T20 INDONESIA 2022 THINK

Policy Brief

DRIVING SUSTAINABLE MOBILITY IN SMART CITIES CONSIDERING SUPPORTING INFRASTRUCTURES, EMERGING NETWORKS, AND OPEN SECURE DATA.

Task Force 2

Meaningful Digital Connectivity, Cyber Security, Empowerment

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Abstract

This policy brief proposes a framework that promotes business and technological innovations toward the development of a sustainable mobility ecosystem in smart cities. It addresses ongoing smart city development initiatives related to establishing green transportation, using different types of Energy Transition Vehicles (ETV) based on battery—or hydrogen-powered Electric Vehicles (EVs).

Despite the high potential for improvement by the tremendous interest in the uptake of green and sustainable mobility worldwide, the ETV adoption rate varies among countries. The differential adoption across nations may be attributed to factors such as the availability of charging station infrastructures ecosystem, recycling and battery swapping facilities, the capability of charging on the move, integration of ETV systems within renewable energy power grids, as well as the reliable and secure wireless connectivity of ETV networks via wireless 5G technologies and the local governmental policies and existing ecosystem support.

Availability of efficient support of the 5G+ broadband infrastructure is another critical success determinant. This ensures uninterrupted and secure network connectivity, protecting the vast amounts of information and data (measurements, observations, and metadata) expected to be generated.

Robustness in open data ecosystems is another prerequisite to augmenting ETV adoption. To this end, appropriate policies should be formulated to enable access to open comprehensive data at the urban or sub-national scale, adopting the proposed G20 Open Data Alliance. It is also important to motivate the development of robust analytical frameworks to distil actionable, policy-relevant insights that will ensure the exploitation of the generated data for enhancing the smart mobility key performance and value indicators without compromising issues related to privacy and security.

Challenges

The Energy Transition Vehicle (ETV) market establishment involves consideration of issues such as the availability of charging station infrastructures, recycling of ETV batteries, the capability of charging on the move, integration of ETV systems with renewable energy grids, development of Hydrogen Fuel Cell technologies and the wireless connectivity of ETV networks via 5G+ Internet of Things (IoT), Artificial Intelligence (AI) technologies for enabling data-driven applications, and simultaneously addressing data privacy and security concerns, along with supporting Government policies that build an innovation ecosystem.

Recent exponential price increases in rare earth metals may slow EV adoption, and high upfront installations of renewables (i.e., solar) remain a challenge. The prices of rare earth materials such as cobalt, copper, nickel, and lithium that are needed for developing ETV solutions keep increasing. Lithium is one of the most important elements for the energy transition to a lower-carbon future. Lithium batteries are replacing the fuel in combustion engines in various applications. As the penetration of electric vehicles rapidly grows, demand for lithium has grown exponentially. However, a lithium price increase can potentially pose a risk to EV car adoption.

Similarly, unless financing of high-cost renewable installations is taken care of, residential solar adoption is expected to remain a large barrier unless financing of high-cost renewable installations is taken care of.

Furthermore, expanding ETV adoption would require contextualized data-driven analytics. Nevertheless, data access inequality among the G20 countries could pose a substantial challenge to such an effort and potentially beyond. Data inequality has also hindered cities and sub-national governments in galvanizing efforts to bring smart, sustainable, and resilient cities from concept to concrete. For example, this proposition is particularly true for cities and sub-national governments in developing countries, including the lower- and middle-income countries in the G20 group. The availability of data scientists is also a challenge in many countries.

Indeed, policymakers, scholars, and concerned citizens have voiced concerns over limited access to robust data to distil actionable insights. Efforts to combine data and build data-sharing platforms relevant to the urban scale came short as most initiatives overly emphasize national-level indicators. While pragmatic reasons such as practicality and convenience might explain the disproportionate focus on the national level, policymakers need to extend and expand the spatial resolution of these data-sharing platforms by incorporating meaningful urban scale indicators to augment initiatives in expanding ETV adoption.

Nevertheless, countries' capacity to collect sub-national data and devise data-driven policies vary wildly. This wide variation holds relevance even among the G20 countries. For example, the Global Open Data Index shows that Indonesia ranked 61st, or the lowest among the G20 countries, which stands in contrast to Australia, which ranked 2nd in the same index. Another study also posits that the completeness of OpenStreetMap varies across countries, further highlighting data access inequality. The study finds a variation in the OpenStreetMap completeness ranging from 40 percent to close to 100 percent completeness.

