel imports and boosting domestic palm oil consumption. While there is economics driving such a move, industry groups have expressed concerns that this blended fuel will lead to engine problems, potentially increasing maintenance costs. There is also the associated environmental cost of mass palm oil production. Electrification can not only help mitigate these negative impacts but can bring a wide range of other positive socioeconomic and associated environmental benefits.

I E-mobility options for ADB Developing member countries (2019). Available at https://www.adb.org/sites/default/files/publication/494566/sdwp-060-e-mobility-options-adb-dmcs.pdf

II Supporting coal powered electricity companies is part of the Indonesian government's post-Covid economy recovery plan: https://climateactiontracker.org/countries/indonesia/

The electrification of the transport sector provides huge potential for GHG abatement, along with the development of a national high technology and high skilled industry. Sustainable mobility options, for example, offer significant opportunities to decarbonise transport in Indonesia. Electric vehicles perform markedly better in terms of their emissions than traditional vehicles. In the European Union currently, petrol- and diesel-powered cars emit almost three times more CO2 than the average electric car.[I] The positive environmental impacts of electric mobility are likely to be negligible in Indonesian cities, however, because of the high carbon intensity of the existing energy system. In fact, experts recommend that it is necessary to decarbonise the grid before transitioning to EVs.[II] As such, the link between energy generation and electric vehicles warrants further exploration beyond the scope of this work. However, there is a confirmed need for a shift to renewable energy and away from fossil fuel reliance from the top down.

> **"[Firstly], the mindset needs to change - for a long time Indonesia has been using coal and gasoline. Secondly, incentivising and making people eager to use battery-powered vehicles. Thirdly, local content - to create technology transfer and local jobs. Finally, high capacity is needed for rolling out a lot of electric vehicles. We need a [better] roadmap for a national infrastructure plan."**
>
> Regional Director, BAPPENAS (Ministry of National Development Planning of the Republic of Indonesia)

As this is a relatively young industry sector globally, the Indonesian government has the opportunity to build a high-tech and high-skilled national industry around its approach to the electrification agenda.

I Transport and Environment Briefing, April 2020. How Clean are electric cars? T&E's Analysis of Electric Car Life Cycle CO2 Emissions.

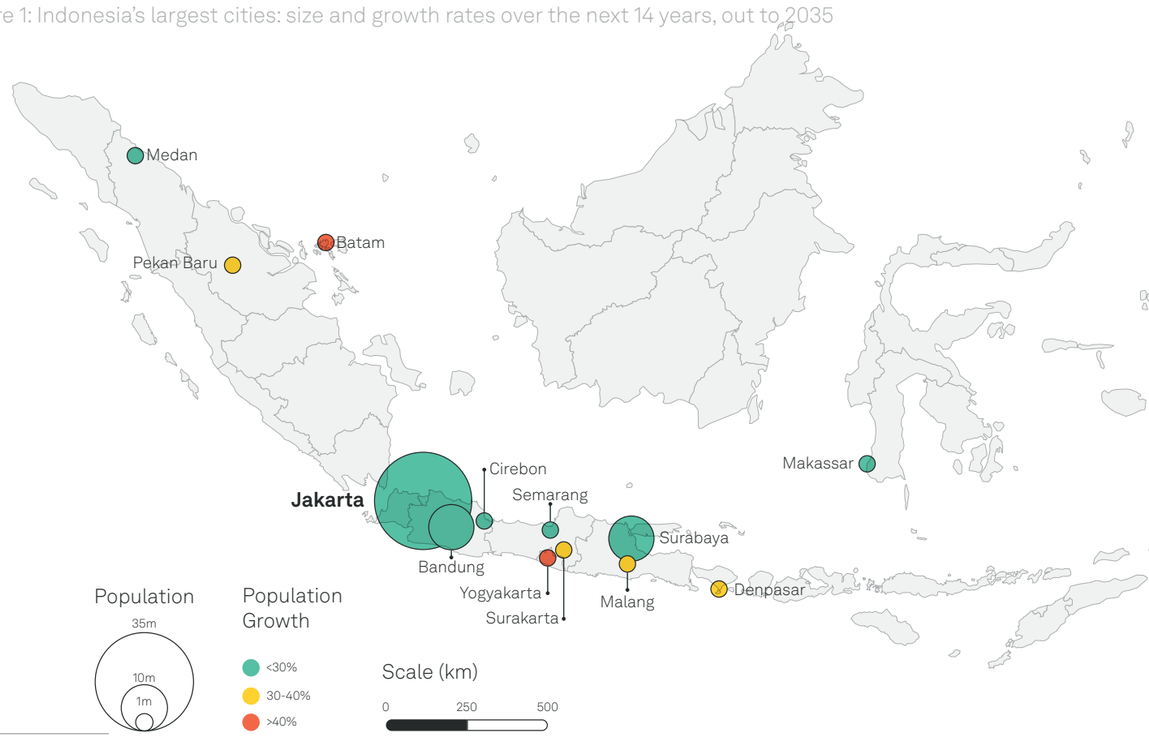
II E-mobility options for ADB Developing member countries (2019). Available at https://www.adb.org/sites/default/files/publication/494566/sdwp-060-e-mobility-options-adb-dmcs.pdf

2.2 Urbanisation, Carbon Emissions and Air Pollution

Indonesia has been on a cycle of urbanisation moving from 12% to nearly 56% urbanised over the past seventy years. Demand from the growing urban middle class is increasing for consumer goods, as well as accessibility and quality of public and private service delivery, in particular transport provision.[III] Indonesia's capital Jakarta is projected to overtake Tokyo and claim the title of the world's most populous city by 2030. With an additional 7m urban consumers added between 2015-2030 the demand pressure for public services increases. The average growth rate of the middle-class population in the same period, in real terms, is projected at over 7% per annum for Indonesia's secondary cities of Bandung and Surabaya, which are experiencing rapid expansion, albeit from a lower base (Figure 1).[IV]

Worldwide, urban centres consume an estimated 75% of natural resources and generate 80% of GHG emissions. It is in cities where challenges related to climate change and air quality must be resolved. Urban growth, with its greater usage of vehicles and transport systems, increases air pollution. According to the Climateworks Foundation, the transportation sector accounts for 26% of energy-related emissions in Indonesia while another 2018 study noted that transport contributes 80% of urban air pollution in the country and this is set to rise as both urban growth and energy consumption increase.[V] The economic and social impact of pollution on the Indonesian archipelago is enormous, with an estimated quarter of a million people dying annually due to pollution related exposure.[VI] Beyond the mortality rate, Indonesians also suffer from high levels of bronchial and respiratory illnesses.[VII]

Figure 1: Indonesia's largest cities: size and growth rates over the next 14 years, out to 2035



III World Bank (2019) Time to ACT! Realizing Indonesia's urban potential. *Between 1996 and 2016, each 1% increase in Indonesia's urban population share = 1.4% increase in GDP per capita (vs 2.7% in East Asia and the Pacific)

IV Economist Intelligence Unit, 2016, ASEAN Cities: Stirring the Melting Pot

V Budi Haryanto, January 2015 "Climate Change and Urban Air Pollution Health Impacts in Indonesia" in book, Climate Change and Air Pollution, Springer 2015

VI Jakarta Post, January 2020 article on release of Health Metrics Report in December 2019. Pollution kills more than 230,000 Indonesians per year: Report - National - The Jakarta Post

VII Air Pollution in Indonesia - The National Bureau of Asian Research (NBR)

Cities in Indonesia are densely populated, with 56% of the population currently living in urban areas, which is expected to rise to 68% by 2035. Yet, urbanisation in Indonesia has not brought the same level of wealth as in neighbouring countries.[I] World Bank research indicates that countries' per capita Gross Domestic Product (GDP) should increase significantly in line with growth in urbanisation. While Indonesia has a high rate of urbanisation, it has endemic infrastructure deficiencies which constrain the ability to reap its benefits.[II]

In the area of transport in particular, many Indonesian cities face major challenges. Transport is a leading cause of air pollution and emissions in Indonesian cities. The sector contributes 70% of pollution across the nation's urban centres,[III] while motorised transport contributes nearly one-quarter of GHG emissions.[IV]

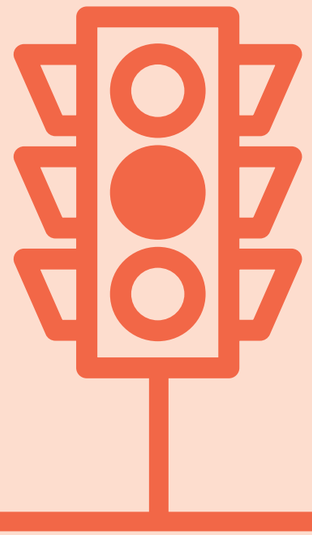
Two-wheelers (motorcycles or scooters) are the dominant mode of transport in Indonesia. Nearly three quarters of all vehicles (around 76% in 2019) are two-wheelers. The road networks are highly congested with average speeds dropping below 10kph during peak hours and associated emissions contributing to poor air quality. Despite major policy initiatives for alternative modes of transportation, such as Bus Rapid Transit and Mass Rapid Transit in Jakarta, motorcycles continue to grow in numbers due to the ease of purchase and lack of license checks.[V]

Indonesian cities are highly polluted by global standards. Twenty out of the country's twenty-eight metropolitan areas had unsafe ambient outdoor air pollution in 2015, which was reducing the life expectancy of Jakarta residents by up to 2.3 years.[VI] In fact, 70% of Indonesian city dwellers identified "less pollution" as the most important urban environment issue.[VII] Indonesian cities are highly polluted relative to other Asia-Pacific (A-PAC) cities as well. Annual average pollution (PM2.5) levels put two Indonesian cities, Surabaya and Bandung, in the 150 most polluted cities globall. Pollution levels tend to be high year-round, with little annual variability and few days where air quality is in line with World Health Organization (WHO) fresh air guidelines.[VIII]

As urban areas are critical centres of growth and innovation, this report focuses on three of Indonesia's largest cities: Bandung, Denpasar and Surabaya. In the next urbanisation cycle, as innovation and development expand beyond the country's capital and largest city, Jakarta, there is an opportunity for this urbanisation and innovation process to deliver much stronger productivity and efficiency gains. If managed carefully it should help ensure that the growth and expansion are environmentally sustainable and able to support new local industries in the mobility electrification agenda.

I Indonesia Is Not Reaping the Full Benefits of Urbanization | Indonesia Investments (indonesia-investments.com) 20 December 2017
II Infrastructure Development & Economy in Indonesia - Analysis | Indonesia Investments (indonesia-investments.com), December, 2017
III Leung, K. 2016. "Indonesia's Summary Transport Assessment." Asian Development Bank papers on Indonesia, No. 15, Asian Development Bank, Mandaluyong, Philippines
IV Transport | UNEP - UN Environment Programme notes that one quarter of GHG emissions come from the transport sector globally
V Leeds Institute of Transport Studies, 2020
VI World Bank (2019) Time to ACT! Realizing Indonesia's urban potential
VII World Bank (2019) Time to ACT! Realizing Indonesia's urban potential
VIII https://air.plumelabs.com/en/ *Among the 474 cities measured as part of The Business of Cities' City Typology Index.

3 E-mobility Opportunity



E-mobility is generally defined as the use of electrically powered vehicles, the products, services and systems that support them, including the design of vehicles that are not dependent on fossil fuels. E-mobility, in the context of this report also includes the raft of programmes, pilots and government initiatives designed to promote the use of EVs in Indonesia.

> **"E-Mobility will be the central component of a smart and resource-saving urban lifestyle."**
> Patrick Lüke, Robiotic[I]

The potential for e-mobility has already been articulated globally[II]: electrifying transport can be the greatest lever for moving from a business-as-usual (BAU) climate scenario to a 1.5ºC pathway consistent with the 2015 Paris Agreement. If all cities electrified their private and public transport, they would already be more than one quarter of the way towards achieving the 2015 Paris Agreement.[III] High levels of air pollution and congestion, together with low affordability and coverage of public transport, mean that there is an urgent imperative to shift mass transit solutions to electric modes of operation. The potential to reduce global NO_X, SO_X and particulate matter emissions would enhance urban liveability substantially and reduce a host of diseases and other well documented health-related negative impacts.

According to the World Economic Forum (WEF), e-mobility remains "one of the best solutions for combatting the twin challenges of the economic and climate crises."[IV] It has the potential not only to reduce global GHG emissions, but also to improve air pollution and create new jobs. Creation of local manufacturing capability for EVs, batteries and battery storage would generate revenue as emerging industry sectors. As countries create domestic markets for EVs and battery related products, they have the potential to export to neighbouring nations. Geographically, Indonesia sits in a unique position when looking at the EV supply and value chain. If the country moves up the value chain, from purely exporting the raw materials of batteries and other associated EV components, to manufacturing them, then the impact on economic growth and development is vast. It could become a global leader in exporting higher-value components in an ever expanding global EV market.

For all of these reasons, **a shift to e-mobility could lead to significant improvements in quality of life.** The United Nations Environments Electric Mobility Programme notes that one quarter of carbon emissions around the world come from transport and this is expected to rise to one third, growing faster than in any other sector. In summary, e-mobility would mitigate further emission rises and provide a number of worthwhile benefits. E-mobility represents an important, if complex initiative for many nations, including Indonesia.

