SMART MOBILITY

EUROCHAM POSITION PAPER 2020

EuroCham SINGAPORE

European Chamber of Commerce (Singapore)

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INTRODUCTION

BACKGROUND

Transport systems have been a cornerstone of urban planning and connecting the globe. The development of the global automotive industry has benefited economies through the provision of access to essentials of education and healthcare, allowing for the creation of jobs to result in a higher quality of life (QoL)[1].

Despite the progress in economic growth and QoL, the automotive industry bears consequences as well. Negative externalities of mass car use comprising of congestion and poor air quality have a detrimental impact on people[2]. In addition, states struggle to manage emissions effectively as well[3].

Today's multi-modal transport systems, account for 24% of direct CO2 emissions, of which land vehicles contribute 18%[4]. This had led to a transition for mobility for community and individuals to have access to a seamless infrastructure of cleaner, more efficient, and connected transport[5], where it is encompassed by the term "Smart Mobility".

Smart Mobility encompasses the following[6]:

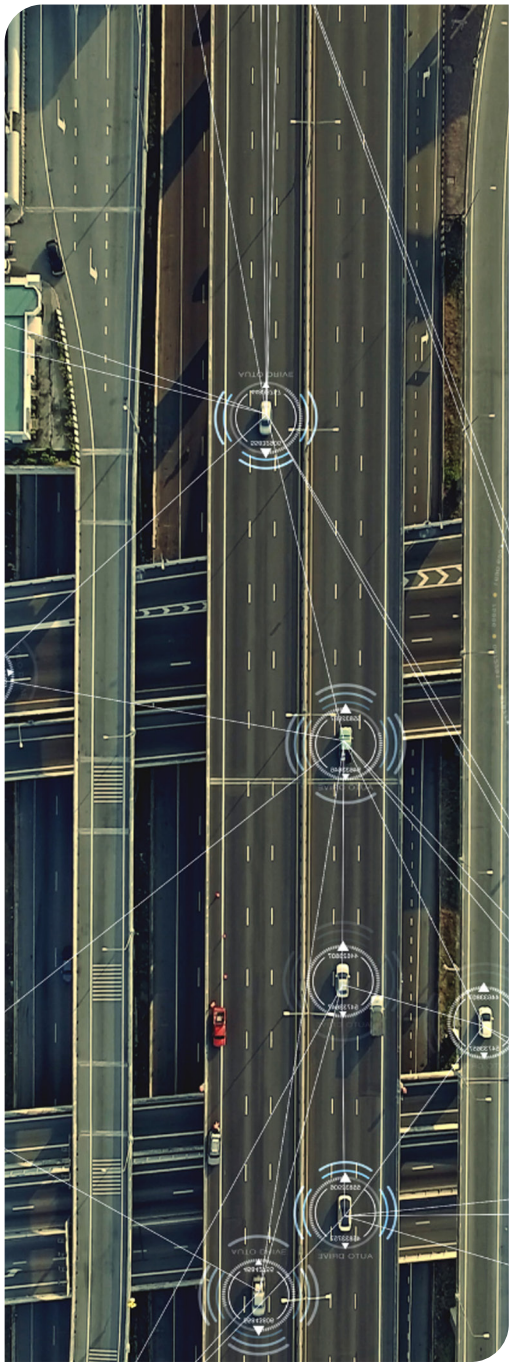
- Mobility as a Service (MaaS)
  - Having an interoperable package of mobility services owned and shared by providers. This is facilitated by the connection of data and integrated platforms of payment.

1 *SIGNALS, EEA. "Towards clean and smart mobility; Transport and environment in Europe." European Environment Agency (2016). Retrieved from https://www.eea.europa.eu/highlights/towards-clean-and-smart-mobility*
2 *Docherty, Iain, Greg Marsden, and Jillian Anable. "The governance of smart mobility." Transportation Research Part A: Policy and Practice 115 (2018): 114-125.*
3 *Ibid.*
4 *IEA (2019), Tracking Transport 2019, IEA, Paris https://www.iea.org/reports/tracking-transport-2019*
5 *Docherty, Iain, Greg Marsden, and Jillian Anable. "The governance of smart mobility."*
6 *Ibid.*

- Digitalization of mobility
  – Crowd-sourced, real-time data allows for the integration of mobility options.
- Electrification of vehicles
  – A smart energy distribution grid in tandem with sustainable mobility through the electrification of vehicles allows for the movement towards lowering emissions via electric vehicles (EV).
- Autonomous vehicles
  – Although the driver has to be present and needs to take over control at some instances, the driver and other occupants will have more time to focus on other tasks.

The above highlight the movement from the traditional form of "ownership" to "usership" of mobility and the shift from fuel-powered vehicles to electric vehicles, underlining a shift in skills required for the development of the above services and products. This shift has been a key priority in both Singapore and the European Union (EU), and the expanding infrastructure of smart mobility provides benefits for sustainability.

SCOPE & OBJECTIVES



Singapore's transport system has been ranked as the best in the world by a 2018 McKinsey report on Urban Transportation[7], based on five criteria – availability, affordability, efficiency, convenience and sustainability. With the emergence of autonomous vehicles (AV), Singapore has rapidly become an attractive location for AV technology development and testing. This is due to Singapore's status as a key financial and digital hub within the region, having resources, ideas and data to support the creation of a world-class integrated transport model.

However, Singapore has much to do to reach the goals it has set for itself. For instance, connectivity and speed, in the area of 5G, needs to be expanded at a faster rate as other peers within Asia, such as Hong Kong, Seoul and Tokyo have been progressing quicker than Singapore. Although having an "island compact" geography, the actions to have 5G coverage by 2025, although one small instance, highlights a larger point: the road to a more sustainable and smarter inter modality transport system will require more adjustments towards policy. We at the European Chamber, situate this road within the context of Singapore and the EU, where both parties have to understand each other's landscapes of smart mobility.

Hence, the objective of the paper is to create in Singapore and the EU a dialogue amongst the various stakeholders of a sustainable urban mobility planning process, ranging from the state/union level to companies as well. Everyone has a responsibility towards creating an ecosystem of smart mobility, to ensure an effective transition towards it.

This transition to Smart Mobility for both Singapore and the European Union – refers to the 27 member states of the economic union and the EFTA[8] countries – will be assessed in this paper, where comparisons will be provided in the following areas:

- Urban Mobility Policy
- Development of Human Capital
- Incentives for EV buyers and users
- EV Homologation Process
- EV Charging infrastructure
- Digitalization and Autonomous driving

The analysis of both Singapore and the EU is crucial as it will allow stakeholders and private companies to understand their respective areas of improvement, establishing an avenue for a smoother transition of smart mobility in Singapore. A combined effort is imperative for ensuring the best possible progress towards sustainability.