Proposals for G20

The proposal aims to highlight policies promoting the key areas impacting smart and sustainable mobility in future smart cities. This involves enabling the necessary technologies and infrastructures and building the socio-technological ecosystem necessary for the massive uptake of green electric mobility solutions. It includes the policies for the appropriate development of advanced battery and fuel cell technologies, densification of electrical charging stations, implementation of charging-on-the-move systems, and even integration of intelligent building systems with ETV charging infrastructures. Additional areas of consideration are related to the energy requirements resulting from the widespread adoption of ETV systems to ensure that renewable energy sources will cover them, regulation of advanced battery recycling frameworks, and efficient support of the 5G+ broadband infrastructure for ensuring uninterrupted and secure network connectivity, protecting the vast amounts of information and data (measurements, observations, and metadata) that will be generated. Another important issue is the provision of incentives to consumers, businesses, and local governments to purchase and operate electric vehicle fleets and actively participate in safe and secure shared mobility service ecosystems.

More specifically, the objective of this policy brief is to promote business and technological innovation toward the development of sustainable mobility in smart cities using Energy Transition Vehicles (ETV) based on battery- or hydrogen-powered Electric Vehicles (EVs). These include (i) electrically-chargeable vehicles (ECVs), which require recharging infrastructure which connects them to the electricity grid; (ii) Battery Electric Vehicles (BEVs) that are fully powered by an electric motor, using electricity stored in an on-board battery that is charged by plugging into the electricity grid; (iii) Plug-in Hybrid Electric Vehicles (PHEVs) with an internal combustion engine (running on petrol or diesel) and a battery-powered electric motor; and, (iv) Fuel Cell Electric Vehicles (FCEVs) that are also propelled by an electric motor, but their electricity is generated by a fuel cell that uses compressed hydrogen (H2) and oxygen from the air, so, unlike ECVs, they are not recharged by connecting to the electricity grid but require dedicated hydrogen filling stations. Sustainable mobility depends on framework conditions and should aim at meeting user and society needs that are reflected in economic, environmental, and social efficiency objectives. Therefore, approaches expanding on demand-driven, attractive, and, at the same time, climate-friendly mobility solutions that complement each other should be prioritized (ACEA 2021). ETV vehicles are “drivers” for reaching environmental goals in road transport in cities. Top automakers believe 40–50 percent of vehicles will be EV by 2030 (Source; Reuters, 2021). Connected mobility may be one of the top revenue-generating sectors within the following years, along with connected industry, smart homes, consumer electronics, and smart cities (UNCTAD, 2021). However, making them the preferred choice for citizens, transport operators, and service providers requires strong enabling conditions, particularly the adequate deployment of recharging and refuelling infrastructure and user incentives. A positive business environment and an alignment of regulations across cities There is a need to provide a local policy framework and private-public partnerships capable of supporting automobile manufacturers in launching innovative and sustainable business models and new urban mobility technologies, such as autonomous vehicles. This can be facilitated by aligning regulations on urban access policies to realize economies of scale and lower costs. They should also provide private companies with a level playing field where they can launch innovative business models representing a major opportunity for companies (ACEA 2022).

Proposal 1

Establish clear pathways for worldwide research and standardization of wireless 5G/6G technologies for utilizing Internet of Vehicles / Energy and smart transportation platforms. Deploy IoT solutions for real-time visibility, route, and fuel optimizations