- **Emissions reduction potential:** Transport accounts for 23% of global energy-related GHG emissions - and for 34% of the 2050 urban GHG emission abatement potential.[V]
- **Air pollution reduction potential:** Transport is also a major contributor to air pollution, accounting for about half of all global NO_X emissions, SO_X and particulate matter emissions. Around 90% of people living in urban areas at present are exposed to air pollution levels that exceed WHO limits.[VI] A shift to sustainable mobility has the potential to decrease this share significantly depending on scale of rollout of electrical mass transit, decreasing number of overall vehicles on the road and electrifying the rest of the fleet.
- **Job creation potential:** Indonesia is well placed to capture a share of the e-mobility industry, widely expected to create tens of millions of jobs by 2030.[VII]

I https://www.robiotic.com/en/blog/posts/e-mobility-iot-makes-driving-a-digital-experience/
II Zeke Hausfather, 2020. Factcheck: How electric vehicles help to tackle climate change (carbonbrief.org)
III https://files.danfoss.com/download/CorporateCommunication/UrbanEfficiency/Navigant-1,5-in-Urban-Areas.pdf
IV https://www.weforum.org/agenda/2020/06/e-mobility-heart-of-green-recovery/
V IPCC report: https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter8.pdf
VI https://www.who.int/health-topics/air-pollution#tab=tab_1
VII Extrapolation of regional forecasts for Europe, India, and other large economies.

3.1 Challenges to E-mobility's Impact in Indonesia

Currently the GHG abatement impacts of e-mobility are likely to be relatively lower in Indonesian cities because of the high carbon intensity of the existing electricity system. Indonesia's grid factor is currently nearly double that of nearby countries, such as Thailand and Laos, meaning the impact of EVs on emissions will be much lower at present. The ADB observes that "Starting first with EVs or greening the grid in parallel to promotion of EVs is not considered an effective strategy since grid greening, in general, takes a lot of time due to the long life span of energy production units."[I] In fact, without a green grid, moving to EVs can have a net negative impact if it drives more consumption of a fossil-fuel source electricity.

Given Indonesia's high grid factor, the main near-term opportunity for e-mobility is currently around improvements to air quality, via a focus on electrifying government-managed fleets in the nation's cities. Because the OpEx (operational expenditure) of EVs is lower, the more intensely used vehicles have the greatest savings and can make the biggest short term and demonstratable impacts. Relative to individual vehicles, mass transport fleets and commercial vehicles have the potential for much greater OpEx savings, due to their much higher mileage. In addition to being more profitable than e-passenger vehicles, the commercial vehicle market mainly operates between major cities and within them, where air pollution levels are highest. This means that focusing on mass transport fleets and commercial vehicles has the potential to lead to significant reductions in air pollution - especially in larger cities.

3.2 Types of EVs

There are many different types of e-mobility, some of which are further along the journey to large-scale deployment in the Indonesian context. For the purposes of this study, we consider only those forms of e-mobility that are either ready or nearly ready for large-scale deployment, or have future capability or potential in the near- to medium-term. We focus on the ones with highest potential for OpEx savings and pollution reductions, particularly distribution of journey lengths and footprint vis-à-vis the chosen categories. Prioritisation based on readiness for deployment and maturity of each mode of transport is summarised in Table 1. These include:

- Last mile electric delivery motorcycles
- Electric buses and minibuses and large vehicles
- Private electric motorcycles and other two-wheelers (for the purposes of this document motorcycles refers to all powered two-wheelers, including scooters, which form the majority of the market)

Because of market viability in Indonesia currently, this study does not consider in detail:

- Private electric cars
- Electric taxis
- Electric bikes

The current lack of fast charging options in Indonesian cities means the environment for e-taxis is less feasible. The need for fast charging options will be especially pertinent to enabling e-taxis to travel longer distances on Friday and Saturday evenings, where most of their weekly business is concentrated. Nevertheless, electric taxi companies could act as early adopters and strong lobbyists for electrifying their fleet.

I https://www.adb.org/sites/default/files/publication/494566/sdwp-060-e-mobility-options-adb-dmcs.pdf

Electric bicycles are not considered a viable first option for electrification. Motorbikes are the primary mode of transport for many, including long journeys and so to replace them with electric bicycles would restrict mobility. Existing worries around electric motorbikes, such as lack of battery capacity and low motor power are heightened for electric bikes. There has been minimal effort to enact any national or local strategy to promote them, with regulations for their use on the road only implemented in late 2020.[II]

Table 1: Types of EVs and their current status in the Indonesian market

Ready or nearly ready for large-scale deployment	Future capability or potential	Not currently a priority
Last mile electric delivery motorcycles	Private electric motorcycles and other two-wheelers	Private electric cars
Electric buses	Electric minibuses ('angkots') and other public transport with a smaller footprint	Electric taxis (although trials are underway)

"The trade infrastructure is well developed in Denpasar. So, e-mobility should be affordable to our SMEs. Our SMEs are the ones who mostly use two-wheelers. We also need to analyse what proportion of society uses public transport compared to using their own vehicles. It is different in other countries where society relies on public transport. Here in Bali, one family can own four motorcycles."

Division Head, Regional Secretariat Cooperation of Denpasar

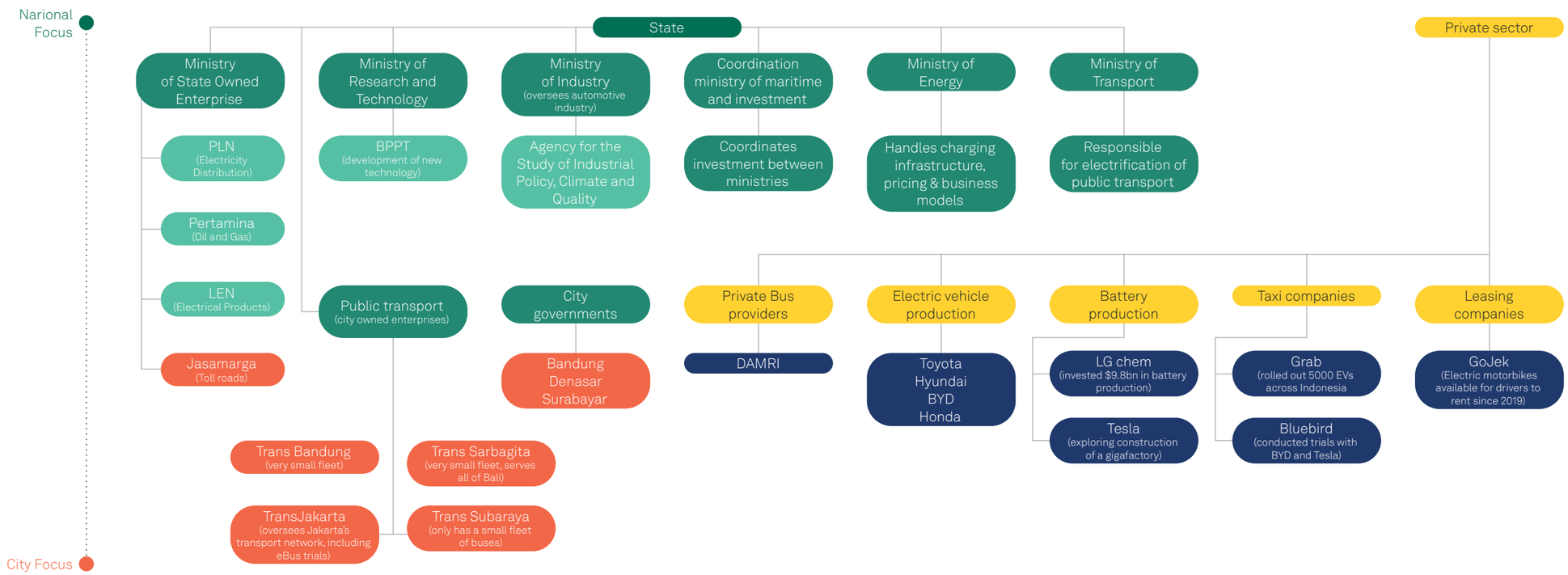
II https://en.minanews.net/indonesia-to-include-electric-bicycle-in-the-third-vehicle-type/

3.3 History of Indonesia's E-mobility Programmes and Main Actors

Indonesia's economic growth has given it the ability to acquire a range of public and private transport options. As the country's middle class has expanded so has its acquisition of new vehicles, with an average annual growth of around 7% per annum over the last two decades. Additionally, Indonesia is the second largest manufacturer of passenger vehicles in the region. It is an important import market for vehicles from China, Japan, Thailand and South Korea. Overall, in 2018 Indonesia's automotive industry contributed 10.2% to national GDP.[I] Because of its domestic manufacturing base, Indonesia is well placed to capture a share of the e-mobility industry expected to create millions of jobs globally by 2030, notwithstanding the country's need to pivot skills and supply chain from internal combustion engines (ICEs) to electrically powered ones. Doing this successfully will have large economic, social and environmental benefits to the country on both the national and local level.

In the face of increasing concerns about air pollution, persistently high levels of private vehicle use (sales of passenger cars are expected to reach 1.8 million annually by 2050, and motorcycles nearly 13 million by 2030)[II] and the large contribution of motorised transport to current CO2 emissions (especially in cities), Indonesia is shifting its attention towards e-mobility options. The organisational diagram below (Figure 2) summarises the current e-mobility landscape in the country in terms of public sector responsibilities and private sector actors.

Figure 2: The e-mobility ecosystem in Indonesian cities, Source: Asian Development Bank



I https://bisnis.tempo.co/read/1074289/menperin-industri-otomotif-sumbang-1016-persen-ke-pdb

II https://theicct.org/sites/default/files/publications/Indonesia-sootfree-CBA-02182020.pdf

The Indonesian e-mobility market is concentrated at its early growth stage due to limited selection, high price barriers, and the dependence on ICEs. Major market contributors include Gesits (a local two-wheeler e-motorcycle start-up), Mitsubishi (a leader for hybrid passenger cars and batteries), and BYD (a Chinese leader in e-buses). The EV charging infrastructure sector is led by PT Perusahaan Listrik Negara (PLN), which is Indonesia's state-owned electricity corporation.[III] The Indonesian government has frequently expressed ambitions to be one of the largest battery manufacturing countries for EVs because Indonesia boasts high yields of natural resources such as nickel, a key battery component. Achieving this will turn Indonesia from a potential high-volume importer of EVs and their components, to a high-volume exporter of these.

Indonesia's national energy plan has set an ambitious target for the number of EVs in operation, which is generally in line with 2015 Paris Agreement goals. In 2017, Indonesia's General Plan of National Energy envisaged 2,200 EVs, 711,000 hybrids, and 2,100,000 electric two-wheelers on the streets by 2025 (or 4m, 8m and 13m respectively by 2050). This is not far off the benchmark that would be consistent with the Paris Agreement goals (which would require about one-third of total vehicle fleet to be electric by 2030)[IV] (Tables 2 and 3).

III https://www.researchandmarkets.com/reports/5144792/growth-opportunity-analysis-of-the-indonesian?utm_source=CI&utm_medium=PressRelease&utm_code=2zq6ll&utm_campaign=1440712+-+Growth+Opportunities+in+the+Indonesian+Electric+Vehicle+(EV)+Market%3a+Competitor+Profiles+Including+BYD%2c+GESITS%2c+Mitsubishi+and+PLN&utm_exec=cari18prd

IV https://iesr.or.id/download/final_the-role-of-ev-in-decarbonizing-road-transport-sector-in-indonesia-pdf

Table 2: Cumulative forecast for battery-based electric vehicles and infrastructure by category in Indonesia (2021 - 2025); Source: Ministry of Energy and Natural Resources, 2020

	Public Electric Vehicle Battery Exchange Station (SPBKLU)	Construction of Public Electric Vehicle Charging Stations (SPKLU)	2 Wheelers	4 Wheelers	Buses	Others (Electric bicycles, trucks, ambulances, fire engines)
Ministries/ National Institutions	510	48	801	907	76	209
Regional Government	35	63	67,569	9,224	1,154	8
State-Owned-Enterprises	1,341	56,521	21,349	1,087	5,213	0
Private ownership	10,000	31,413	625,975	16,190	1,821	5,760
Total	**11,886**	**88,045**	**715,694**	**27,408**	**8,264**	**5,977**

Table 3: Market forecast for battery-based electric vehicles and infrastructure by type and year (2021 - 2025); Source: Ministry of Energy and Natural Resources, 2020

	2021	2022	2023	2024	2025	Total
Public Electric Vehicle Battery Exchange Station (SPBKLU)	1,103	1,179	3,350	3,527	2,727	**11,886**
Construction of Public Electric Vehicle Charging Stations (SPKLU)	14,610	14,211	16,799	18,261	24,164	**88,045**
Electric motorcycles	41,474	139,250	171,786	227,409	135,775	**715,694**
Electric cars	2,523	3,941	7,545	7,199	6,200	**27,408**
Electric buses	220	717	2,866	2,111	2,350	**8,264**
Others (electric bicycles, trucks, ambulances, fire engines)	1,032	1,084	1,143	2,253	465	**5,977**

"There is a target to grow charging stations for electric vehicles: 2,400 stations out to 2025, up from 20 units in operation now. Several laws are still needed for investors to work together with PLN to prepare the rollout. Regions can offer their own incentives."

Regional Director, BAPPENAS

The national government has issued a regulation to support reaching these targets, but incentives and specific roadmap actions have not yet been defined. In 2019, the government issued a regulation to boost the domestic EV industry and support reaching targets, while announcing that 20% of all domestically produced vehicles would be low carbon by 2025.[1] Financial incentives such as import and value tax rebate and electricity price discount for charging have been issued. However, the details of incentives are not yet well defined, and the regulation does not yet provide a clear roadmap or supporting details. The Ministry of Transport is expected to issue a national roadmap to 2030 by the end of March 2021.

"It's also about society's trust, since most of us here are lower-middle class and are still using two-wheeled vehicles. Despite roadshows, many question the e-vehicle's durability and infrastructure availability of charging stations. In my opinion, the Government should focus on charging stations first, so the public will feel assured in purchasing the electric vehicle."