7 *Elements of success: Urban transportation systems of 24 global cities (June 2018), McKinsey & Company.*
8 *European Free Trade Association*

METHODOLOGY

This position paper has been developed by engaging the Singapore government's statutory boards and having extensive interviews with industry stakeholders, pertaining to the issue of smart mobility.

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STRUCTURE

This paper will first commence with the identification of the various stakeholders within the landscape of smart mobility in setting the foundation for the analysis of policies. Next, this paper will streamline the above areas into three chapters, before rounding up and concluding the paper:

Chapter 1: Assessing the web of smart mobility
- Urban Mobility
- Development of Human Capital

Chapter 2: Evaluation of regulations towards EV
- Incentives for EV buyers and users
- EV Homologation Process
- EV Charging Infrastructure

Chapter 3: Future of mobility
- Digitalization and Autonomous driving

Chapter 4: Looking ahead
- Coalescing recommendations and highlighting the micro and macro objectives

Chapter 5: Conclusion
- A meaningful transition towards smart mobility

CHAPTER 1

ASSESSING THE LANDSCAPE OF SMART MOBILITY

In both Singapore and the EU, the transition to Smart Mobility results in an undergoing transformation of the urban landscape and automotive industry. This transition overarches the paper, where shifts have to be assessed in determining the pathway for stakeholders and private companies in ensuring a meaningful transition.

URBAN MOBILITY

Transport is a shared responsibility amongst the state, businesses, and individuals. Urban Mobility is key for the connectivity of people within a state and across borders. Singapore and the EU have made inroads towards transforming their landscape with the transition to Smart Mobility.

SINGAPORE: LAND TRANSPORT MASTER PLAN 2040 (LTMP 2040)[9]

The Land Transport Authority (LTA) outlined their plans through the LTMP 2040, focusing on having a well-connected, swift, and inclusive infrastructure.

9 *European Free Trade Association*

- "45-Minute City & 20-Minute Towns": This plan aims to increase the efficiency of transportation to reduce the time taken for travel from point to point. "Walk-Cycle-Ride"10 target of having 90% of all peak-period journeys will be completed in less than 45 minutes, and journeys to the nearest neighbourhood will be completed within 20 minutes.
- This will be achieved through the expansion of the active mobility network, to achieve 1000km of cycling paths by 2040. Moreover, the rail network will be expanded as well, with the completion of new completion of new railway lines such as Thomson-East Coast Line (TEL), Jurong Region Line (JRL) and Cross Island Line (CRL). In addition, feasibility studies are carried out to demand, alignment, station locations and implementation timeline of upcoming lines.

The LTMP 2040 also sets out initiatives to develop the infrastructure to be clean and green as well.

- The aim is to improve streets and reduce the carbon footprint of the land transport system. Fleet vehicles, such as buses and taxis, have much higher carbon emissions per vehicle compared to private vehicles. For example, the average carbon emission of a taxi is more than seven times that of a private car. The commitment is to have a 100% cleaner bus fleet and taxi fleets by 2040, with trials on 50 diesel hybrid buses since December 2018 and taxi companies committing to have 90% of their fleet run on cleaner energy by 2025.
- Private adoption of cleaner energy vehicles: Reviewing regulatory regimes, vehicle registration schemes and vehicular emissions schemes and expansion of BlueSG by working with relevant stakeholders.

Budget 2020[11]

- The government aims to phase out Internal Combustion Engine (ICE) Vehicles by 2040, in efforts for their transition to EVs.

For individuals in this transition, the government will allow them to play an active role for commuters, transport workers, industry players, academics, and experts to shaping the land transport system. The government will hold extensive consultations when planning local transport infrastructure improvements.

EUROPEAN UNION: SUSTAINABLE URBAN MOBILITY[12]

The European Commission (EC) has in place its Sustainable Urban Mobility policy, where it focuses on having member states commit to action on urban mobility.

- 2013 Urban Mobility Package: Updated through Sustainable Urban Mobility Plans (SUMPs), committing member states to local action on urban mobility. These plans are consistently updated from feedback gathered from member states.
- The EC aims to halve the use of conventionally fuelled cars in urban areas by 2030 and phase them out by 2050, achieve CO2-free city logistics in major urban centres by 2030, and move close to 0 fatalities in road transport and halve casualties by 2050.
- Moreover, by 2050, Greenhouse gases (GHG) from transport is mandated to be lowered by 60% than that of the level in 1990, focusing on the efficiency of the transport system and transition towards zero-emission vehicles.
- On the connectivity front, the EC has outlined in its "Intelligent Transport System (ITS) Directive 2010" that it aims to achieve coordinated and effective deployment and use of ITS within member states and across borders. They are developing the specifications necessary to ensure the compatibility, interoperability and continuity for the deployment and operational use of ITS for-priority actions.
- The EC is also providing financial support for urban mobility. There is the European Structural and Investment funds catered to walking and cycling infrastructure. Research initiatives such as Horizon 2020 are ongoing to develop smart, green, and integrated transport. The focus is on multi-modal inter-urban transport, regional mobility, and spatial planning. Another programme is the CIVITAS Initiative: City, Vitality and Sustainability, which conducts living lab projects such as car-sharing, bike-rental systems, and clean vehicles.

ANALYSIS

Both Singapore and the EU have a mutually beneficial set of complementary policies in addressing Urban Mobility. This presents a golden opportunity for Singapore and the EU to work together. Singapore can share key data and Key Performance Indicators (KPIs) with the EU, and in exchange, the EU can work together¬ with achieving the phasing out of ICE vehicles, through importing more EVs. This can be achieved if both parties set out key regulatory requirements in a joint bilateral effort. Furthermore, both parties are progressing towards transforming their public transport system as well, aiming for zero-emission vehicles. Once again, Singapore and the EU can share information towards achieving a synergy in their efforts.

10 *While "Walk" probably needs no further explanation, "Cycle" refers to travelling by bicycle or other PMDs such as e-scooters. "Ride" refers to public transport such as buses and trains and point-to-point transport defined as taxis, private hire cars and shared cars.*
11 *Singapore Budget 2020: Push to promote electric vehicles in move to phase out petrol and diesel vehicles, Straits Times. Retrieved from https://www.straitstimes.com/singapore/transport/singapore-budget-2020-push-to-promote-evs-in-move-to-phase-out-petrol-and-diesel*
12 *EU policy for sustainable urban mobility, European Commission, Intelligent & Sustainable Transport Unit.*

The current policies towards addressing vehicular emissions are updated to be in line with goals set out by both parties. However, the political mechanisms and policies are not clearly outlined, which is essential towards clarifying the pathway for the transition towards e-mobility. Similar efforts towards reducing the reliance on private transport through car-sharing and bike rentals have also been implemented, where public infrastructure for alternative modes of transports are planned. Car-sharing continues to rise in both Singapore and the EU, albeit at a fairly low level. These are praiseworthy initiatives, but we believe that more can be done, if we approach the issues together.