One of the key enablers for ETV systems is the wireless network connectivity among all ecosystem stakeholders, including vehicles, road, and energy infrastructure, users, charging stations, and buildings. Ubiquitous, seamless network connectivity allows the uninterrupted data flow among the stakeholders above. It enables mobility services related to various key objectives such as road safety, collision avoidance, passenger health, pedestrian safety, traffic regulation, energy autonomy, charging schedules, building energy systems, and many more. All these actors can be considered network nodes within an Internet of Vehicles and Energy network based on human-to-machine interconnections. Such a vision is completely in line with the ongoing evolution of 5G+ and 6G networks, which aims to develop intelligent network systems to provide advanced intelligent services. IoT and wireless connectivity are the foundations of a smart and sustainable city. IoT and sensor-based vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communication networks guide drivers around hazards, congested areas, and other obstacles that increase time spent inside the vehicles. IoT-enabled smart traffic lights collect traffic data and use machine learning to create efficient traffic control schemes. V2I and V2V communications also guide drivers to available parking spaces, reducing the time a driver spends looking for parking spaces and thereby reducing carbon footprints. Internet of Vehicles frameworks has been extensively studied within the context of Intelligent Transportation Systems that focus on collecting and exchanging critical information among vehicles and infrastructure for enhancing driving safety, avoiding traffic congestion, monitoring the vehicle status and driver health, triggering alarms, and supporting in-vehicle entertainment applications. The architecture of V2X communication integrates the Intra-Vehicle, Vehicle-to-Vehicle, Vehicle-to-Infrastructure, Vehicle-to-Network, Vehicle-to-Person, Vehicle-to-Grid, and Vehicle-to-Cloud (V2C) networks (Chen, 2019). Such a network architecture can convey the required ETV services, namely energy status, distance to/availability of nearby charging stations, charging-on-the-move lanes, smart grid buildings/homes, and many more.

Key elements of 6G networks that are expected to drive towards sustainable solutions are the considerably higher data rates (e.g., total peak rates of more than 1 Tbps), wireless communications mechanisms embodied with intelligence and automation using Machine Learning and Artificial Intelligence (AI), dynamic and robust network architectures matching different vertical users and services requirements. All these innovations will directly address various Sustainability Development goals related to SDG 9 (innovation and infrastructure) and SDG 11 (sustainable cities). Also, Artificial Intelligence (AI) is at the forefront of OECD discussions as a definite technological enabler that has to comply with specific conditions regarding trustworthiness, human values, fairness, transparency, clarity, robustness, security, safety, and accountability, that have also to be considered by G20 (Greco, 2021). The evolution of IoT, autonomous vehicles, and AI highlights the value of data collection and analytics since it introduces data types that have critical importance, enormous value, and disruptive potential (Lomba, 2022). Furthermore, 6G networks will facilitate the development of innovative energy harvesting and wireless power transfer energy efficiency technologies that are related to SDG 7 (renewable energy) (Shehab, 2022). Related Green IoV scenarios include Green V2X Communications based on Integrated sensing and communication technology that can lead to energy efficiency, Green Vehicular Edge Computing for offloading energy and computation intensive processes to edge infrastructure sites using Artificial Intelligence, Green Intelligent Traffic Management employing Artificial Intelligence for reducing energy consumption for both the vehicles and roadside infrastructures, Energy Management of Electric Vehicles using optimization models with respect to the driving paths, charging and discharging behaviors for improving the Electric Vehicles' energy efficiency, Energy Harvesting Management for exploiting in the best possible way renewable energy for IoV infrastructure (e.g Road Side Units) and for coordinating the operation of fixed and mobile IoV nodes (e.g., by facilitating energy exchanges between them) towards higher energy efficiency using data that reveal daily traffic patterns and Green IoV architectures based on Software-defined Networking and Edge Computing (Wang, 2022). The focus on renewable energy generation should be emphasized in all countries and continents irrespective of their development level and wealth status since it has been documented that countries with the highest GDP are not necessarily those with the highest percentage of renewable electricity in their respective electricity matrices (Sokulski, 2022).The European Union is also focusing on the deployment and adoption of IoT standards and platforms for distributed storage systems related to both stationary and electric vehicles and for the development of cost-effective and sustainable distributed storage ecosystems and related business models, as well as on the interconnection of Electric Vehicles to grids and smart charging applications via the respective Research and Innovation Work program (Horizon Europe, 2021). The role of Public-Private Partnerships (PPP) in developing the enabling technologies and infrastructures is fundamental. It is equally important to address the related challenges and risks of PPP projects by determining optimum levels of private sector investments and risk transfer (Beckers, 2021) that can ensure success and business sustainability. In order to drive mutually beneficial collaboration between public and private sector partners in green projects, key enablers have been identified, such as the combination of inexpensive long-term financing, especially for supporting high-risk investments (Arbouch, 2021).

Proposal 2

Promote vehicle sharing business models and the development of the supporting ETV infrastructure.