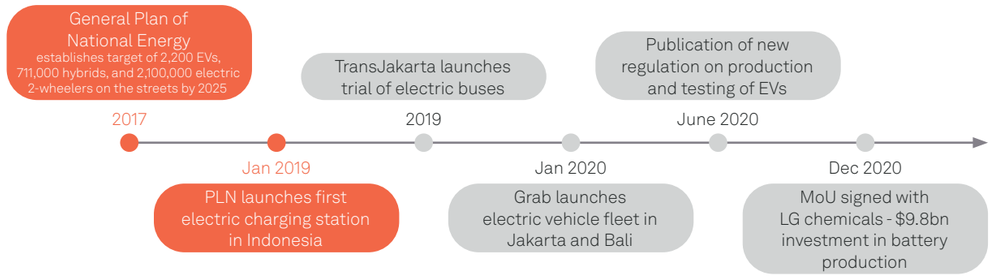
Professor, Udayana University

1 https://indonesien.ahk.de/en/infocenter/news/news-details/indonesia-takes-another-step-forward-in-adopting-electric-cars

Figure 3 looks at the timeline of key events as related to the Indonesian e-mobility ecosystem. The most recent national electricity supply plan includes a strategic plan to develop EV charging infrastructure with the goal to have 2,400 charging stations nation-wide by 2025.[I] The state-owned utility company PLN has signed memorandums of understanding (MoUs) with 20 companies to push EV adoption in Indonesia. Thirteen of the companies are set to provide support with installing charging stations, six companies will help build the vehicles and one company aims to develop their own charger. Companies that have been chosen to provide charging infrastructure by means of installing charging stations include ride-hailing rivals Gojek and Grab, toll road operator Jasa Marga, energy company Pertamina, Bus Rapid Transit (BRT) operator TransJakarta and Indonesia's largest private lender, BCA. State-owned electronics manufacturer LEN will be backed by the Agency for the Assessment and Application of Technology (BPPT) to develop a home-grown charging station.[II]

- The group that has been given the task of building EVs, is made up of six international automakers. This has been reported to include China's DFSK, Japan's Mitsubishi, Germany's BMW and Indonesia's Gesits.
- In addition to this, there are many ongoing pilots nationwide. These include TransJakarta (e-buses), BlueBird (e-taxis), Grab (e-taxis and e-scooters) and Gojek (e-scooters).
- There is a legal framework in place for electric vehicles to encourage domestic production. According to a presidential decree, by 2021 electric cars produced in Indonesia must have at least 35 percent local components (manufactured in Indonesia), at least 40 percent by 2023, at least 60 percent by 2029, and at least 80 percent by 2030.[III] The increasing share of local content requirements follows the trajectory of more mature industries - from construction through traditional ICE automotive - which already boast over 80% domestic content.

Figure 3: Timeline of key events as related to the Indonesian e-mobility ecosystem



International experience points to the need for full-spectrum interventions that consider e-mobility alongside wider energy systems changes, strategic planning and policy innovations. This is easier for smaller, geographically contained, and high-level GDP countries.

I https://opengovasia.com/more-charging-stations-to-drive-electric-vehicle-uptake-in-indonesia/
II https://www.len.co.id/resmi-beroperasi-fast-charging-station-bppt-di-bandung-siap-tingkatkan-local-content/
III https://indonesien.ahk.de/infothek/indonesia-issues-legal-framework-for-electric-vehicles

For companies entering the e-mobility space in Indonesia, there is an element of risk if the ecosystem does not work together seamlessly. In an urban context, the experience of leading cities suggests that e-mobility is more likely to scale when there are:

- Public incentives, exemptions, and preferential lanes
- Adequate charging infrastructure installed across the whole metropolitan space
- Adoption by large institutions or public fleets
- Restrictions and disincentives on non-EVs entering cities or city centres
- Subsidies linked to vehicle usage and mileage, plus access to capital. A focus on high mileage is especially effective from a Capital Expenditure (CapEx) return perspective: buses, trucks, taxis, mobility-as-a-service (MaaS) provider, car sharing, and rickshaws.[IV]

For countries with large and complex geographies or a wider spectrum of incomes and of geographical development, a small scale 'building block' approach, has been seen as being more practical and logical. Therefore, for Indonesia to adopt national policies across energy production, distribution and management, as well as transition public and private mobility to EVs in a short space of time is not possible. But small-scale deployments across high use public services, such as waste collection, may catalyse wider adoption and spur the development of more widely scalable deployments.

IV CapEx of EVs is significantly higher than of conventional vehicles. The purchase cost remains the most cited barrier to entry of potential EV customers, however, incentives for individual customers are out of scope for this study.

3.4 Government Structure and Policy

The e-mobility ecosystem in Indonesia is characterised by complex regulatory landscape and lack of clear roadmap for rollout of e-mobility solutions. Transport policy is divided between local and central government adding difficulties for foreign SMEs offering solutions to a sector that may not be prioritised (for example, the latest national Covid-19 recovery plan lacks clear sustainability guidelines). No comprehensive plan has yet been agreed as to how EVs can be implemented nationwide, and how these should work alongside each other. In addition, coordination and enforcement are challenging amongst the numerous ministries (see Table 4 below): Coordinating Ministry of Maritime and Investment, Ministry of Transportation, Ministry of Finance, Ministry of Industry, Ministry of Energy and Mineral Resources, PLN, Pertamina and new bus manufacturers and operators for example are not all working together at the same time or at the same level in all cities.

Table 4: Roles and responsibilities for E-mobility in Indonesia. Source: expanded from Wijaya & Imran, 2019[I]

Ministry	Role and Responsibility
Ministry of National Development Planning (BAPPENAS)	Construct national development planning, including transport sector
Ministry of Transport (MoT)	Construct national transport policy and manage public transport infrastructure operation
Ministry of State-Owned Enterprise (MSOE)	Manage the national transport infrastructure and operation of public transport services; administer state-owned enterprises, like toll roads and rail
Ministry of Public Works and Housing (MPWH)	Prepare policy for development of national road and bridges network
Ministry for the Environment and Forestry (MoEF)	Prepare national policy for pollution control and environmental impact management of transport sector
Ministry of Home Affairs (MoHA)	Regulate development programs at sub-national level (provincial, city and regency) including for local transport
Ministry for Economic Affairs (CMEA)	Develop national economic and fiscal policy, including for the transport sector; provide economic policies for urban transport proposed by different ministries
Ministry of Finance (MoF)	Prepare state budgeting, including for road and public transport infrastructure
Ministry of Energy and Mineral Resources (MEMR)	Develop energy planning and supply, including for the transport sector

I https://www.researchgate.net/publication/331322400_Transport_Planning_and_Policies_in_Indonesia_Case_Studies_from_Indonesia

Ministry	Role and Responsibility
Ministry of Communication and Information Technology	Communication and information affairs
Ministry of Trade	Responsible for ensuring local domestic components, TKDN (Tingkat Komponen Dalam Negeri)
Ministry of Industry	Coordinates and synchronises the formulation, determination, and execution of ministerial policy in industry. It also executes technical guidance and supervises policy implementation in industry
PT Perusahaan Listrik Negara (PLN)	State-owned electric company of Indonesia
DAMRI (Motor Transport Enterprise of the Republic of Indonesia)	State-owned company that carries out passenger and cargo transport on the road using motorised vehicles
Pertamina	Pertamina is the national energy company, 100% owned by the Government of Indonesia with the Minister of State-Owned Enterprise (SOE) as the Shareholder Proxy.
Regional Development Planning Board (BAPPEDA)	Carries out government affairs and development for employment and economy, infrastructure development planning and others.

The Indonesian Energy and Natural Resource Ministry developed Energy Grand Strategy with battery-powered electric vehicles (BPEV) as one of its programmes. In addition, roadmap to BPEV was also supported with plans for development of public EV charging stations and battery exchange stations with plans to develop 2,400 charging stations and 10,000 battery exchange stations by 2025 as well as increased electric power on households owning BPEV. The Ministry established Indonesia Battery Holding (IBH) as a consortium for several state-owned companies: MIND ID, PT Pertamina, PT PLN, and PT Aneka Tambang. This holding company would be responsible for battery production from nickel mines to battery manufacturing. The Industry Ministry has laid out an ambitious plan for Indonesia's EV and battery sector that incorporates the concept of a circular economy. Indonesia is one of the world's largest producers of nickel and aspires to derive more value from its reserves though battery production. The country does not have lithium but, via processing of recycled batteries, hopes to produce enough supply to become a hub for this activity.[II]

Table 5 summarises general barriers and policy challenges to progressing e-mobility initiatives in the country. In addition to the general business operation challenges, the literature points to a series of additional barriers that apply to the current Indonesian e-mobility landscape specifically. These include manufacturing, service provision and policy barriers, infrastructure, cultural and governance challenges, and challenges relating to attitudes and prioritisation. **These barriers point to the differential progress cities in Indonesia can make, depending on institutions, policies, leadership, and financial leverage and the need to pull lots of different levers - often simultaneously - to achieve sustainable urban development.**

II Indonesia to develop circular economy for EVs, boost battery industry - Business - The Jakarta Post

Table 5: Current barriers to progress e-mobility in Indonesia

	General barriers	E-mobility sector specific barriers
Policy challenges	**Difficulty establishing new businesses.** There remains a complex bureaucracy, which make setting up a business difficult, involving 9-11 procedures and 20-60 days (compared to an OECD average of 5 procedures). Indonesia is ranked 166th globally for ease of doing business. It also takes up to 500 days to enforce contracts with frequent and unpredictable changes of regulations, lack of legal certainty and clarity. In addition, e-catalogues is something companies need to access the procurement system and naturally, to understand the procurement system in the first place.	**Challenges relating to the specifics of the Indonesian strategy** posed by the requirement for components to be domestically sourced and the nascence of the industry. The **restrictions on foreign ownership** limit retail businesses supporting car, motor cycle and commercial vehicles and spare parts which currently require 100% domestic ownership. Automobile maintenance firms are permitted to have maximum foreign ownership of up to 49%.
	Restrictions on foreign businesses entering the Indonesia market. Indonesia has a complex system of four types licensing for foreign companies importing goods or services. In addition to complying with licensing, companies must be aware of the Negative Investment List, which lists areas of the economy closed or partially closed to foreign investment or ownership. A company qualifies as foreign even if only 1% is foreign owned and must abide by the licensing systems.	**Low price competitiveness**. Diesel is publicly subsidised in Indonesia which makes it harder for EVs to achieve cost competitiveness and reduces incentives among commercial as well as private vehicle operators to switch to electric options.
	Language and cultural differences mean that it is recommended to **engage a local partner as an on the ground representative** (this is sometimes a legal requirement). Oftentimes, there is a preference to doing business face to face making remote working a challenge. A local agent or distributor is recommended for most government procurement, as successful bids are often based on long-established relationships, and participants not well-known in the market may miss out.	**Competition with major firms in Japan, China and Korea.** Up to now there is a sense that Asia Pacific companies such as BYD and LG Chem have clearer brands attached to them in the Indonesian market, granting them greater competitive advantage.
	Lower access to capital and credit, making it difficult for businesses and local governments to raise funds to support expansion or investment. Skeptical view towards the investment climate and political environment as businesses are looking for more than just "pro-business" proclamations by the government.	**Established interests and livelihoods.** Denpasar in particular is resistant to the idea of public transport-based e-mobility initiatives (e.g. e-buses) as many of the city's residents are currently employed as taxi drivers.
	High carbon intensity of the electricity grid. Currently the GHG abatement impacts of e-mobility are likely to be relatively lower in Indonesian cities because of the high carbon intensity of the existing electricity system. Indonesia's grid factor is currently nearly double that of nearby countries, such as Thailand and Laos.	**In terms of public transport, e-bus rollout investment is still costly for the government** so there is hesitation from cities to invest in it. Budget reductions during the recent pandemic are also delaying investment plans.
		Lack of education of the public with regards the benefits of e-mobility. It has been widely reported that the general Indonesian public are not aware about e-mobility options and there is a lack of trust in investing in a new technology, especially because the necessary infrastructure, such as charging stations, is not visible yet in many parts of the country. Moreover, floods are frequent in many parts of the country - education is needed as there is a common belief that people could get electrocuted with an EV in a flooded area.
Manufacturing and services challenges	**Skills shortages.** Indonesia suffers from low levels of acquisition, development and retention of high skilled workers, especially engineers. Moreover, there is also the issue of the process of obtaining required work permits for foreign workers, which is improving but remains a significant hurdle.	**Cost and experience of maintenance and repair of e-mobility.** In the UK mechanics are retrained and certified to service electric vehicles due to the high voltage and risk of electrocution (they also require completely different repairs for the battery and powertrain). A MaaS option would place the responsibility of repair on the service provider which would allow more government control on the process.