Urban mobility problems cannot be not solved solely through the improvement of public transport and investments in infrastructure. People are still reluctant to leave their cars, and for good reason: in terms of time savings, flexibility, convenience and privacy, there is a huge gap between private car ownership and public transport. The LTA's approach to "zero car growth" through policies primarily through taxation to curb traffic congestion and discourage private car ownership, although commendable, should be expanded. Instead, the pathway to a safer, more sustainable industry has to consider encouraging competition across various modes of mobility.

Within this COVID-19 pandemic, the emphasis on the government to provide assistance to companies is amplified, as companies within the industry face high operating and maintenance costs. Jobs will be a key area for both Singapore and the EU to consider, where the impact of this pandemic is already being felt. Jobs in retail for car dealerships, in service for insurance and in the aftermarket for car repair, maintenance and the supply of spare parts are some areas to highlight. This area will be explained further in the subsequent sub-chapter.

Therefore, we believe that a more integrated approach towards mobility will be able to revamp the economy whilst making mobility increasingly sustainable, with the government promoting MaaS solutions and the private sector offering integrated first and last mile transport solutions. A combined and coherent inter-modality model with the involvement of all stakeholders is required here.

On the side of cost, road pricing has been proven to be the most efficient political tool of influencing traffic. In Singapore and Stockholm for instance, relatively low fees have led to people changing their travel behaviour. And since congestion is non-linear, a small drop in traffic leads to a large drop in congestion and consequently in emissions. Moreover, financing traffic infrastructure by road pricing – as compared to taxes – is a sustainable solution, where the actual costs for society, both direct and indirect, are charged to the people and businesses that are using it.

Hence, road pricing with a local emissions component would have an additional benefit for e-mobility. In order to pay less for road pricing, customers would want to maximise their electrical driving. This would work as additional motivation to charge frequently and accelerate the build-up of both private and public charging infrastructure. Therefore, cost savings on road pricing would be an important factor to motivate customers to purchase and use electrified vehicles.

RECOMMENDATIONS

- All stakeholders required for a smooth transition for urban mobility policies in both Singapore and the EU must be engaged and involved in the process. Extensive consultations have to be carried out to ensure that all interests and needs are accounted for, where communication is key to achieve this.
- The Singapore government should encourage competition between all modes of mobility, implementing policies to encourage people to choose sustainable travel options, instead of adopting policies that restrict vehicle ownership or ban the usage of vehicles.
- Set up quality objectives for urban mobility. The implementation of a dynamic road pricing scheme based on the quality objectives below would encourage customers to choose more sustainable travel modes:
  - Traffic flow (road usage efficiency, Pax/m2/time)
  - Parking (e.g. average time for parking space search)
  - Emissions (amount of local emissions caused by traffic)

- At the same time, road pricing would be a sustainable way of financing road infrastructure. Revenue generated from road pricing should be re-invested in road infrastructure and public transportation. A well-established infrastructure will reduce time of travel and appeal to users to switch over to more sustainable modes of transport.
- Cost is a primary factor for road users' decision making towards switching over to sustainable modes of transport. A reduction of road taxes for both Electric Vehicles (EVs) and Autonomous Vehicles (AVs) should be considered.

DEVELOPMENT OF HUMAN CAPITAL WITH THE TRANSITION TO EVS

With both parties having urban mobility policies to create a connected, safer, and greener landscape, the transition to EVs and Autonomous Vehicles (AVs) is predicated upon the development of human capital. The requirement for industries to have skilled workers with the effective technical knowledge towards the development and production of EVs and AVs needs to be prioritised by both parties.

SINGAPORE: LAND TRANSPORT INDUSTRY TRANSFORMATION MAP 2.0[13]

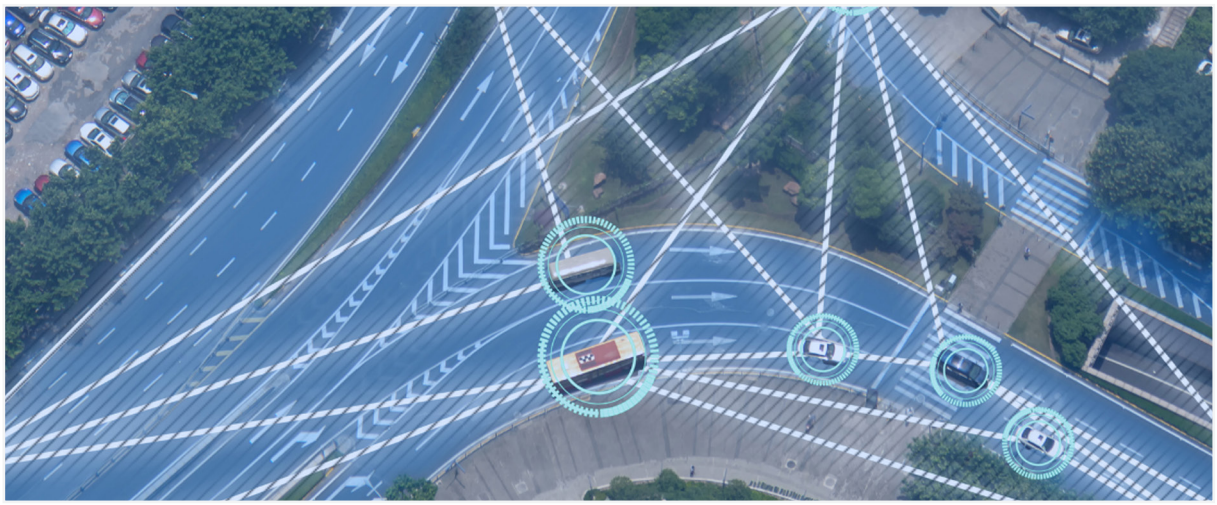
The government's adoption of new technologies will require familiarisation by manufacturers and operators, to ensure a smooth transition towards sustainable modes of transport. The Land Transport Authority (LTA) works together with unions and industry players to prepare workers for new job opportunities in the automotive sector. Key initiatives include:

- LTA works with stakeholders such as the National Transport Workers' Union (NTWU) and Public Transport Operators (PTOs) to develop a skills and training roadmap to be launched in 2020. This roadmap will lay out the essential skills required for jobs and the roles of new jobs arising from the deployment of AVs. Therefore, the LTA is planning to first train about 100 bus captains on courses for AV safety protocols and operations.
- This training also extends to the railway workforce, through the Rail Manpower Development Package (RMDP). The RMDP will ensure that operators are trained in key technologies and skillsets such as data analytics and condition-based maintenance.
- On the front of taxi and private-hire car drivers (PHC), the LTA will work with Skillsfuture Singapore, to develop training programmes for drivers, learning skills such as the operation of e-payment technologies. Grab and the National Private Hire Vehicles Association (NPHVA) also launched the Grab Driver-Partner Training Kit that includes courses on safety and digital skills.