In transportation, digital information, platforms, and tools -using AI- have been identified as enablers for achieving evolved transit services, including ride-sharing, micro-mobility, and ETV mobility (ITU/UNESCO, 2021). The objective is to develop sustainable mobility solutions for 'liveable cities' stimulating increased efficiency and sustainable innovations reaching economic, environmental, and social efficiency objectives focusing on user-centricity, efficiency, and innovation. A fact-based approach to policymaking is needed, with a fair and scientific comparison of transport modes based on better statistics. Limited availability of comparable data in the field of urban transport makes this task challenging, as information is lacking on key sustainability variables such as space efficiency, parking pressure, congestion, environmental impacts, and many others.

There are over 110,000 fuel stations worldwide, and transitioning them to ETV fuel stations would be a giant step towards green transportation. Around 70 percent of top car brands plan to phase out Internal Combustion Engine (ICE) vehicles by 2030. Hence the migration to ETV fuel stations should begin immediately. This paradigm is also followed in Indonesia, where there are an ongoing effort in electrifying non-Bus Rapid Transit (non-BRT) buses using depots for overnight charging, and also formulating plans for charging Bus Rapid Transit buses using on-corridor charging, with the ambition to have a charging infrastructure to realize the operation of 74 Transjakarta electric buses in 2022 and to have 100 percent electric buses by the year 2030 (U20, 2022). Furthermore, important factors include better access to the electrical power grid, more efficient charging systems, longer-life batteries, higher density of charging stations, even the introduction of ETV-only routes, and enhanced network connectivity of all ETV stakeholders (Al-Alawi, 2020).

Intelligent Transport Systems (ITS), digital platforms, connected vehicles, and intelligent infrastructure can contribute to delivering clean, safe, accessible, affordable, and efficient mobility. Platform solutions such as Mobility as a Service (MaaS) and Transport / Logistics as a Service (TaaS / LaaS) bring all together in an efficient mobility ecosystem that optimizes the use of transport infrastructure and vehicles. An important aspect of this transformation is the offering of seamless interfaces for enabling Door-to-Door mobility or logistics applications, autonomous vehicles, and shared and public mobility services that will enhance the quality of transportation and save energy and fuel resources (B20, 2021)). TaaS/LaaS solutions have the potential of saving 750 billion liters of fuel savings, out of which 236 billion liters of fuel could be saved in 2030 through traffic control and optimization and 220 billion liters of fuel through connected private transportation. By 2030, smart logistics solutions could generate savings of 267 billion liters of fuel and 3.8 billion kg of wood. In addition, $1 trillion of avoided costs can be obtained in economic terms, traffic control and optimization could translate into $409 billion of avoided costs and connected private transport to around $611 billion of avoided costs. Various smart logistics processes and methods could also add an additional value of around $174 billion by 2030 to the economy as a whole. Around 42 billion hours could be potentially saved in 2030 through efficient traffic management solutions, and high-quality navigation systems could save around 42 billion hours by 2030. Vehicle sharing business models in both private and commercial sectors have the potential to reduce CO_2 consumption. A study in the Netherlands demonstrated that shared car services led to an average reduction of between 175 and 265 kilograms in CO_2 per respondent. This equals a reduction of around 8 percent to 13 percent in emissions related to car ownership and car use. As a result of car sharing, 135 million cars could be taken off the road by 2030 (Nijland, 2015).

Proposal 3

Promote robust open, comprehensive data ecosystems at the urban or sub-national scale

In order to establish a robust ETV adoption and its pertinent infrastructure development as outlined in the above sections, it is imperative that countries need to have a mature (open) data ecosystem. Indeed, studies have shown the importance of the availability of high-resolution data (e.g., mobile platforms, charging stations) to shed light on various factors that influence ETV adoption, users' behavior and experience, and infrastructure allocation (Asensio, 2020), (Asensio, 2021).

Rather unsurprisingly, however, there is a wide variation in data ecosystem readiness among the G20 countries, not to mention a variation in digital, data, and analytical skill availability in the regions. To this end, efforts to augment ETV adoption and initiatives to establish mature open data ecosystems must go in tandem. Furthermore, it should be noted that the benefits of augmenting mature data ecosystems would go well beyond increasing ETV adoption and streamlining analytics required to maintain robust ETV markets.