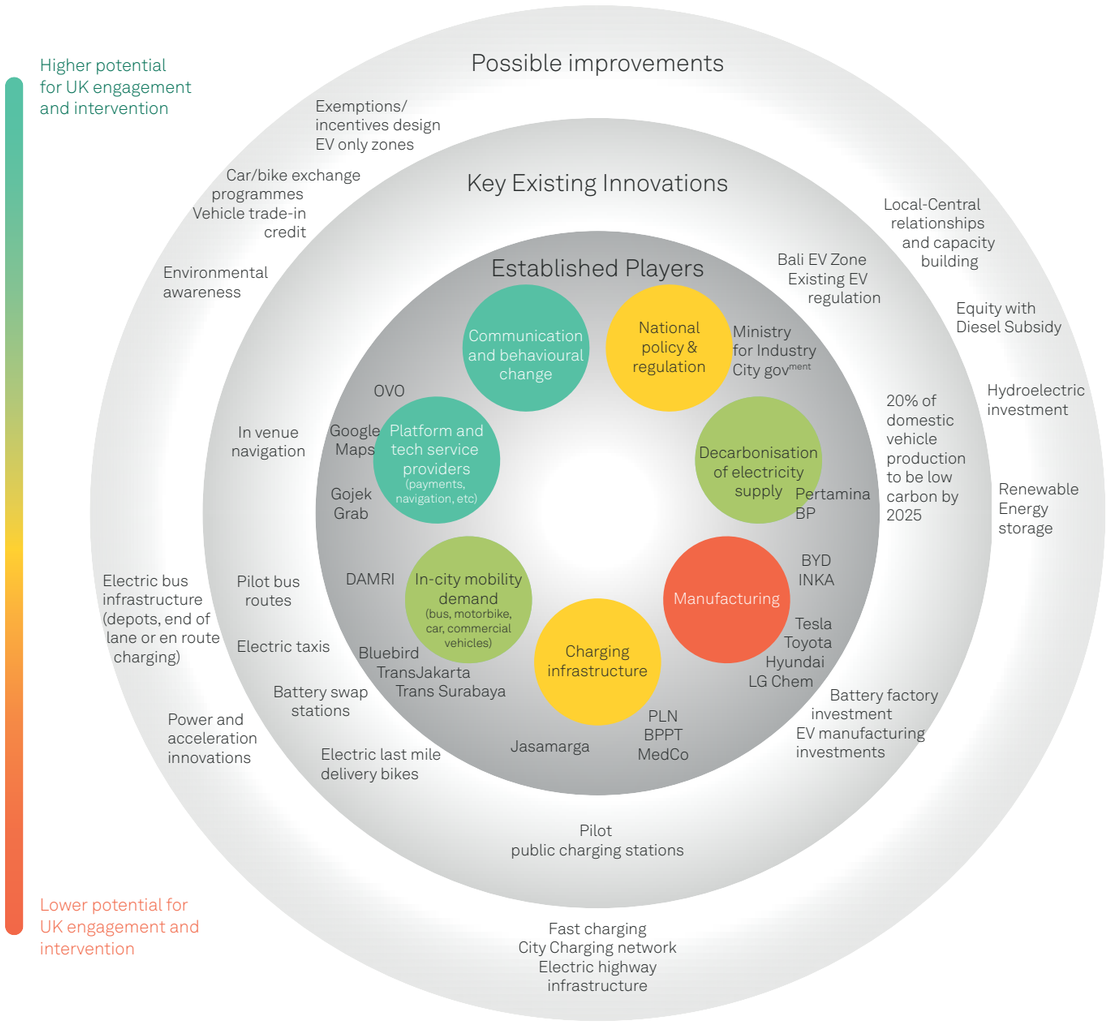
General barriers	E-mobility sector specific barriers
Local content requirements. For example, by 2021 electric cars produced in Indonesia must have at least 35% local components (manufactured in Indonesia), at least 40% by 2023, at least 60% by 2029, and at least 80% by 2030.[1]	**Price of the vehicles.** Currently, it is still considered high for some EVs. The price of the batteries is 30% of the cost of the vehicle. Total cost of ownership for EVs is on parity or lower than ICE vehicles, but only for commercial use type of vehicles with high degree of usage.
High logistics costs and poor infrastructure have implications for vehicle design and needs due to the poor road quality and archipelagic nature of the country. Subnational roads, which are critical to local connectivity, are in especially poor condition - with 40% being classified as damaged or poor.	**Battery life.** Without the ability to partake in battery swapping, if there are traffic jams, it will take 3-4 hours to charge the battery which needs to be made more efficient and optimised.
Underdeveloped electricity infrastructure. There is a lack of electric infrastructure and electric storage capacity in or close to cities. Space in urban areas, particularly in Jakarta, for charging infrastructure is limited. Grid integration for EVs also needs to be planned for in Indonesia.	**Long charging times or uncertainty around charging locations and availability.** The charging network needs to be easy to find, with high availability. Understanding the current supply and demand graphs for electricity supply in Indonesia and how they currently respond to any outages would be extremely beneficial to evaluating how 'smart' the charging network needs to be (i.e. charging only when there is surplus energy supply).

1 https://indonesien.ahk.de/infothek/indonesia-issues-legal-framework-for-electric-vehicles

4 The Indonesian E-mobility Ecosystem and Opportunities to Partner with the UK

The Indonesian e-mobility ecosystem - including the visualised timeline and processes in Figure 3, the established players, key existing innovations and possible improvements across the six main stages of the e-mobility supply chain - is mapped in the following diagram (Figure 4). It shows an emerging and vibrant ecosystem of pure EV players and non-traditional players who are adapting to the new market opportunity. This ecosystem has the potential to drive this new and highly skilled sector and provide considerable economic growth opportunities for the country in a sector that is relevant across Indonesia's vast and varied geography. **The current ecosystem does, however, have significant gaps, and these can either be filled by foreign companies selling into Indonesia, or by turning them into compelling foreign direct investment (FDI) opportunities. These FDI flows from countries like the UK offer the chance for partnering with Indonesian companies and helping with knowledge transfer, local growth and employment, the introduction of new and high tech solutions, among others.** This FDI option will also act as a catalyst to grow this emerging industry sector at an even faster rate than seen at present.

Figure 4: Potential for UK engagement and market entry in Indonesia's e-mobility sector. Source: The Business of Cities research



What this figure shows is that different elements of the supply chain have different levels of saturation in terms of the number of already established players, and therefore differing levels of suitability for engagement and partnerships. The identified e-mobility market entry opportunities for UK companies range from electrification options to charging infrastructure. These include:

- Greening public transport and publicly owned vehicle fleets (buses, taxis, scooters)
- Electrification of minibuses and licensed and unlicensed private minibus operators ("angkots"), as they dominate mobility outside of Jakarta
- Working with Post Indonesia on electrifying their vehicles fleet
- Electrifying the waste collection in Indonesia (for instance, the start and stop function that this service involves creates added air pollution)
- E-vehicles supporting the mining industry, which is a major sector contributing to the Indonesian economy
- Developing charging stations and battery swap infrastructure.

A simple gap analysis shows three clear areas for UK SMEs to engage with the ecosystem:

- **Communication and behaviour change** where the UK can leverage its expertise and experience in persuasion, influencing and communications to enhance uptake of mass transit e-mobility options.
- **Platform and technology service provision** where UK expertise in designing pay-as-you-go e-mobility and charging subscription services, integrated payments systems and fares-as-a-service models may help to reduce financial disincentives to e-mobility uptake.
- **Greening the grid and green financing.** With the presence of UK government funded programmes, such as Mentari[I] and UKPACT[II], which are providing assistance on e-mobility planning at sub-national level, the UK private sector, alongside the UK government, benefit from a successful track record in strong planning consultancy providers with a focus on green transport and e-mobility.

At present, opportunities to partner with the UK EV ecosystem are less suited to certain other aspects of the e-mobility supply chain. Chief amongst these is manufacturing, where high levels of saturation and more stringent requirements on foreign ownership of firms imply a lower return on investment for UK firms, and particularly SMEs (see barriers above in Table 5). The manufacturing landscape is dominated by existing providers, and the Indonesian market is unfolding rapidly as a result of decisions to exploit the country's vast nickel reserves. Therefore, it would be much more challenging to define a compelling FDI proposition for this sector of the UK ecosystem.

The opportunities for UK contribution across each of these areas are reviewed in more detail in subsequent sections of this report.

I https://ukabc.org.uk/event/mentari-program-uk-governments-support-for-indonesian-renewable-energy-projects/
II https://www.ukpact.co.uk/green-recovery-challenge-fund

4.1 Key Stakeholders in the Indonesian E-mobility Sector

Success stories in associated sectors are typically large manufacturers such as Hyundai and LG chemicals who have signed agreements with the Indonesian government on processing their vast nickel reserves and locating manufacturing in the country, including a large manufacturing plant between Jakarta and Bandung. Tesla has recently submitted proposals to build a battery and energy storage gigafactory in Indonesia, although the details of this are not yet known.[III] Indonesia is keen to invest in opportunities like this, in order to make an ASEAN battery manufacturing hub. Other key parties involved in the Indonesian e-mobility sector include:

Supranational development banks

- **ADB:** whose strategy from 2020 aims to "contribute to smart cities with a reliable and affordable supply of electricity through smart grids and distributed systems as well as charging infrastructure for electric vehicles."[IV]

Energy and electricity agencies and companies

- **PLN:** The state-owned electricity distributor is overseeing EV rollout projects, signing MoUs with automobile and energy companies to build cars and support charging infrastructure.
- **Pertamina:** The state-owned oil and gas distributor is planning to add charging stations to its petrol stations.
- **MedcoEnergi:** The private energy company has entered into agreements with PLN and Grab to develop EV charging stations across the country, with a focus on Jakarta and Bali. In Bali, it has launched a platform for charging infrastructure by partnering with local government, OEMs, and charging infrastructure developers in order to create a new pilot ecosystem, with the ultimate aim of scaling to other cities.

Major overseas firms

- **BYD:** The Chinese vehicle maker has already entered the Indonesian market, with two buses used in the TransJakarta e-bus trial and another trial that has just finished in Bali, testing e-buses in tourist areas. Bluebird has also ordered electric vans from BYD to be used as taxis in Jakarta and Bali. Its success seems to stem from partnerships with established, large companies like Bluebird and TransJakarta.
- **LG Chem:** The South Korean giant is heavily involved in the e-mobility industry, investing in a $9.8bn battery factory, as well as seeking to participate in an electric motorcycle battery swap scheme.
- **Major car companies:** Hyundai, Honda and Toyota are all investing in the Indonesia e-mobility sector. The Hyundai Ioniq is available for commercial sale and the Honda PCX is available through fleet rental for institutions. Toyota has invested $2bn to develop EVs in Indonesia.

III https://electrek.co/2020/11/13/tesla-tsla-inches-closer-battery-factory-deal-indonesia/
IV https://www.adb.org/what-we-do/sectors/energy/strategy

Foreign companies in the Indonesian e-mobility ecosystem

There have been long standing partnerships in Indonesia between Chinese and Japanese manufacturers simply because of supply and demand, as well as regional proximity, compared to European manufacturers. Japanese automobiles are viewed as dependable, while Chinese manufacturers have an advantage when it comes to cost. Indonesia is an extremely price-sensitive market. BYD, the automotive subsidiary of the Chinese multinational BYD Co Ltd, have been producing electric buses for the Indonesian market. BYD have been reported to be a global leader in batteries, energy management and e-mobility. The issue with increasing market penetration for vehicles that are produced in Indonesia by companies such as Gesits, one of the local e-motorcycle and e-scooter companies, is one of cost. Currently, there is a pre-pilot, where BYD and a domestic company, Mobil Anak Bangsa, are lending electric buses to Jakarta for a short period as a trial phase. The first pre-pilot will involve 90 buses and it is hoped that this will increase to 200 buses during a subsequent phase. The trial was not open to the public. Buses had to carry water buckets instead of passengers because the necessary permits to have human participants in the trial could not be obtained. Thanks to a recently adopted regulation[I] by the Ministry of Transport (MoT) that specifies type-approval steps and allows electric buses to operate on Indonesian roads, one six-meter and another nine-meter BYD bus subsequently ran on the busiest route in Jakarta and served passengers from July 2020 to October 2020.[II]

Within the current automotive sector, Japanese automotive makers hold the bulk of the market, commanding over 90% of the automotive sales market share in 2020. Sepuluh Nopember Institute of Technology, an Indonesian public technological university located in Surabaya, East Java has been reported to be working with Toyota to change the internal combustion engine of the current car into an electric powertrain, to reduce the need for current owners of Toyota vehicles to purchase new EVs altogether. It is hoped that this would reduce the cost of ownership and spur usage of EVs through conversion.

Within the motorcycles segment, the Japanese Big Four (Honda, Yamaha, Kawasaki and Suzuki), also dominate the sector, accounting for over 70% of the total market share in Indonesia. However, Gesits has made a significant in-road in this segment with an electric motorcycle resulting in a double digit fall of market share for the Big Four Japanese motorcycle manufacturers. Furthermore, Gesits is using Indonesia as a base to export to the rest of the ASEAN market.[III]

Another prominent partnership in Indonesia includes that formed by Grab Indonesia with Gesits. Grab is a multinational ride-hailing company that also offers food and courier services, operating across nine countries in Asia, with headquarters in Singapore and a plan is to build an ecosystem of electric vehicles.

I http://jdih.dephub.go.id/assets/uudocs/permen/2020/PM_44_TAHUN_2020.pdf
II https://jakartaglobe.id/business/TransJakarta-bakrie-autoparts-trial-electric-buses-on-busiest-route
III https://www.motorcyclesdata.com/2021/02/25/indonesia-motorcycles/

Local manufacturers and charging developers

- **Inka:** A rolling stock manufacturer which has signed a memorandum of understanding with Bali - represented by Perusda Bali - to develop an electric public transport system, including electric buses and trams. One of their electric buses is undergoing testing with TransJakarta on an operational route.
- **BPPT (Agency for the Assessment and Application of Technology):** is a non-ministerial agency that is heavily involved in the installation of charging stations, with three nationwide, including one in Bandung.

Local mobility disruptors

- **Grab:** The ride hailing company has deployed over 5,000 EVs across Indonesia, with drivers reporting lower overall costs. They are invested in deploying charging stations, battery swap stations and electric bikes.
- **Gojek:** Grab's competitor in Indonesia is also investing in electric vehicles, making bikes available to rent for delivery drivers and providing financing for user EVs.
- **Gesits:** an Indonesian e-scooter and motorcycle manufacturer, has made significant in-road in this segment with the electric motorcycle.

Overseas consulting firms and niche players

- **Grutter Consulting:** A Swiss consulting firm that is involved in designing the charging infrastructure for Bali and the larger urban zone of Jakarta, and also looking at the grid implications for home charging, including how to integrate with energy service delivery.

Pilot projects in cities to demonstrate what is possible are key. The perception of Western-origin activities so far has been that they focus on studies and workshops as opposed to implementation. Table 6 summarises the existing pilots and investments focused on e-mobility in Indonesia.