EUROPEAN UNION: EUROPEAN SKILLS AGENDA[14]

The European Skills Agenda is an initiative by the European Commission towards pursuing a paradigm shift in skills to take advantage of the green and digital transitions and support a prompt recover from the COVID-19 crisis. Key initiatives include:

- Upskilling Pathways – New opportunities for adults. The EU aims to provide essential skills for the employment of low-skilled adults. Mutual learning workshops are funded by the EU Programme for Employment and Social Innovation (EaSI), where key stakeholders are engaged to cooperate and provide services to upskill the adults. Funding of €30.8 billion is introduced for sustainable and quality employment, where member states plan to engage around 8 million low qualified individuals.
- A blueprint for sectoral cooperation on skills is also created for stakeholders to work together in sector-specific partnerships, called alliances for sectoral cooperation for skills. These alliances help to address skill gaps in identified sectors. Through this blueprint, stakeholders can gather information and develop effective vocational programmes in the long term to be rolled out at the national and regional levels. Alliances have been created in the automotive industry and more recently on batteries for electro-mobility and towards digitalization as well.
- Platforms of Centres of Vocational Excellence (CoVEs) are developed to bring together a wide range of local partners, such as providers of vocational education and training, employers, research centres, development agencies, and employment services to develop "skills ecosystems" that contribute to regional, economic and social development, innovation and smart specialisation strategies. At the national level, the CoVEs are linked to local innovation ecosystems and connects them at the EU level. At the international level, the aim is to establish major hubs through this platform through coalescing centres with common interests in specific sectors or trades to tackle specific societal challenges.



13 *Speech by Dr Janil Puthucheary, Senior Minister of State for Transport and Communications and Information at The Ministry of Transport's Committee of Supply Debate 2020 on Towards A Future-Ready Land Transport System, Ministry of Transport. Retrieved from https://www.mot.gov.sg/news-centre/news/Detail/speech-by-dr-janil-puthucheary-senior-minister-of-state-for-transport-and-communications-and-information-at-the-ministry-of-transport-s-committee-of-supply-debate-2020-on-towards-a-future-ready-land-transport-system/*

14 *Employment, Social Affairs & Inclusion, European Union. Retrieved from https://ec.europa.eu/social/main.jsp?catId=1224&langId=en*

ANALYSIS

Both Singapore and the EU have key considerations towards the transformation and creation of jobs in the automotive industry. The shift in technical skills required to operate key areas in both EVs and AVs are imperative to be taught to employees. This shift has to be championed by the government, working with other stakeholders, where effective communication allows for the best policies to be rolled out.

Policies are similar in both Singapore and EU. However, the Singapore government is focusing on the public sector transformation and should consider extending its current services to the private sector as well. The shift to EVs and AVs cannot be borned by the government in Singapore alone. Similar to the EU, aiming to create an ecosystem for all stakeholders will be important for private companies to be attracted to Singapore and have confidence towards being supported by the government in terms of having their own employees being upskilled and having opportunities to develop themselves.

RECOMMENDATIONS

- Establish a roadmap for both public and private operators in the automotive industry. Currently, grant calls for a proposal are provided by the government. This needs to be expanded through consultations with private companies, to understand their needs for financial support and other innovation programmes.
- The platforms in Singapore through Skillsfuture needs to extend its aid towards private companies. The current landscape of aiding public companies will stunt the progress of the nation's transformation. Employees in private companies also require upskilling and the government can collaborate with companies to roll out programmes catered for respective companies.
- The government can consider expanding this platform for private companies within the regional level as well, where it can establish itself as a hub for attracting companies to develop solutions for creating jobs and innovating current ones as well.
- Singapore should leverage its position to attract R&D in this region, and the government should leverage on its opportunities to develop global solutions with the transition towards electrification. This will be beneficial for all parties, where cost-efficient methods can be developed, and Singapore can be a leader in its region to lead this transition.

CHAPTER 2

EVALUATION OF REGULATIONS TOWARDS ELECTRIC VEHICLES (EVS)

Electric Vehicles (EVs) have been highlighted as a key priority within Smart Mobility by Singapore and the EU. Both Singapore and the EU are working together in this issue, where articles within the European Union-Singapore Free Trade Agreement (EUSFTA) highlight the following[15]:

Article 3 (3) of Annex 2-B (Motor Vehicles and Parts Thereof) to the FTA provides that Singapore will "accept new Union products covered by this Annex and which are covered by an EC or UNECE type-approval certificate on its market as complying with its domestic technical regulations and conformity assessment procedures, without further testing or marking requirements to verify or attest compliance with requirements covered by and EC or UNECE type approval. …"

Article 4 (1) of Annex 2-B states: "Neither party shall prevent or unduly delay the placing on its market of a product covered by this Annex and approved by the exporting party, on the ground that the product incorporates a new technology or a new feature that the importing party has not yet regulated, unless the importing party can demonstrate, based on scientific or technical information, that such new technology or new feature creates a risk for human health, safety or the environment."

The above underline the supposed streamlining for the entry of European products into the Singaporean market, where technologies or vehicles covered by

15 *EUSFTA, MTI. Document retrieved from https://www.mti.gov.sg/Improving-Trade/Free-Trade-Agreements/EUSFTA*

regulations will be accepted by both parties. However, in practice, there are areas of improvement which will be explained in the following sub-chapters.

INCENTIVES FOR EV BUYERS AND USERS

Customers worldwide have similar concerns about switching to EVs:

- They are afraid that using an EV will become an inconvenience due to limited range, long charging times and poor charging infrastructure.
- They do not want to pay more for an EV than a comparable ICE vehicle.

This sub-chapter will consider the cost. One of the major challenges Singapore faces is the higher cost of an EVs, when compared to comparable ICEs. In order to encourage customers to transition to EVs, policies need to be adjusted to reduce these costs. Financial incentives will boost consumer demand for EVs and make it more cost competitive as compared to Internal Combustion Engines (ICE) in Singapore.

SINGAPORE: BUDGET 2020[16]

In 2018, the Government introduced the Vehicular Emissions Scheme for cars and taxis. Under the scheme, car buyers and taxi operators who choose cleaner car models can receive an upfront rebate of up to $20,000 and $30,000, respectively.

For cars and taxis, Singapore will provide an EV Early Adoption Incentive, those who purchase fully electric cars and taxis will receive a rebate of up to 45% on the Additional Registration Fee, capped at $20,000. This incentive will be implemented for three years, from January 2021.