Considering the intricate relationship between ETV adoption and open data ecosystems, outlined below is a set of proposals aimed to inform policy coordination among the G20 countries, and potentially beyond, on developing mature data ecosystems, especially those that are related to ETV. These proposals were formulated in a synergistic manner and as follow-ups to existing policy frameworks that have substantial relevance to the G20. For example, the G20 Global Smart Cities Alliance's Model Policy: Open Data (G20, 2020), empirical studies by the World Economic Forum, in collaboration with Deloitte (WEF, 2021), and Open Data Charter (ODC, 2022).

- Develop G20 Open Data Alliance and Ecosystem through collaborations with the industry, policy formulation institutions, academics, research centers, and communities whilst recognizing and building on existing open data frameworks and policies (G20, 2020) (WEF, 2021) (ODC, 2022).
- Establish an open data advisory committee that would provide recommendations and streamline building synergies among countries within the G20 Open Data Alliance. This initiative would reduce associated economic and transaction costs while overseeing international, national, and sub-national initiatives.
- Identify emerging data sources, including crowdsourced data, that would offer real-time, highly interoperability snapshots of the population to complement data garnered from traditional sources. In particular, leveraging measures from collaborations with the industry, these emerging data sources may come from technology companies in various sectors, from ride-hailing to financial technology (fintech), from e-commerce to online learning platforms. Indeed, an example of such initiatives has materialized in the form of a collaboration between the Asian Development Bank and several leading e-commerce platforms in Asia (e.g., Alibaba, Gojek, and Grab) (ADB, 2021).
- Mobilize resources to assist sub-national governments in developing meaningful open data platforms. As indicated in the World Economic Forum's report (WEF, 2021), unequal data availability and access have painted a picture where well-resourced cities were more likely to have open data platforms than less affluent ones. The proposed G20 Open Data Alliance may handle the tasks of mobilizing resources and implementing efforts to address this persistent issue of data availability and access between and within G20 countries.
- Augment efforts to train a data-literate workforce through policy coordination facilitated by G20 Open Data Alliance. Indeed, just as there is an issue of unequal data availability and access, another significant issue relates to unequal access to the data literature workforce, indicating the need for policy coordination among the G20 countries to address such issues.
- Enforce data privacy and ethical utilization of the data.

These key practical actions would pave the way for developing and, eventually, closing the gap of having access to mature open data ecosystems amongst the G20 countries. However, policymakers and stakeholders should recognize that bringing these proposals from concept into concrete implementation is not without challenges. Most major might be the challenge associated with sustaining adoption from sub-national governments. A staggered approach strategy could be adopted, according to which a few selected sub-national governments could serve as pilots and, eventually, become catalysts for others. Notwithstanding these challenges, the increased maturity of open data ecosystems enabled by each key practical action would tick the need for foundational blocks to drive ETV adoption.

Conclusion

This policy brief proposes a framework that promotes business and technological innovation toward the development of sustainable mobility in smart cities. It suggests three policy actions related to (a) the establishment of clear pathways for worldwide research and standardization of wireless 5G/6G technologies for utilizing Internet of Vehicles/Energy and innovative transportation platforms. Deploy IoT solutions for real-time visibility, route optimizations, and fuel optimizations, (b) the promotion of vehicle sharing business models, as well as the development of the supporting ETV infrastructure, and (c) the promotion of open, comprehensive data at the urban or sub-national scale. The proposed policy framework is relevant to the G20 scope, and it is aligned with the G20 2030 Agenda for Sustainable Development that provides a global policy and economic forum for discussing and promoting strategies that can bring fundamental changes in developing infrastructures and services in various sectors affecting the citizens' everyday lives (G20 Riyadh, 2020). Additionally, the recent 2021 G20 Rome Leaders' Declaration maintains their support for clean and sustainable energy as well as for safe mobility, seamless travel sustainability, and digitalization, also highlighting the need for responsible use and development of trustworthy human-centered Artificial Intelligence (AI) technologies as well as data protection and security (G20 Rome, 2021). The success of such a policy framework depends strongly on adequate public and private financing opportunities, appropriate regulatory frameworks, and public and private sector coordination for sharing good practices, as has been denoted by last year's G20 Guidelines for enabling broadband connectivity for a Digital World (G20, 2021), also considering the mitigation of related private investment risks. The proposed policy framework can motivate the formation of interdisciplinary working groups to focus on sustainable ETV mobility in Smart Cities, considering effective governance and open data principles to provide valuable best practices & guidelines in international global policy roadmap accelerators such as the G20 Global Smart Cities Alliance (G20, 2022).

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