Table 6: Existing international e-mobility pilots and investments in Indonesian cities

Partners	Focus of Pilot	What made it work
ADB/ DAMRI	Research into viability of electric bus fleet replacement	Concessional loan funding. ADB was prepared to offer loans to DAMRI (Motor Transport Enterprise of the Republic of Indonesia) if it could become financially stable enough, as the high up front cost of electric buses would have hindered ability to transition their fleet.
BYD/ Trans-Jakarta	Electric bus trials in Jakarta	New buy-to-service financing model. TransJakarta is aiming to have a fleet of 10,000 e-buses by 2030, which is only possible through a buy-to-service scheme. The operators would finance the buses and the city, who lacks the same investable resource, will pay a fixed fee per kilometre.[IV]
ADB/GCF	$150m funding available in concessional grants focused on e-mobility (designed for buses, last mile and two-wheeler delivery)	Concessional finance availability. The availability of concessional loans is key to adoption by firms who lack the capital to invest in high expenditure, risky projects. Grant finance linked to the social cost of carbon is lower due to the country's high grid factor, meaning concessional finance availability is even more important.
Grab/ Hyundai	Grab launched Grab Electric with the aim of deploying 2 million EVs by 2025, with the Hyundai Ioniq as the main model.	Large investment by multinational corporation. Softbank invested nearly $2bn in Grab which is focused on improving Indonesia's digital and electric infrastructure.

IV https://news.busworld.org/en/article/13771/TransJakarta-wants-10-000-electric-buses-in-service-by-2030?referer=left-div

4.2 UK Success in Indonesia to Date

UK success in the Indonesian mobility sector has to date occurred among large companies, typically partnering with government or other large firms. UK conglomerate Jardine Matherson is one of the key players in the Indonesian e-mobility sector through its majority stake in Astra, the leading provider of automobile products in the country. Astra has partnered with Grab and Honda to provide a fleet of 30 electric motorbikes as a trial in Bali, focused on Denpasar. BP, Shell and Rolls-Royce are also active in the mobility sector in Indonesia, mainly via high value agreements with the government, state-owned enterprises and the largest private companies (e.g. Lion Air).

UK businesses and research institutions have acquired significant and transferable expertise in low carbon urban mobility in a range of city contexts both in the UK and globally. But as the above has shown, there is a large opportunity for Indonesia to fill supply chain gaps and encourage countries like the UK to move beyond consultancy work in the sector. In turn this would stimulate highly innovative UK SMEs to select Indonesia as a location of choice to invest in and grow with the local ecosystem. The benefits of this approach to stimulating the existing local ecosystem are vast.

4.3 UK's Competitive Edge

"it will be challenging for a UK e-bus manufacturing company to be successful in Indonesia. But in terms of charging system, technology, integration, there is an opportunity for UK to come in."

Project Director, Mott MacDonald Indonesia

There are several global comparative advantages of UK companies that should be borne in mind when considering the Indonesian e-mobility context. In particular, expertise lies in:

EV hardware and software. The UK is a leader for new energy efficient EV models that meet low emission targets - for electric buses, cars, taxis, and private bikes. It possesses a niche in the subscription services and pay-as-you go schemes. Such expertise supports wider adoption of EVs in middle-income contexts. The UK also has a long tradition of automotive manufacturing, mainly based in the West Midlands. In recent years this has seen a successful pivot into electric drivetrain design and the universities in the area have also helped drive fast growth in skills and R&D in the wider UK EV sector.

"ITS Surabaya developed an e-motorbike whose adoption we would like to see scaled. We see the UK bringing in technology transfer and commercial solutions to speed up the adoption of this."

Provincial Government of East Java

Building out the necessary supporting infrastructure. UK SMEs have become agile providers of electric infrastructure in cities, with particular success in on-street charging points and hubs. Large public transport institutions and universities have expertise in how to connect electric transport to the existing grid infrastructure and transport network. Cities have also found routes to deploy enabling cycling infrastructure, such as cycle lanes and locking stations, to boost demand.

"Our people are not accustomed to think about transportation using e-mobility, they are used to moving around using biofuel. The availability of infrastructure such as charging facilities is important to accustom e-mobility."

Department Head, West Java Government Agency

Advanced battery storage. Many UK start-ups and SMEs are driving next generation battery energy storage solutions for cities. These range from using new materials for battery applications and smart 3D structures to improve performance, to creating batteries based on recyclable materials. In addition, the bespoke battery packs customised to local conditions (weather and usage patterns) represent another strength of the UK e-mobility technology scene. The ambition of the £246m Faraday Battery Challenge government research and innovation fund, launched in July 2017, focuses on making the UK a world leading centre for the battery industry.

"You can get the cells from any country. There is a lot of technology about building the pack and Britain is very good at designing bespoke packs for use. There are different types of battery chemistry - it doesn't matter where you get the cells from - but how you put them together is important."

UK Automotive Technology Industry Expert

Battery life and range and battery swapping infrastructure. Current evidence suggests that range anxiety among prospective consumers is high in Indonesian cities and may be overcome by a shift to MaaS, while battery swapping infrastructure is also growing and a key area for opportunity.

> **"Important support for Bali is power charging, making batteries available. Until now we haven't seen any serious direction for battery swapping. The business model should be built soon to speed up the charging process."**
>
> Head of Bali Regional Transportation Agency

Marketing and market analysis to shape consumer perception and uptake. The UK can be considered one of the marketing capitals of the world. There are a host of large and small companies who can help provide the appropriate incentive strategies, marketing and market analysis engagements to drive up product demand and uptake of a new and emerging technology. For instance, uptake could be constrained by safety and other concerns. A small initiative currently providing e-motorcycles to rent at subsidised prices ($60/month) that has been marketed online and in print has not yet taken off due to concerns around safety and acceleration.

> **"From what I've observed, if people have experienced an electric motorised vehicle, they would not think about going back to their conventional combustion engine. So, our main target is to have society try and test drive this electric motorcycle, as much as possible, supported by the government through initial market and socialisation."**
>
> Indonesian E-mobility Manufacturer and Supplier

Skilled engineers and trained personnel. The UK benefits from a highly trained workforce in the e-mobility skilled-based sector, especially maintenance training and research and development. Training and upskilling the local Indonesian workforce will be important, especially with the challenges to the economy and resulting high unemployment borne by the recent Covid-19 pandemic.

> **"Education of the local workforce is important. We know Bali should not only depend on the tourism sector, because we know we are in a very bad condition now [during the Covid-19 pandemic], so if we look to human capital and upskilling, we are actually ready to head towards the e-mobility era."**
>
> Professor, Udayana University

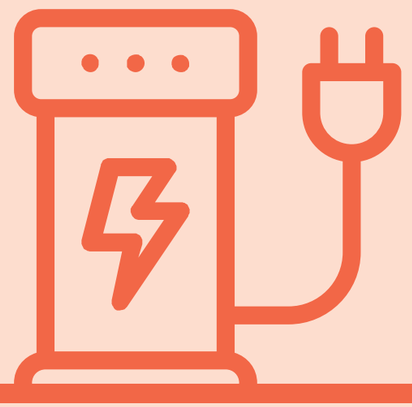
In addition, the Institute for Transportation and Development Policy (ITDP) identified a specific niche role for UK companies to help overcome e-mobility rollout challenges in Indonesia. They shared an opportunity for **UK specialist consultancy in providing a key service such as a guide** for local and national level governments to plan the investments and incentives to provide mass e-mobility options, supported by data and evidence of the benefits outweighing the costs in this space.

> **"We have a few electric vehicles but it is not enough. If we want people to use e-mobility options, then you need to have them everywhere, plus parking space and the charging infrastructure. People need to see more of that on the streets to develop their trust in EVs." -**
>
> Professor, Institut Teknologi Sepuluh Nopember (ITS) Surabaya

Smartphone apps and mobile ticketing for public transport. UK companies are globally leading in digital innovations to support net-zero transport. This includes smartphone apps for city-wide bikeshare schemes and the effective integration of big open transport data sets to optimise travel efficiency. UK firms lead in "fare payments as a service", mobile ticketing, and contactless payments systems for public transport, which help to drive modal shift. Smartphone uptake would also be important for a MaaS option to locate, reserve and pay for the use of e-modes.

While a lot of UK engagement in the sector to date has been consultancy based, there is a much wider pool of expertise that is matched to identified gaps in the Indonesian EV ecosystem. This provides an excellent opportunity for the national and local government to partner with academia and industry in Indonesia to construct a compelling FDI narrative, which will bring in the right companies to complement and stimulate the emerging local EV ecosystem. At the same time, this will drive market growth for the country to become regionally and globally competitive, while reaping local socioeconomic and environmental benefits.

5 Supporting UK-Indonesia Linkages



In order to encourage and support UK companies to enter, successfully navigate and flourish in the Indonesian e-mobility market, there is a clear need for structured support from national and local government, as well as the industry and academic players in the market.

> **"If the mayor and the province governor work together, implementing changes can happen a lot faster and easier than at a national level."**
> Global Transport Leader, PwC

In this report we have identified and engaged with three Indonesian cities with small-scale, pilot government e-mobility projects already implemented that have high interest and high market potential in welcoming UK companies to be part of their e-mobility ecosystem. We have gauged the interest of academics, government officials (on city, provincial and national levels) and private companies in order to identify the best business opportunities. We start with a discussion of the opportunities that lie within the three Indonesian cities and their wider provinces and the characteristics that make them unique, open and suitable to engagement with UK companies.

5.1 A Tale of Three Cities: Bandung, Denpasar and Surabaya

The global e-mobility market is expanding to emerging economy cities. The 25 largest metropolitan area-level electric vehicle markets contained 40% of the world's passenger electric vehicle stock as of the end of 2019 - lower than in 2016 (45%).[1] Leading cities with higher levels of uptake are no longer growing at a faster pace than the rest of the world, as urban centres with smaller populations begin to experience more rapid e-mobility growth.

We focus on three Indonesian cities as a starting point to understand how to navigate the Indonesian e-mobility ecosystem and identify supply gaps UK companies would be well positioned to fill. We selected Bandung, Denpasar and Surabaya for their economic diversity and innovation characteristics which make them open to piloting new technologies and services. Two of the cities are also involved in several projects with the UK government funded Global Future Cities Prosperity (GFCP) programme.

1 https://theicct.org/sites/default/files/publications/ev-capitals-update-sept2020.pdf

Prosperity Fund Programme in Indonesia

The aim of the UK Foreign, Commonwealth & Development Office (FCDO) GFCP programme is to work with a select number of cities in middle income countries, one of which is Indonesia. The programme runs over a three-year period to improve the way cities are planned and managed, resulting in increased local prosperity and quality of life, including a reduction in levels of poverty and gender inequality, together with creating mutually beneficial trade opportunities. The programme will also help create opportunities and develop sustainable economic relationships with cities in sectors where the UK has a comparative advantage, leading to a mutually beneficial increase in future cross-border trade.

There are many challenges in terms of public transport provision in Indonesia, such as lack of good service, facilities and crucially, first- and last-mile connectivity, which remains a main issue in Bandung, Surabaya and Denpasar.

The FCDO is currently providing assistance via the GFCP programme to the Bandung City Government on improving their public transport service quality as well as technical assistance and capacity building to the Bandung City Transport Agency to develop a city-wide Integrated Transport Plan. In addition, there are other donor programmes in Bandung Basin Metropolitan Area helping with infrastructure development of mass urban railway and BRT.

The programme is providing technical assistance to the Surabaya Planning Department to develop urban planning and design guidelines for the neighbourhood of Putat Jaya to transform the area into a liveable vibrant neighbourhood and to promote economic growth. While these interventions do not focus on the transportation system directly, there is a plan to integrate e-bike and e-bus route within the heritage tourism area of Surabaya city.

There have not been any FCDO projects to date in Denpasar, however, it has been listed as one of five cities chosen by the central government for a pilot programme related to public transport. The aim is to establish a Public Transportation Information System (PTIS) and Intelligent Transport System (ITS). Technology tools needed for this will include radars, cameras and the hardware and software system itself. In addition, Denpasar has been using 14 electric school buses for over two years.

The three cities of Bandung, Denpasar and Surabaya exemplify some of the challenges that Indonesian cities face with regards to urban pollution and transport (Table 7). At the same time, these cities are entering a period of growth and innovation which would benefit from the introduction of e-mobility and programmes to align growth with Indonesia's commitment to reduce carbon emissions. High levels of air pollution and congestion, together with low affordability and coverage of public transport, mean that there is an urgent imperative to shift more private vehicles as well as the mass transit fleet to electric modes of operation. This can help to dramatically improve air quality.

Table 7: Three cities' air quality index profiles. Data from The Business of Cities City Typology Index

	Surabaya	Bandung	Denpasar	A-PAC average	A-PAC leader
Annual average Air Quality Index (AQI) (lower = better)	70	51	22	42	15
No. of days within fresh air guidelines	18	0	-	42	266
Annual average AQI profile	Highly polluted, moderate annual variation in pollution levels	Highly polluted, little annual variation in pollution levels	Moderately polluted		

As a result of high motorisation rates, Indonesian cities are some of the most highly congested cities in the world. Congestion levels refer to the higher travel time a driver or vehicle incurs compared to the length of time it would take to travel the same distance in uncongested conditions. In 2017, Denpasar, Bandung and Surabaya were all in the world's top 250 most congested cities, with annual congestion levels of above 13% (see Table 8)[I]. The annual cost of congestion for the three cities combined reached over $40bn in recent years.[II]

Table 8: Congestion in Jakarta and the three target cities for this study[III]

City	Annual average congestion level (%)	Global rank (1st = least congested)
Jakarta	17.3%	1043rd
Bandung	20.1%	1000th
Surabaya	14.5%	924th
Denpasar	13.5%	843rd

I INRIX Global Traffic Scorecard 2017. Global rank also takes into consideration peak hours spent in congestion.
II World Bank (2019) Time to ACT! Realizing Indonesia's urban potential
III INRIX Global Traffic Scorecard 2017. *Global rank also takes into consideration peak hours spent in congestion.