The government will also revise the road tax methodology for cars to better reflect the current trends in vehicle efficiency from January 2021. This will lead to an across-the-board reduction in road tax for EVs and some hybrids. To compensate for losses in fuel excise duty, a lump-sum tax for Battery-powered Electric Vehicles (BEVs) will be introduced.

EUROPEAN UNION: ELECTRIC VEHICLES: TAX BENEFITS & PURCHASE INCENTIVES IN THE EUROPEAN UNION[17]

Presently, there are 20 EU member states which offer incentives, such as bonus payments or premiums to buyers of electric vehicles. 6 countries – Belgium, Bulgaria, Cyprus, Denmark and Latvia and Malta - do not provide purchase incentives, granting tax reductions or exemptions for electric cars. Lithuania does not provide any form of tax benefits or incentives.

For example, Germany has a range of incentives, some of which summarised below[18]:

- Ownership Tax Benefits: there is a 10-year tax exemption for initial registration from 2016-2025 for electric vehicles (purely electric or fuel-cell vehicles, not hybrid vehicles). After the exemption, the car tax will amount to 50% of €11.25 (up to 2,000kg), €12.02 (up to 3,000kg) or €12.78 (up to 3,500kg) for each 100cc or part thereof.
- Local incentives: for Battery-powered EVs, there are reserved parking spots, free parking and bus lane use accorded.
- Purchase incentives: electric vehicles having a nett list price of up to €40,000 have more subsidies. For purely electric and fuel-cell vehicles the total bonus is €9,000 and for plug-in hybrid and range-extended electric vehicles it is €6,750. The costs of these bonuses are equally shared between the government and the manufacturers.

ANALYSIS

Singapore, similar to many countries in Europe, has already implemented financial incentives to speed up the adoption of EVs. As cost is a primary factor in decision-making for the purchase of vehicles, incentives can have a strong pull factor for customers. It is important to consider reducing the Total Cost of Ownership (TCO) of EVs, compared to similar combustion engine vehicles.

Countries that have been most successful in promoting e-mobility – Norway, Sweden, Netherlands and China etc – have taken a holistic policy approach. By adjusting fiscal policies and providing usage incentives, they have made it more attractive, more convenient and less expensive to choose an electrified vehicle over a conventional vehicle. For instance, purchase and ownership taxes such as annual road tax, have been drastically reduced or even exempted for EVs. Some countries have introduced special license plates for electrified vehicles. This allows national and local authorities to introduce usage incentives easily, such as free parking and charging, bus lane access, and reduced fees for toll roads.

16 *Singapore Budget 2020: Push to promote electric vehicles in move to phase out petrol and diesel vehicles, Straits Times. Retrieved from https://www.straitstimes.com/singapore/transport/singapore-budget-2020-push-to-promote-evs-in-move-to-phase-out-petrol-and-diesel*
17 *Overview - Electric vehicles: Tax benefits & purchase incentives in the European Union, ACEA. Retrieved from https://www.acea.be/publications/article/overview-of-incentives-for-buying-electric-vehicles*
18 *Germany, European Alternative Fuels Observatory. Retrieved from https://www.eafo.eu/countries/germany/1734/incentives*

Through the announcements from its 2020 budget, Singapore is taking steps to increase the attractiveness of purchasing and owning an EV. However, the annual road tax for Plug-in-Hybrids (PHEVs) is as high as ICE vehicles. For BEVs, including the annual lump sum tax mentioned above, the annual road tax can range from being 2 to 4 times the tax for a comparable ICE vehicle.

Therefore, targeted policy changes towards the above areas are required to encourage customers in Singapore to choose EVs. In addition, there is much more room to promote EVs by providing incentives, such as free parking and charging, access to bus lanes and reduce Electronic Road Pricing (ERP) fees.

RECOMMENDATION

- Singapore should revise the road tax system to encourage EV adoption. Road taxes for BEVs and PHEVs should ideally be exempted or significantly be reduced compared to an ICE vehicle.
- The government should continue with CO2 based taxation schemes – such as the Vehicular Emission Scheme (VES) – to promote sustainable vehicles. However, the government should analyse if the complexity of additional pollutants can be reduced, as the current Particle Matter levels often times vastly reduce the chances of receiving incentives.
- Free and preferential parking for electrified vehicles and low-polluting vehicles should be considered, whilst increasing the cost for high polluting vehicles.
- Electric vehicles should be allowed to use bus lanes, which has been effective in countries such as Norway.
- Charging solutions should be intelligent to allow peak shaving and Vehicle-to-Grid solutions. For customers, this would enable charging at lower electricity rates during off-peak hours.
- With the move to ERP 2.0, a GPS based road pricing system, Singapore should consider introducing a local emission-based component in the pricing scheme. Thus, electrified cars would pay less so long as they are driven electrically. This will definitely encourage customers to choose EVs and make sure that they are primarily utilized electrically.
  - This incentive can be understood through the behavioural psychology term of "Loss aversion". People prefer to avoid losing as compared to receiving an equivalent gain. To visualise this, people will prefer to not lose $5 than to find $5. Hence, this same principle can be employed to encourage the purchase and usage of EVs. With road pricing, in order to avoid a small charge, people make small but still helpful changes to their mobility behaviour.
- The Singapore government has to consider the categorization of EVs to ensure the effectiveness of rebates.
  - The following chapter, on homologation highlights the various categories of vehicles in Singapore. Virtually all EVs have more than 97kW of power and fall into the Certificate of Entitlement (COE)[19] category (Cat) B. The COE for Cat B is higher than Cat A vehicles, translating to higher prices. An expected fall in the COE quota will likely result in a rising gap between Cat A and Cat B vehicles, where the COE gap is ascertained to be more than S$ 10,000. This would effectively wipe out the rebates offered by the government. Therefore, the Singapore government should consider all e-vehicles to be categorized under a special category to reduce the premium on them and for incentives to be effective.

EV HOMOLOGATION PROCESS

It requires that all vehicles that are being manufactured have to undergo approval, known as the homologation process. This process is required for the vehicle to be allowed into the respective parties' markets. EU and Singapore have the European-Union Singapore Free Trade Agreement (EUSFTA) in place, where the annex below underlines the benefit:

SINGAPORE

During the homologation process in Singapore, the Original Equipment Manufacturer (OEM) understand the classification of vehicles highlighted below, ranging from Category (Cat) A to E:

- Cat A - Cars 1600cc & below, and the engine power should not exceed 97 kilowatts (kW)
- Cat B - Cars 1600cc & above, or the engine power output exceeds 97 kW
- Cat C - Goods Vehicles & Buses (including public transport buses)
- Cat D – Motorcycles
- Cat E - "Open" (for any kind of vehicle, in 2017 motorcycles are no longer included in Cat E COE)

Category A cars will be required to undergo the power output testing process for both Internal Combustion Engines (ICE) and EVs[20]:

- ICE:
  - When a new vehicle arrives in Singapore, it is homologated with test reports based on UN ECE R101 from the

19 *The Certificate of Entitlement (COE) is a quota licence received by vehicle users which allow them to have the legal right to register, own and use a vehicle in Singapore for a period of 10 years.*

20 *E-Mobility Technology Roadmap, 2015, National Climate Change Secretariat (NCCS). Retrieved from www.nccs.gov.sg › e-mobility-technology-roadmap*

test lab. The vehicle then undergoes a power testing, ranging from power outputs of 81 -97 kW. It then is placed under 1 of 4 categories: Petrol, Petrol-Electric, Diesel, Diesel Electric, before being approved by LTA.