Surabaya

Surabaya is Indonesia's second largest city, a port hub home to approximately three million people which plays increasingly international roles in trade, logistics, finance, food and beverage, and manufacturing. The city currently does not have any high capacity public transport, and the mobility market is dominated by private operators and minibuses. Catalytic projects planned include a high speed rail link to Jakarta worth $4.3bn, a new metropolitan commuter train line and expansion of the Juanda international airport.[I] Surabaya's local leadership has been supportive of e-mobility, committing recently to an electric government vehicle fleet and planning an e-bus pilot in 2021. The city's transport network is overseen by the Surabaya transport department. In 2018, Liverpool and Surabaya became sister cities, with a focus on port management, creative industries, smart cities and human resource capacity development.

Bandung

Bandung is a large, hilly city 150km from Jakarta whose manufacturing economy has increasingly diversified into digital, tourism and financial services. Its strong university has helped to foster innovation and enterprise. High capacity public transport services are provided by the BRT company TransBandung, DAMRI and AKDP (Provincial Intercity Transportation), but the popularity of private taxis or minivans ("angkots") continues to grow. A high speed rail link with Jakarta and a $570m LRT and commuter train scheme are important upcoming projects.[II] Bandung is known for its mobility leadership, as the first province to commit to all government vehicles becoming electric. Current progress on the rollout of e-mobility charging infrastructure has so far been relatively slow, with only one public charger installed in the city.[III]

Denpasar

As the capital of Bali province, Denpasar is a coastal visitor capital whose hospitality and trade sectors shape patterns of mobility demand. A large minority of the local population works in the taxi or car rental industry, which have resisted the development of a public transport system. There is however a regulatory framework for electric vehicles already in place and pilots with Grab and others underway. The Bali Provincial Transport Department oversees and regulates transportation and is responsible for licensing private operators, such as Grab. Despite limited charging infrastructure available for electric cars, there are already several stations operating for electric motorbikes, including six battery swap stations.[IV]

I https://www.benarnews.org/english/news/indonesian/rail-way-01192021153111.html
II https://www.pwc.com/id/en/media-centre/infrastructure-news/february-2019/greater-bandung-LRT-to-utilise-PPP-scheme.html
III https://www.len.co.id/resmi-beroperasi-fast-charging-station-bppt-di-bandung-siap-tingkatkan-local-content/
IV https://www.len.co.id/resmi-beroperasi-fast-charging-station-bppt-di-bandung-siap-tingkatkan-local-content/

"West Java is not 100% urban. It consists of metropolitan and rural areas. The challenge is to segregate public policy on e-mobility so that it can be customised for the different characteristics of the areas."

Department Head, West Java Government Agency

Into the 2020s and notwithstanding the profound shock of Covid-19, the development path of Indonesia's cities, and Surabaya, Bandung and Denpasar in particular, now benefits from stronger macro fundamentals, a more dynamic private sector, more robust entrepreneurial culture, more reliable power supply, faster mobile internet speeds, higher access to skilled graduates and civil servants, and increased readiness to adopt new technologies.

In parallel to this growth potential, Surabaya, Bandung and Denpasar face a number of challenges. These include limited internal and external connectivity due to the high cost of domestic transport and limited competition between transport providers. Fragmented institutional arrangements for metropolitan governance, data gaps in the mapping the terrain, and spatial disparities in infrastructure coverage add further challenges for the cities (Table 9).

Despite the challenges, taken together, these three cities collectively are a major influence on wider processes of Indonesia's urbanisation. With the right interventions and partners, they have significant potential to accelerate towards more sustainable and efficient mobility over the next 10 years and beyond. These cities are now entering a growth cycle that hinges on:

- Expanding and diversifying their infrastructure systems to keep up with population growth, including via expanded metropolitan commuter trains, high speed rail connections to other cities, and more agile-mobility choices.
- Reducing inequalities through improvement programmes and improved access to jobs and reduced pollution.
- Fostering innovation activity and developing sharper clustered specialisations to make their economies more future proof.

Table 9: Bandung, Denpasar and Surabaya's Barriers and Opportunity to E-mobility

	Economy and Physical Character	E-mobility Context	Barriers
Surabaya	Low-lying coastal port city. Economy dominated by trading, both through its port and financial institutions and industrial manufacturing.	Limited high capacity public transport. Mobility sector dominated by private vehicles. High levels of government support for EVs.	Limited track record of mounting successful public transport projects.
Bandung	Hilly city with a restrictive urban landscape. High innovation economy with a strong university and many start-ups.	Small existing fleet of public buses. Demand still mainly focused on private vehicles. Pioneering province with high levels of government support for EVs.	Some track record of mounting successful public transport projects. Opportunity to focus on electrifying road-based transport alongside improvements of urban railway system.
Denpasar	Coastal gateway to tourism on the island of Bali and other islands. Vibrant economy dominated by services and tourism.	Strong culture of using and customising motorbikes and bikes. e-mobility seen as a potential draw for tourism. National government plan for an EV zone to enhance attractiveness.	Strong established interests opposed to significant modal shift. Existing e-motorbike rental scheme that is well marketed and cost competitive has not yet taken off.

5.2 Physical Characteristics and Governance Structures of the Three Cities

Electric mobility has the potential to contribute significantly to addressing the structural gaps identified in all three cities. A shift to e-mobility can lead to major improvements in the quality of life of the cities' millions of residents.

Delivering e-mobility requires, where possible, whole-city approaches. The three target cities benefit from at least some level of metropolitan or regional coordination, which could make whole-city impacts resulting from e-mobility more viable to design and deliver in this local context. Both Bandung and Denpasar have formal metropolitan-level government institutions, while both Surabaya and Denpasar have coordination mechanisms that prioritise cooperation on spatial planning, transportation and infrastructure (Table 10). However, the leadership capacity and priorities of different provinces and transport authorities vary widely across cities, making the success of e-mobility initiatives up until now and in the future highly dependent on local leadership. In the short-term, Covid-19 and related pressing public health issues may be more immediate concerns for local leaders than e-mobility.

On the one hand, Bali has lower levels of appetite among local government leadership, and a visitor economy that is more challenging to drive reform, relative to Surabaya and Bandung. In the latter, vocal and supportive mayors have underpinned bolder ambitions to electrify government-owned vehicle fleets. On the other hand in Bali, there is a lot of enthusiasm and demand for e-mobility in principle. However, current efforts remain focused mainly on how to support recovery from the Covid-19 pandemic and its impact on the local tourism industry.

Table 10: Metropolitan-level governance arrangements in the three cities.[1]

	Formal metro-level government	Joint metropolitan secretariat	Informal metro-level coordination forum	Areas of cooperation
Bandung	●			Governance, economy, physical development, social development, culture
Surabaya			●	Spatial planning, transportation, infrastructure, environment
Denpasar	●			Waste management, transportation, infrastructure

1 Adapted from World Bank (2019) Time to ACT! Realizing Indonesia's urban potential

Table 11 highlights how - by ASEAN and Asia-Pacific standards - the three Indonesian cities stand out as:

- Being medium- to high-density cities
- Inheriting less walkable spatial forms that make accessing key services on foot more difficult
- Becoming denser and more land use efficient in the current cycle.

Table 11: Track record of compact development

	Surabaya	Bandung	Denpasar	A-PAC average	A-PAC leader
Built-up area expansion rate, 2000-2015 (%)	+10.4%	+4.9%	-	+6.3%	+1%
Per capita built-up area expansion rate, 2000-2015 (%)	-0.2%	-16.1%	-34.0%	-17.0%	-41.0%
Weighted population density (per sq. km)	12,000	20,900	10,500	19,150	84,000
% of population living within walking distance of services	35%	21%	42%	41%	72%

*Weighted population density = population density of many small areas within the city, averaged where weighted by population. *% of population living within walking distance of services = % of residents living within 1km walk of both education and healthcare facilities. Data from The Business of Cities City Typology Index

In particular, Denpasar emerges as a city that is becoming much more land use efficient relative to population growth, while Bandung emerges as being an efficient high density city by Asia-Pacific standards (Table 12).

Table 12: Urban development characteristics of the three cities

		Surabaya	Bandung	Denpasar
Track record of compact development	Track record of compact urban development	Very rapid metropolitan footprint expansion	Substantial metropolitan footprint expansion	Stable metropolitan footprint
	Track record of densification	No clear pattern of densification	Re-urbanising with some densification	Becoming more land use efficient
	Weighted population density	Medium density	Efficient high density	Medium density
	% of population living within walking distance of services	Medium walkability	Low walkability	Medium walkability

5.3 The ASEAN comparison

When further compared to ASEAN and Asia-Pacific counterparts, Indonesian cities find themselves with significant mobility deficits. **The most urgent challenges are around the coverage, efficiency and uptake of high-capacity public transport**, where Surabaya, Bandung and Denpasar are all behind the average among Asia-Pacific cities. Public transport as a whole is also relatively expensive in Indonesia, with residents spending a greater proportion of monthly income on public transport than in other Asia Pacific cities.

Current evidence suggests that EV interventions may be even more important for driving emissions and pollution reduction in areas with much less high-capacity public transport. Especially in a post Covid-19 context where emerging evidence suggests that many people in Indonesia may be more reluctant to travel by bus, EVs can help to fill the gap and maintain high levels of mobility while simultaneously reducing emissions and air pollution (Table 13).

Table 13: Public transport fundamentals in the three cities

	Surabaya	Bandung	Denpasar	A-PAC average	A-PAC leader
% of monthly income spent on public transport	7.5%	4.8%	-	4.0%	1.3%
Coverage of high capacity public transport (1 = max)	0	0.01	0.03	0.05	0.44
Monthly income spent on public transport	Unaffordable for ordinary residents	Expensive for ordinary residents	-		
Coverage of high capacity public transport	Major core mobility gaps and deficits	Major core mobility gaps and deficits	Major core mobility gaps and deficits		

*Coverage of high capacity public transport refers to length of metro, light rail and BRT systems, no. of stations, and ridership, per capita. Data from The Business of Cities City Typology Index

A key challenge is that few people are able to access core education and healthcare services on foot - especially in Bandung. This is particularly relevant considering the current circumstances relating to the Covid-19 pandemic, which has reduced uptake of public transport. Coupled with the lower affordability and more limited coverage of public transport, this means that many residents are reliant on private vehicles - especially two-wheeled vehicles - to access these services. Current government initiatives are focused on increasing the uptake of EVs in public transport and government vehicles. Successful pilot programmes demonstrating effectiveness and ease of use will allow for a wider rollout of e-mobility options across the spectrum of vehicle uses.

Despite the high cost that city governments are not equipped to deliver, **the current state of poor coverage by large public transport vehicles presents an opportunity for a concerted effort between the public and private sectors to build a mass transit EV network from scratch rather than attempting to retrofit and replace old, conventional transportation stock**. As every city has public transport backbones, this means that the solutions developed and delivered in one city are highly scalable to others throughout Indonesia.

5.4 Urban Innovation Ecosystems

Relative to many other Asia-Pacific urban centres, Indonesian cities' innovation ecosystems are less developed. The innovation intensity of Indonesian cities - according to the number of high-innovation start-ups, scale-ups and corporate firms per person - is lower than the average across Asia-Pacific. The track record of Surabaya and Denpasar of scaling firms to catalyse the wider ecosystem and attain global reach and appeal is not as developed as Jakarta or Bandung. This is a clear opportunity for all three cities.

Bandung stands out as a city with a more promising innovation ecosystem that can be built upon. The commitment of the Bandung municipal government to stimulating the creative economy through supporting new innovation centres, establishing industry hubs and providing R&D support means that the city has been more successful at scaling start-ups to mid-size prospects, relative to others. The Regional Development Acceleration Programme credit system that provides support to creative industries start-ups and the Bandung Techno Park business incubator have all helped the city to grow the presence of local tech-enabled firm HQs, where Bandung now ranks in the global top 225 (out of 488 cities). Bandung also has a relatively higher level of innovation specialisation in mobility and allied sectors relative to other cities.

The market for innovative firms in mobility and allied sectors is not yet saturated in Indonesian cities. All three of the cities have relatively low levels of innovative firm specialisation in these sectors. This suggests that there is much room for new e-mobility solutions to enter the market (Table 14).

Table 14: Innovation ecosystem profiles of Surabaya, Bandung and Denpasar

	Surabaya	Bandung	Denpasar	A-PAC average	A-PAC leader
No. of local tech-enabled firm HQs*	139	199	47	730	7,339
Per capita density of local tech-enabled firm HQs	0.5	0.8	0.5	2.5	16.1
No. of successful catalytic start-ups**	3	15	1	85	1,197
% of tech-enabled firm HQs in mobility and allied sectors	0.79%	0.86%	0.73%	1.35%	4.39%
No. of local tech-enabled firm HQs	Limited size and scale of innovation economy	Modest size and scale of innovation economy	Limited size and scale of innovation economy		
Per capita density of local tech-enabled firm HQs	Very low intensity of innovation activity	Some but low intensity of innovation activity	Very low intensity of innovation activity		
No. of successful catalytic start-ups	Little track record of successfully scaling innovation firms	Some track record of successfully scaling innovation firms	Little track record of successfully scaling innovation firms		

*No. Of local tech-enabled firm HQs = no. of registered technology-enabled start-ups, scale-ups, and established corporates according to Crunchbase's database of over 1m firms that have a high technology quotient, are recognised in global media as having innovated in terms of product or process in the past 12 months, or have experienced significant VC investment.
**No. Of successful catalytic start-ups = ranked in the global top 100,000 firms on aggregate across measures of firm activity, online and media visibility, and investment momentum. Data from The Business of Cities City Typology Index

5.5 Partnership Capacity and Capability

There are fewer major urban innovation players for e-mobility firms to partner or compete with in Indonesian cities, relative to other Asia-Pacific cities. Surabaya is home to around 13 of a sample of 50 of the world's leading urban tech firms, while Bandung is home to just five. In both cases this is lower than on average across the region's cities (19)[I] . Denpasar does not have any leading urban technology firms (Table 15).