- EV/PHEVs:
  – When a new vehicle arrives in Singapore, it is homologated with test reports based on UN ECE R101 + 100. The vehicle then undergoes a power testing, ranging from power outputs of 81 -97 kW. It is placed under 1 of 3 categories: Electric, Petrol-Electric (Plug-in) and Diesel-Electric (Plug-in). The local CO2-Output formula added with grid factor to determine the grid emission factor – which is an emission factor that is associated with each unit of electricity, before being approved by LTA.

All EV charging systems have to be certified compliant to technical safety standards (TR25) before they can be installed and used.

EUROPEAN UNION

The EU introduced its new laboratory test, the Worldwide harmonised Light-duty vehicles Test Procedures (WLTP)[21], updating its current processes with technological innovations in the automotive industry.

- The WLTP is a new regulatory test procedure for light passenger cars and commercial vehicles to determine fuel consumption and emissions. It provides a more uniform procedure for calculating a vehicle's fuel consumption and emissions.
- Manufacturers are required to ensure correspondence between the CO2 emissions recorded in the certificates of conformity of their vehicles and the CO2 emissions of vehicles in-service measured according to the WLTP.
- The homologation process is based on the Whole Vehicle Type-Approval System (WVTA). The EU's Regulation – 2018/858 of the European Parliament and of the Council of 30 May 2018 – will replace the current directive and be made mandatory for all vehicles by 1 September 2020.
- Under the WVTA, a manufacturer who has obtained the Certificate of Conformity (CoC) after approval, will be able to market their vehicle throughout the EU, without any further tests which would delay the process.

ANALYSIS

Both Singapore and the EU have been updating their approval requirements with the changing developments in the automotive industry. The National Environment Agency (NEA) announced its acceptance for emission test results for pollutants from the WLTP employed by the EU, for type approval of new vehicles and assessment under its Vehicular Emissions Scheme (VES). It aims to monitor international developments and work with the local motor industry towards a complete switchover to the WLTP in the longer term.

This is in line with the EUSFTA signed by both parties, where neither Singapore nor the EU should, under Article 4 (1) of Annex 2-B, delay the entry of products into their markets. The movement towards the common approval standard is well-received.

As for the previously mentioned Vehicular Emissions Scheme (VES), we hope that the new VES could better distinguish between the different propulsion technologies, which is essential and crucial towards customers' decision-making, and also aid in the implementation of Singapore's adoption of EVs.

For charging systems, charging networks have been deployed across Europe and they have been certified to ensure that users have access to convenient high-powered EV charging. However, in Singapore, the current local regulation (TR25) charging systems impose technical barriers and limitations. The regulation is not consistently reviewed and its not does not have provisions to accommodate technology advancement or updates which resulted in the debarment of certified equipment and products from entering the market.

RECOMMENDATIONS

- As the government accepts the WLTP, it should work towards a common type approval process for EVs in Singapore. If there are additional safety guidelines required for the homologation process, the Singapore government should clarify them to ensure that there is no delay between both parties in approval of EVs.
- The current regulatory requirements for the homologation and certification process of charging systems have to be reviewed. Charging systems are essential for EV users and the Singapore government has to ensure that technical requirements are justified, as they only drive up the EV infrastructure costs and increase time for implementation,

21 *Will wltp end the discrepancy between the laboratory and on-road performance of cars? WLTP FACTS. Retrieved from https://www.wltpfacts.eu/wltp-discrepancy-laboratory-road-performance-cars/*

which is detrimental for the transition towards EV. A clearly defined process for the above and towards ownership will serve as a catalyst to promote investor confidence and help materialize and swiftly implement the government's target of 28,000 charging stations.
- A clear timeline towards the WLTP implementation by LTA and NEA will provide manufacturers with a certainty and confidence towards the time they can bring in newer and cleaner engine technologies currently used in the EU.
- Overall, the homologation requirements should be streamlined and lead times for new vehicles be reduced. This is highly possible due to the existing EUSFTA in place.

CHARGING INFRASTRUCTURE

The Charging Infrastructure is imperative towards establishing a seamless network for the EVs in Singapore. Regulations by both parties are explained below.

SINGAPORE

Budget 2020[22] in Singapore has outlined the following details. There are currently an estimated 1,600 charging stations in Singapore. The government aims to increase the number of charging stations to 28,000 by 2030. The status of the charging infrastructure in Singapore consists first of an estimated 1,100 AC stations, which range from 3.7 – 50 kW and an estimated 45 DC stations, ranging from 22 kW - 50 kW. Although there are charging infrastructure challenges, there is positive traction and more Charging Point Operators are expected to enter this business domain.

The Singapore government recommends the Combined Charging System (CCS), with Type 2 for AC and CCS Combo 2 for DC. This is the same standard as used in Europe, as well as in most world markets. Most Original Equipment Manufacturers (OEM) prioritise Type 2 and CCS Combo 2 as well.

EUROPEAN UNION

The EU has a robust charging infrastructure in place, where there are common charging standards amongst member states. As of 2020, there are 6 charging points per vehicle[23]. The EU also utilizes Type 2 for AC connectors and inlet, with high power DC charging utilizing CCS Combo 2. The CCS has identical safety measures and identical charging communication.

ANALYSIS

Both the EU and Singapore have adopted the same charging standards. This is great news to customers, original equipment manufacturers (OEMs) and charging providers alike, as it ensures that investments into charging infrastructure remain relevant and that charging infrastructure can be used by all vehicles. Singapore has announced ambitious plans for the roll out of charging infrastructure and is on the right direction. However, we feel that more could be done in terms of communicating a clear roadmap for the establishment of the charging infrastructure, as well as adjusting policies to make it happen more organically. In addition, different agencies must obtain the technical knowledge on EVs, charging technologies and communication protocols.

There are a number of things governments can do in order to improve the conditions for charging infrastructure. In all markets today, 80-90% of charging happens where people spend most of their time – at home or at work. Charging installation in residential buildings is often limited by bureaucracy or by bottlenecks in power distribution. Having the right policies and incentives to prepare new buildings in advance (e.g. require that new buildings have sufficient power capacity to prepare for charging of vehicles) can help to overcome this.