Table 15: Ability of government and private sector to partner and procure services in the three cities

	Surabaya	Bandung	Denpasar	A-PAC average	A-PAC leader
Presence of 50 leading urban tech Advanced Urban Services (AUS)[II] firms	13	5	-	19	42
Per capita density of 50 leading urban tech (AUS) firms	0.10	0.06	-	0.79	5.03
Overall city-level spending capability (1 = max)*	0.04	0.00	0.01	0.09	0.52
Presence of 50 leading urban tech (AUS) firms	Modest availability of major urban innovation players to partner and/or compete	Some but very low availability of major urban innovation players to partner and/or compete	-		
Per capita presence of 50 leading urban tech (AUS) firms	Modest levels of urban innovation market saturation	Low levels of urban innovation market saturation	-		
Overall city-level spending capability	Some but very low spending capability	Negligible spending city authority	Negligible spending city authority		

*Weighted average of absolute city government capital budget (33%) and city government capital budget per person (66%), relative to global leader. Data from The Business of Cities City Typology Index

I Presence of a sample of 50 of the world's leading advanced urban services firms (Google Analytics).

II Advanced Urban Sservices (AUS) is a term coined by Connected Places Catapult to refer to the way rapid urbanisation and new technologies are providing opportunities to improve life in cities by redesigning public services, creating new products and services, and overhauling existing governance structures.

The ability of Indonesian city governments to procure services from overseas partners is also lower. City-level capital budgets are low across the three urban centres, with only the city of Surabaya having some modest spending capability. This means that any e-mobility trials must demonstrate clear efficiency savings to the city in terms of costs when baselined against existing services.

The implication for e-mobility demand is that while it may be more difficult for firms to find globally influential innovation players to partner with, saturation levels are also lower, which may improve the likelihood of success.

5.6 UK E-mobility Case Studies

The UK has one of the most developed e-mobility ecosystems globally. Investment into transforming the UK's general domestic transport, and e-mobility sector in particular, has boosted UK businesses to become well placed to share best practices globally with cities and businesses. UK SMEs have distinct expertise in:

- Smart charging infrastructure (points and hubs) (e.g. Engenie, Elmtronics).
- On-board technology to enhance the cost effectiveness of e-freight (e.g. Tevva Vehicles).
- Cloud-, AI-based software & IoT to increase efficiency in public transport and EV grid charging, providing infrastructure operators with real-time movements data (e.g. Vivacity, Alchera Technologies).
- E-mobility subscription services and supporting smartphone apps (e.g. elmo).
- Developing bike sharing and e-bike infrastructure (e.g. Swytch, Human Forest).

In fact, alongside UK research institutions and local governments, these companies are global leaders in e-mobility, particularly in:

- Exploring the readiness of grid infrastructure for electric vehicles.
- Solving challenges in integrating electric transport systems into the existing networks, including supply chain issues, electric vehicles and charging infrastructure, and electric rail networks.
- Small EVs with reference to light three and four wheelers.
- Optimising air quality and health benefits associated with a low-emission transport and e-mobility revolution in the UK.

The following selection of UK companies highlights SMEs in the e-mobility sector that are well positioned to fit into the Indonesian e-mobility ecosystem in the three cities - Bandung, Denpasar and Surabaya.

The UK Electric Mobility Ecosystem

Batteries

Nyobolt
New generation superfast (under a minute) niobium charging battery company.
www.nyobolt.com

Addionics
Creating next-generation batteries through intelligent 3D battery architecture and engineering.
www.addionics.com

Battery Storage

Connected Energy
Breakthrough energy storage systems using 'second life' electric vehicle batteries.
www.c-e-int.com

OXTO Energy
Global energy storage and technology provider.
www.oxtoenergy.com

Zenobe Energy
Delivering clean power and transport solutions through the innovative use of battery storage.
www.zenobe.com

Charging Infrastructure

Urban Electric Network
Urban new generation on street EV pop-up charging infrastructure solution provider.
www.urbanelectric.london

POD Point Ltd
Building and providing the charging infrastructure needed to enable mass adoption of EVs.
www.pod-point.com

Andersen
UK producers of smart and customisable charge points for electric vehicles.
www.andersen-ev.com

cityEV
EV charging point provider.
cityev.net

Charging Networks

CrowdCharge
Digital platform to manage multiple EV chargers to provide EV owners with cheaper and greener electricity.
www.crowd-charge.com

ev.energy
Intelligent platform to manage EV charging to make it greener and cheaper.
ev.energy

EVs (car, bus, van & truck)

Arrival
Human-centred, intelligent e-bus and e-van design - to revitalise public transportation.
www.arrival.com

Tevva
Leading the drive to zero-emissions freight using revolutionary range extension technology.
www.tevva.com

Manchester Electric Vehicle Ltd
UK's most affordable EV maker, with a target price of under £10,000.
www.beeanywhere.com

Alcraft Motor Company Ltd
Alcraft focused on developing unique low-carbon vehicles and technologies.
www.alcraftmotor.com

EV Technology
Consultancy and technology company focused on the electric vehicle market.
www.ev-tech.uk

Shared Mobility (cars & two wheelers)

Manchester Electric Vehicle Ltd
UK's most affordable EV maker, with a target price of under £10,000.
www.beeanywhere.com

Ginger
Shared micromobility solution provider; shared bikes, shared e-scooters, shared e-bikes, shared e-microcars, or any other innovative vehicle that emerges.
www.ginger.town

Zwings
E-scooter and e-bike fleet rental operator and one of the UK's fastest growing micromobility start-ups.
www.zwings.co.uk

GoZero Mobility
Shared e-bike operator and manufacturer.
www.gozero.in

Electric Assisted Vehicles Ltd
New generation EV design e-cargo, engineering and production company developing solutions in the rapidly growing zero-emissions vehicles market.
www.eavcargo.com

Mobility Platforms & Behaviour Change and Integration

Liftango
Demand Responsive Transport and MaaS digital technology platform designer and operator.
www.liftango.com

Better Points
Behaviour change company with cutting-edge habit changing for transport & mobility, health & wellbeing and climate change; Software-as-a-Service digital platform.
www.betterpoints.ltd

EV Components

Hypermotive
Alcraft focused on developing unique low-carbon vehicles and technologies.
www.hyper-motive.com

Integral Powertrain
Powertrain in vechicle and E-Drive systems specialist.
www.integralp.com

Battery Management and Analytics

GreenEnco Limited
Renewable energy (battery pack, battery management systems) strategy and risk management consulting.
www.greenenco.co.uk

Eatron Technologies
Alcraft focused on developing unique low-carbon vehicles and technologies.
www.eatron.com

Traffic Management

Fotech Solution
Delivering advanced monitoring solutions using fibre optic sensing and AI.
www.fotech.com

Now Wireless
City networking infrastructure and smart city development including traffic optimisation with AI and IoT.
www.nowwireless.com

End-of-life Battery Technologies

Aurelius Environmental
Battery recycling company developing a radical, green way of recycling batteries in conjunction with Cambridge University.
ael.global

Ecobat Logistics
UK's leading authority on waste (EV) battery collection and recycling.
www.ecobat-logistics.com

Liftango

Liftango guides global organisations and cities on how to plan, launch and scale shared multi-modal mobility projects. They solve parking, congestion, and zoning problems by improving the efficiency of transport services using on-demand transport technology and reduce GHG emissions. From corporate transport, public buses, carpooling and paratransit services—Liftango has invented the most advanced demand-responsive tech to enable communities to leverage the power of shared transport that is sustainable, cost-effective, reliable, and inclusive.

Why partners should work with Liftango

Liftango recently completed a successful trial in North Lincolnshire Council and Staffordshire County Council. Currently, they are operating in UK, Australia, US, and New Zealand. Their rapid growth and international success imply their MaaS transport technology can deliver sustainable transport behaviour in Asian market too.

www.liftango.com

Nyobolt

Nyobolt is a cutting-edge battery company that is defining a new category of ultra-high-power technology, University of Cambridge spin-out. Nyobolt batteries represent a paradigm shift – delivering super-high discharge power and ultrafast charge. This technology is ideal when fast charging and high power are needed, along with high energy density. Their technology also provides better safety and longer cycle life than existing battery technology and performs exceptionally well at low and high temperatures.

Why partners should work with Nyobolt

After securing $10 million in Series A funding from Cambridge Enterprise and Slicon Valley investors, Nyoboly initiated commercialising high-power battery technology that will meet the demands of many electric vehicle applications. The fresh funds will enable the company to expand its operations globally, build a new production and testing facilities and expand their teams in the UK, the USA and Asia.

www.nyobolt.com

Arrival

Arrival, the UK-based sustainable mobility start-up is developing commercial electric vehicles using in-house developed technologies, scalable platforms, and its pioneering flexible micro factories. This approach allows cost-effective production of many different vehicle types including light vans and large buses. Arrival's new method of design and production makes the cost of its electric vehicles comparable to fossil fuel equivalents, which it anticipates will accelerate the mass adoption of electric mobility.

Why partners should work with Arrival

Arrival is regarded as UK's most valuable start-ups. In October, the company has raised $118 million investment from Hyundai and Kia and generated $660 million which has fuelled its global expansion. It has orders for 10,000 battery-powered commercial vans from delivery giant UPS. Arrival is already building its first two $50 million "micro factories," one in England and another in the USA.

www.arrival.com

Tevva

Tevva Motors Ltd is a UK-based, leading developer of modular electrification systems for medium duty commercial vehicles. Using systems engineering approach, Tevva has developed world-class electric vehicle technology that adheres to the most rigorous of standards to ensure safety, reliability and durability. Every Tevva e-truck reduces CO2 emissions by approximately 20 tonnes per annum, accelerating the drive to net zero.

Why partners should work with Tevva

Tevva e-trucks are packed with proprietary advanced technologies, all of which are designed to offer the operator a more environmentally friendly, more cost effective and more operationally practical EV, facilitating the move away from fossil fuels and to a cleaner greener future, with confidence.

www.tevva.com

EV Technology

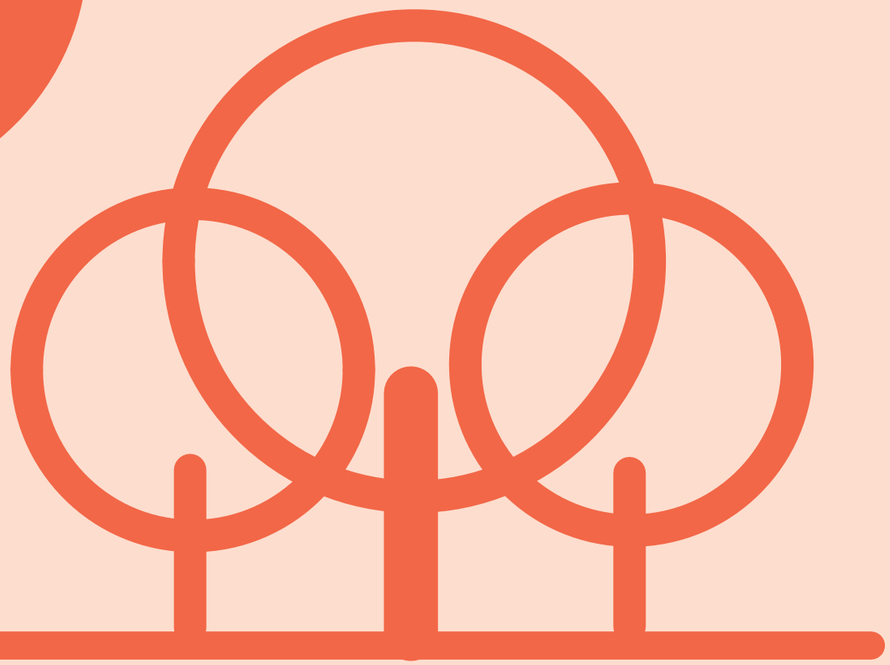
EV Technology is a consultancy and technology company focused on the electric vehicle market. Born out of the first fully electric taxi fleet in London, they aim to make the transition of fleets to electric as easy as possible. They use their domain expertise to advise customers on how to transition to electric vehicles in a value-enhancing way, from infrastructure requirements and installation to managing and monitoring their vehicles and how to train drivers in eco-driving. They analyse fleets for the propensity to use EVs and ascertain the charging requirements of a proposed fleet and then deliver a plan to make sure the vehicles are charged when needed.

Why partners should work with EV Technology

EV Technology's ultimate ambition is to become the main aggregator of data for all EV market participants. In this position, they can provide information to a range of customers including car manufactures, insurance companies, energy providers and other smart city service companies.

www.ev-tech.uk

6 Summary



The e-mobility sector in Indonesia has seen strong local growth over recent years, yet the potential remains largely untapped. This sector holds the potential to not only address climate change and urban pollution, but also drive local and national growth through a young and fast-growing global industry. Indonesia is uniquely blessed with resources and a home market, as well as with a strong academic and industry ecosystem. If this ecosystem can be catalysed then Indonesia is well positioned to be not only a regional player, but a global power in the e-mobility sector.

This report has looked at the current state of the e-mobility sector in Indonesia as well as at how the transformative potential of this sector can be tapped into to provide wider ranging environmental and socioeconomic benefits of supporting the reduction of urban pollution. Indonesia is well placed to take advantage of this unique moment in time and engage with its science and innovation agenda in approaching the area of net zero.