In many markets, there are plenty of companies that are trying to install Public Charging Infrastructure. But oftentimes they are struggling on the business side, since there are not enough EVs, and the few that are around do not get charged. The best thing governments can do is to make it attractive for customers to own and charge EVs. In addition they can help out with incentives to the charging providers. There are already a lot of countries doing all of this. Best practices can be found in the Nordics, Netherlands, France, Japan, and Korea.

It is of paramount importance to ensure that different ministries, agencies, and companies are collaborating in order to maximize the efficiency of the charging infrastructure. In Singapore, there are different agencies in charge of various developments, and this could potentially cause a delay towards the operation of the charging infrastructure.

22 *Singapore Budget 2020: Push to promote electric vehicles in move to phase out petrol and diesel vehicles, Straits Times. Retrieved from https://www.straitstimes.com/singapore/transport/singapore-budget-2020-push-to-promote-evs-in-move-to-phase-out-petrol-and-diesel*
23 *European Union, European Alternative Fuels Observatory. Retrieved from https://www.eafo.eu/electric-vehicle-charging-infrastructure*

RECOMMENDATIONS

- The Singapore government needs to establish a clear roadmap towards the implementation of charging stations in both public places and places of residence. This roadmap must focus on tangible steps, and not solely focus on the end goal of a numerical quantity of charging stations in Singapore. A detailed roadmap will allow companies to understand the aims of the government and provide their feedback as well.
- As there are multiple agencies concerned with the transition to EV, it will be beneficial for both the government and companies if a joint taskforce was created to set out the goals for the charging infrastructure in Singapore, to discuss both the short and long term aims.
- Government agency coordination needs to be in tandem with private companies, for investment in charging stations and equipment. Effective communication is required and further financial incentives such as tax reductions for private companies can be considered to develop an attractive climate towards investment in the charging infrastructure.
- The approval process for the installation of charging infrastructure needs to be streamlined, also including establishing policies for both condominiums and HDBs. For parking, dedicated parking lots can be considered, where consumers will purchase parking lots in Singapore for their charging systems to be installed.
  – This recommendation is in tandem with the increasing number of charging stations planned in Singapore.
- The government should take into consideration the homologation process for charging equipment as well, to reduce confusion and ambiguity for both manufacturers and users.
- Ideally, Singapore should strive for the implementation of smart charging solutions with Vehicle 2 Grid (V2G) technology. This enables the grid operator / the OEMs to control when the actual charging (and potentially discharging) of vehicles takes place. Thereby, peak loads on the grid can be prevented, redundant (short term) capacities can be avoided, and the integration of renewables can be simplified.

CHAPTER 3

THE FUTURE OF MOBILITY

DIGITALIZATION & AUTONOMOUS DRIVING

The shift towards smart mobility is also based upon the digitalization of the automotive industry and the attainment of autonomous driving. The future of mobility is one that is Connected, Autonomous, Shared and Electric. Within this chapter, the focus will be on connectivity between users and industries boosted by data connectivity, where autonomous driving is being pushed to ease congestion, reduce emission and allowing people to be more productive.

Through autonomous vehicles, the element of human error margin is removed, and this will be beneficial towards having a decline in accidents, making roads safer. To achieve this, connectivity is essential and important data must be gathered and shared. The opportunities for this industry is high, where education is required to upskill workers and job opportunities can be created as well, for the operations of newer systems.

SINGAPORE: SMART NATION INITIATIVES[24]

The government has been rolling out initiatives with the shift towards Intelligent Transport Systems (ITS) being targeted towards achieving Smart Mobility in Singapore. The initiatives are summarised below:

- Autonomous vehicles (AV)
  – Trials for AV has been undertaken by A*STAR, where testing was done in 2015 at One-north. Collaborations with institutions such as the National University of Singapore and the Singapore-MIT Alliance for Research and Technology (SMART) has led to working research prototypes being tested as well, around the NUS campus and

24 *Transport, Smart Nation Singapore. Retrieved from https://www.smartnation.gov.sg/what-is-smart-nation/initiatives/Transport*

with Self-Driving Vehicles (SDVs) being tested at the CleanTech Park in Singapore.
  - The Land Transport Authority (LTA) in collaboration with ST Kinetics, aims to develop AV technologies onto buses, these buses will use a satellite-based GPS and sensors to scan surroundings and assess actions to be taken.
  - Singapore has expanded the testing area for AVs to the entire western part of Singapore. This will increase the length of public roads for AV testbeds from 70km to more than 1000km. This expansion will allow developers to progressively test AVs in a wider range of traffic scenarios and road conditions and demonstrate the safety and reliability of AV systems in order to gain wider public acceptance.
- Open Data & Analytics for Urban Transportation
  - The LTA highlights that there will be 92% reduction in the number of bus services with crowding issues through transport planning aided by public data. Data on bus arrival timings, taxi availability, traffic conditions and carpark availability are accessible by both the public and third-party developers. In the future, a new ERP system will be developed to optimize traffic systems and the Fusion AnalyticS for public Transport Emergency Response (FASTER) system will analyse data to develop commuting patterns and provide better predictions towards first response in times of emergencies

Within the LTMP 2040, the government highlighted a new initiative of an Autonomous, Dynamically Routed Services (DRS)

- DRS services can adjust their routes based on passenger demand so that commuters can make fewer transfers, while optimising the resources of our transport network. When paired with Autonomous Vehicles, it will be able to reduce operating and manpower costs. Current pilot programmes are ongoing in Punggol, Tengah, and the Jurong Innovation District.

EUROPEAN UNION: CONNECTED AUTOMATED DRIVING ROADMAP[25]

The Union has been working on initiatives as well, with its aim to increase the availability of automated cars in 2020. The current target is set towards having level 4 of automation – a high level of automation which will still require human control over vehicles. The initiatives towards the digitalization of mobility and autonomous vehicles are summarised below:

- STRIA Roadmap on Connected and Automated Transport (CAT)
  - The Commission is in close cooperation with member states and stakeholders from industry, academia and national authorities to develop transport mode-specific roadmaps towards CAT. This will allow the identification of areas where innovations can overlap, allowing the acceleration of deployments. These roadmaps are also targeted with short, medium and long terms, pointing to 2023, until 2030 and beyond 2030.
- Horizon 2020 Programme
  - The Aligning Research & Innovation for Connected and Automated Driving in Europe (ARCADE) is a project conducted by the commission to coordinate consensus-building across stakeholders for sound and harmonized deployment of Connected Automated Driving (CAD) in Europe. It collaborates with member states, to ensure that automated road transport systems and services are compatible at EU level and are deployed in an efficient manner. A knowledgebase via a website has been created to share information amongst member states, allowing for effective communication and understanding on the combined shift towards CAD. Cooperation at an international level is also undertaken through ARCADE, shown by Trilateral ART Working Group formed with the US and Japan.
  - Public-Private Partnerships (PPPs) are set up at the European level, where funding for research and development are provided through Horizon 2020. These partnerships allow for a connected approach to accelerating the development of technologies required for connectivity and automated vehicles. 5G is also considered with the 5G-PPP, where fast connectivity is essential for communication with the target of increasing autonomous vehicles to be launched.
- Cooperative Intelligent Systems (C-ITS) & C-Roads
  - The C-ITS establishes the connection of vehicles with one another and combined with an effective infrastructure, this will allow road users and traffic managers to share information and use it to coordinate actions. This benefits road safety and traffic efficiency. In addition, the C-Roads platform is a joint initiative for the development of harmonised specifications towards communication in the road network. The platform supports the use of hybrid communication technologies.
- European Data Task Force (DTF)
  - The European Member states also launched the European Data Task Force (DTF), which aims to prioritise access to safety data and enable collaboration between vehicle manufacturers and member states. This will ensure that traffic safety is enhanced for all road users. The Memorandum of Understanding (MoU) is based on the principle of reciprocity where safety data will be offered in return for safety services.

ANALYSIS

The European Union's initiatives provide critical insights that are essential for the digitalization of mobility and the progress towards AVs in Singapore. The Singapore government's initiatives highlighted above lay the inroads towards the development of AVs and the digitalization of mobility. However, more could be done towards engaging businesses. Europe's overarching focus towards establishing a clear roadmap for the infrastructure and for communication between the Union,

25 *Connected Automated Driving Roadmap, European Road Transport Research Advisory Council (ERTRAC) Working Group.*

member states and other stakeholders within the industry is important. This focus is important in Singapore too. Despite the benefits of testing AVs and allowing access to traffic information for third-party developers, the infrastructure needs to be firmly established and assessed with companies' perspectives being understood as well.

Digitalization requires clear two-way communication, where the government can expand its efforts on this front, which will be beneficial for companies to view Singapore as an essential hub to invest in and conduct operations.

RECOMMENDATIONS

- The government should consider, similar to EVs, to have standard approval processes which will allow for companies' products seamlessly enter the market. In addition, extensive consultations with such companies should be carried out, for them to understand specific regulations pertaining to issues such as software and safety.
- Despite Singapore garnering first place in KPMG's annual autonomous vehicle readiness index this year, we believe that progress in Singapore can continue to be optimized. Within the index, Singapore is ranked 11th in terms of Technology & "Innovation", which highlights opportunities for improvements. Industry Investments and Investments into AV are some areas which Singapore can consider towards having partnerships with private companies.
- The development of an open data network should also be considered for the exchange of key information on the operations of AVs, where optimal information available will be important for safety. This will require a development of standards to be agreeable by all stakeholders in this industry.
- The expansion of AV testing in public roads in Singapore, although beneficial for the government, should prioritize safety at all times. This is an effective initiative, and for it to be an effective implementation, more areas of AV testing should also be considered, working together with companies for smooth operations.
  - With the various projects towards AVs, there is sentiment that such projects are geared towards publicity. The government needs to spread awareness of its commitment towards AV testing. Singapore should consider more EU examples. E.g. autonomous ports.
- The data consumption through connectivity also needs to be considered with the ongoing testing with AVs. Similar to the EU, Singapore should consider connectivity via LTE/5G Networking, which will provide better support for the vehicle-to-vehicle communication. This would also require consultations with companies.

CHAPTER 4

LOOKING AHEAD

As the Singapore government takes action for its transition to Smart Mobility, it will need to consider the micro and macro levels of initiatives. Within the micro level, the government's initiatives will be required to expanded and detailed to provide an attractive climate for companies to continue investing in and conducting operations in Singapore. At the macro level, the government needs to consider its current agreements with the EU, such as the EU-Singapore FTA, to ensure clarity between both parties. This will be optimal for all stakeholders, ranging from the government, to companies and to individuals as well.

The transformation of the automotive industry should be embedded in the whole region of ASEAN, not just in Singapore. Here, Singapore has the capacity to establish itself as a hub and for the progress of conversion of the region towards smart mobility. Championing the role to communicate with neighbouring countries and understanding their own regulations towards smart mobility will be a key priority in the future, as the automotive industry continues to become more data-driven and where Mobility as a Service (MaaS) will continue to rise.

CONCLUSION

The objective of this paper, as mentioned above, is to facilitate discussion between parties in the EU and Singapore on the transition towards Smart Mobility. This began with the understanding of initiatives by both Singapore and the EU, which this position paper has summarised in the respective chapters above. Following which, analysis and recommendations have been put forth, to prescribe a pathway for both parties to consider for their actions in the future.

This paper enables all stakeholders to further identify their role and work towards the creation of an effective, efficient and an exemplary ecosystem for smart mobility. Ultimately, we strongly believe this transition for both Singapore and the EU,

must be a combined and synergic effort, leveraging on existing bilateral agreements and more importantly, trust between all stakeholders. The amalgamation of shared experiences and knowledge will ensure that the transition will be a meaningful one.

CONTRIBUTORS

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LIST OF ACRONYMS

ARCADE	Aligning Research & Innovation for Connected and Automated Driving in Europe
AV	Autonomous Vehicles
BEV	Battery-powered Electric Vehicles
CAD	Connected Automated Driving
CCS	Combined Charging System
COE	Certificate of Entitlement
CoVE	Centres of Vocational Excellence
CRL	Cross Island Line
EaSI	EU Programme for Employment and Social Innovation
EC	European Commission
ERP	Electronic Road Pricing
EU	European Union
EUSFTA	European Union-Singapore Free Trade Agreement
EV	Electric Vehicles
FASTER	Fusion Analytics for public Transport Emergency Response
ICE	Combustion Engines
ICE	Internal Combustion Engine
ICE	Internal Combustion Engines
ITS	Intelligent Transport System
ITS	Intelligent Transport Systems
JRL	Jurong Region
KPI	Key Performance Indicators
LTA	The Land Transport Authority
LTMP	Land Transport Master Plan
MaaS	Mobility as a Service
NEA	National Environment Agency
NTWU	National Transport Workers' Union
OEM	Original Equipment Manufacturer
OEM	Original Equipment Manufacturers
PHEV	Plug-in-Hybrids
PPP	Public-Private Partnerships
PTO	Public Transport Operators
QoL	Quality of Life
SDV	Self-Driving Vehicles
SUMP	Sustainable Urban Mobility Plans
TCO	Total Cost of Ownership
TEL	Thomson-East Coast Line
V2G	Vehicle 2 Grid
VES	Vehicular Emission Scheme
VES	Vehicular Emissions Scheme
WLTP	Worldwide harmonised Light-duty vehicles Test Procedures