In the short term, fossil fuels will continue to drive energy production in the country, mitigating the national carbon footprint reduction that increased adoption of e-mobility services can bring. **Thus, the success of e-mobility for reducing emissions within Indonesia's mid-sized cities will firstly depend on the decarbonisation of the electricity grid. But this should not dissuade or delay the increased adoption of e-mobility services.** They bring multiple benefits, and in a fast growing and young industry, Indonesia needs to develop its own capabilities quickly or risk being locked into importing solutions in this sector for the long term.

The pace of the development of this sector can be sped up through the support from city authorities, academia, industry and the partnering with appropriate companies and academic institutions from the UK. It is through the city-wide deployment of e-mobility services that Indonesia will see the initial positive impacts of the sector, both economically, socially and environmentally. Its successful deployment has the potential to significantly improve congestion and air quality in Indonesian mid-sized cities, with positive impacts on job creation, productivity, health and quality of life.

As indicated from expert interviews and the development of public transport electric fleet goals and policies **within each of the three cities, demand for e-mobility solutions is moderately high,** but Denpasar is something of a special case, due to the strength of the private transport (taxi) sector and local government preoccupation with visitor economy recovery after Covid-19. Therefore, fleet based e-mobility solutions have an obvious market.

In a context of low availability of high-capacity public transport and a spatial form that discourages walking, EVs – especially two-wheeler EVs – will be key to strengthening mobility in Indonesian cities post-Covid-19 pandemic. **The immediate e-mobility focus should logically be on electric buses, commercial vehicles, set route city services, like waste collection, and last-mile delivery motorcycles. These are also compatible with the key UK strengths in science, innovation, technology and service capabilities.** The personalised or individual e-mobility market is not currently as developed, while commercial vehicles offer strong opportunities for cost savings in cities where budgets are low and where small investments can generate financial savings as well as environmental and socioeconomic benefits.

The process towards Indonesian cities scaling e-mobility solutions depends on their ability to build on existing key innovations with improvements around policy incentives, charging infrastructure, financial de-risking of engaging with innovative solutions and new business models and behaviour change.

In order to fully engage with the e-mobility sector cities need pilot projects and testbeds to demonstrate what is feasible and to allow highly innovative small companies to test and trial their solutions. To date a lot of Western-origin activities in this area so far has been focused on studies and workshops with recommendations for action, as opposed to direct implementation on the ground. The e-mobility opportunity in Indonesia can be broken down into smaller project sized blocks that can, while being delivered, catalyse the local start-up and innovation ecosystem.

The trialling of technologies or interventions in the built environment by piloting in cities has the advantage of getting things done more quickly and efficiently than those delivered via national level agencies. Cities in the largest provinces especially - like Bandung, Denpasar and Surabaya - can have a key role in test bedding e-mobility solutions in public services which are designed to be safe and predictable, as well as scalable, across any city which shares the same urban challenges. For instance, picking a city challenge like city-wide waste collection, and electrifying the solution via refuse e-vehicles for it as a pilot would be a turnkey trial to show the art of the possible and how it would work in practice before scaling up across the city, and the country. It mitigates the need for city-wide charging infrastructure. The vehicles are high use, but predictable in routes and distances. They spend a lot of time at slow speeds and are an essential public service in every city. Successful trials of electrifying them can showcase the benefits of e-mobility solutions and allow real, on-the-ground partnerships between UK and Indonesian companies to flourish.

7 Recommendations

To bolster the further development of the Indonesian e-mobility ecosystem through partnership with the UK this report offers three recommendations. They are geared towards supporting the acceleration of the deployment and adoption of e-mobility solutions in the Indonesian urban space. Connected Places Catapult is experienced at creating these programmes both in the UK and overseas as highlighted in our project case studies at the end of this section. The Catapult has for many years worked around the world to create projects that stimulate local ecosystems across a range of themes and technologies. It does this through understanding what is needed and what is possible, and then supporting the collaboration of local businesses, academia and government with UK SMEs to create win-win projects that provide real socioeconomic benefits for all involved.

1. Establish a "Clean Air Testbed for E-mobility" in one or more cities

Building on Connected Places Catapult's work on clean air testbeds in India, a clean air testbed for e-mobility could be deployed in one or more cities in Indonesia. The focus of the testbed would be to develop an in-depth understanding of specific application areas of e-mobility solutions in the city that are commercially viable and that drive the right outcomes around positive environmental, economic and societal impact. An acceleration programme can then be run that pairs UK and Indonesian companies to support their application's development and deployment in the city testbed.

This is a low cost, highly scalable and repeatable model that can boost the pace of innovation and development of commercially viable e-mobility solutions for identified challenges. The aim is to drive the application of science and innovation in a commercial context.

The structured acceleration programme would allow for collaboration between UK and Indonesian companies, the further development of their solutions, their deployment, and the modelling of their impacts and benefits. The focus is to take successful trials to procurement stage with the city authorities or private company sponsors.

There are two ways a testbed could run, and the model is dependent on the funding source. They can either be funded specifically solution by solution, as in the challenge sponsor approach, or by the public sector, which allows for a wider range of solutions to be test bedded and is not tied to specific commercial goals of the private sector.

- **Sponsor-led challenge.** The end client (city department of private company) identifies their need in advance. The testbed's structured programme facilitates Indonesian and UK start-ups and SMEs to collaborate to deploy their solution via a trial in order to showcase its impact. This approach de-risks the client's engagement with innovation and emerging technologies, encourages participation in new ways of working and displays cutting edge-innovation in e-mobility. It also allows small local and UK companies the opportunity to showcase their solutions that can solve real public and private challenges. This approach means solutions will be deployed that directly relate to commercial opportunities.
- **Funded testbed programme.** Core funding is provided by national or local government to support the collaboration and test bedding of UK and Indonesian start-ups and SMEs. With a focus on city challenges, the aim is to allow the trials of potential solutions for the public sector. City procurement is not traditionally set up to allow cities to experiment with emerging technologies and new services. This testbed allows UK and Indonesian start-ups and SMEs to access public data and support from local and national governments in order to showcase how their solutions can deliver better services or drive efficiencies. After evaluating whether solutions are commercially viable and deployable, the city procurement department is able to select and support the procurement of highly innovative solutions. While doing so it bolsters local business growth and foreign direct investment by UK companies.

Typically, these testbeds require a city location, access to relevant data, and run on six-month cycles with between 10 to 20 participating companies per cycle.

Direct outcomes are the acceleration of bringing science and innovation to the market, the ability to support the local and UK start-ups and SMEs in showcasing their solutions in line with real market demands and allowing end users to see the efficiencies and business models around them. City-based solutions globally are often embodied by mature products from large companies with the resources to engage with city procurement mechanisms. That is why this proposed testbed model allows local and national governments to play a role in bringing smaller players to the market effectively and efficiently and to support the local innovation ecosystem by offering a direct route to market and growth.

2. Alongside the Indonesian government, identify medium- to long-term infrastructure priorities where e-mobility can and should play an important role. Run capacity building, sandboxing and/or accelerator programmes

Connected Places Catapult has extensive experience of supporting national policy, standards development and accelerating innovation in companies and infrastructure projects through its Intelligent Mobility Accelerator, HS2 Innovation Laboratory, Simulate Clean Air Demonstrator, and Department for Transport Innovation Laboratory, among others. Building on the experience through these programmes, the Catapult would work with the Indonesian national and local government to identify medium- to long-term infrastructure priorities which are aligned with potential e-mobility rollout. Jointly with the Indonesian government, the Catapult would then run capacity building for the public sector, standards and regulatory sandboxes to support development of the appropriate regulatory frameworks and standards, and/or an accelerator programmes to catalyse partnerships between the Indonesian and UK companies to deliver high impact solutions.

The aim is to increase medium-term growth and allow for UK and Indonesian companies to collaborate over a longer period, leading to several potential positive outcomes:

- **Support the government to better understand policies, regulations and standards that either exist or are needed.** The public sector would seed fund specific challenges or competitions that UK and Indonesian companies would collaborate on to inform better government understanding of the impact and development of policies, standards and/or regulations around specific areas. The Catapult would support with capacity building within the national and local government in these areas.
- **Encourage skills development and the application of science and innovation around specific industries.** The Indonesian government could run an accelerator associated with its large national infrastructure programme to allow for the testing, trialling and development of Indonesian and UK start-up and SME solutions. After completing the accelerator programme these solutions should be developed and tested to a level where they can be brought into the infrastructure supply chain. This would create market-ready and market-tested innovative solutions from small companies that are commercially viable. This in turn would lead to sustainable growth of start-ups and SMEs that can be scaled across similar projects nationally, regionally and globally.

Typically, these programmes will be focussed on specific challenges for government and infrastructure. They could range from emerging technologies and highly innovative applications that are further advanced than current policies, standards or regulations (for instance connected and autonomous vehicles) to those that are new to the market and considered too high-risk to procure at scale into large infrastructure projects. These do not have to be limited to e-mobility. For instance, highly innovative digital construction technologies, in which the UK is a world leader, have an important role to play in infrastructure projects.

Structured programmes such as these usually last for six months and require sponsors to seed-fund Indonesian and UK start-up and SME participation.

Direct outcomes include governments engaging with highly innovative technologies and solution providers in line with their major infrastructure investments. The government can use this programme to better inform policy, regulation and standards development to ensure they support the application of science and innovation in the country. In addition, such programmes can drive socioeconomic prosperity as they provide commercial access to big government funding pools to start-ups and SMEs, thus creating stable revenue streams and allowing them to invest in more staff and in further developing their solutions. Therefore, as the government infrastructure programme progresses, it provides for the Indonesian and UK start-up and SME companies a route to engage and deploy highly innovative solutions. This model allows local and national government to play a role in bringing innovation to the market and supporting the local ecosystem develop and grow by offering a route to market and growth.

3. Private sector led trials in one or more of the cities

Connected Places Catapult has long-standing partnerships with large corporations, such as Hyundai, where it supports them to understand market opportunities, the latest emerging solution providers from the UK, and how to partner with them. The Catapult would seek to partner with large Indonesian companies in the e-mobility space and support them to further develop their services through collaboration and deployment of UK solution providers. This would allow companies like Gojek to access the Catapult's "experimentation as a service" offer with provided support in running trials with highly innovative UK companies in a structured programme to understand if and how they can work together. These trials would initially be in partnership with one of the three cities identified as desirable markets in this report, with a view to scaling successful trials across all three cities.

This approach is very much focussed on supporting large Indonesian companies to access cutting edge UK innovation and incorporating it into their supply chain. Therefore, large companies providing mobility services in the city space are enabled to partner with the Connected Places Catapult to access world leading innovative SMEs and their solutions, test and trial them, before bringing them into their supply chain.

The Catapult has a tested methodology it uses with partners like Hyundai, Network Rail and HS2 where we spend time understanding not only the clients' needs but supporting the client to understand what is possible that they may not be aware of. Through a structured set of programmes, the end user is then able to test and trial highly innovative solutions in the e-mobility space.

This approach is very much bespoke around end user needs with the associated bespoke impacts and benefits.

Connected Places Catapult's Expertise and Case Studies

Innovating for Clean Air (IfCA) programme in India

The IfCA urban innovation programme is a two-year UK-India joint initiative supporting UK and Indian innovators in Bengaluru to promote best practice innovation and technology exchange, improve the local business ecosystem and create a sustainable platform for ongoing UK-India government and industry cooperation. There are two main work-streams:

The Air Quality Innovation stream: Supporting promising innovations with the potential to improve air quality and tackle pollution at source, the programme explores:

- Innovative ways to measure and visualise air pollution
- Solutions promoting active mobility (walking and cycling)
- Electric micro-mobility
- Ways to promote and empower behaviour change

The EV Innovation stream: Supporting the uptake and integration of EVs in Bengaluru and India as a whole, this has supported the demonstration of technology, business models and consumer approaches for:

- Charging infrastructure solutions
- Grid management
- Renewable energy integration, and
- Electric mobility (all aspects, including battery management systems).

The IfCA programme highlights the opportunity which India represents to the firms in the UK EV ecosystem and provides practical guidance on how to access it. In doing so, it seeks to help UK firms build more linkages with their Indian counterparts.

The programme had positive impact across a range of areas, with 18 collaborations established between UK or Indian entities, ranging from MOUs to pilot projects and solution deployment. In addition, through partnership with the Bangalore Directorate of Urban Land Transport, a popular street in the centre of the city was pedestrianised at weekends for four months, and clean mobility solutions were demonstrated, raising awareness amongst citizens and businesses, of the opportunities in this area.

The SIMULATE Live Lab in the UK

The SIMULATE (Smart, Infrastructure & Mobility Urban Laboratory and Test Environment) accelerator is a partnership between Staffordshire County Council, AMEY, Keele University and the Connected Places Catapult. The programme aims to provide the environment and framework for game-changing SMEs with new solutions to trial and incubate their concepts, with the ultimate aim of them being adopted into the local and strategic road network.

SIMULATE's four mobility challenges are centred around tackling sustainable transport problems:

- **Clean Community** — connecting communities with quick and carbon-neutral mobility options
- **Dynamic Connections** — providing a service that connects both urban and rural dwellings with critical amenities
- **Rapid Transit** — delivering a rapid point-to-point solution that takes into consideration the volume of users at different times throughout the day
- **Integration and Behavioural Change** — seeking solutions to address the shift in attitudes and behaviours that are needed when moving from single-use and private vehicles to a different mobility model
- **Public Engagement support for user education to increase uptake.**

SIMULATE LIVE LAB

Running alongside these challenges, SIMULATE is also looking for solutions that can be deployed to tackle air pollution in areas with poor quality in Staffordshire, UK, with three AQMAs selected as test environments for trialling new solutions.

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