

Public Consultation on Developing Singapore's Long-Term Low Emissions Strategy

16 July 2019

This background document was prepared by the National Climate Change Secretariat, Strategy Group (NCCS) and relevant agencies, to invite public views on Developing Singapore's Long-Term Low Emissions Strategy

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Introduction

The global climate situation is changing. Extreme weather events are expected to be more intense and frequent, and global mean sea levels are projected to rise.

As a small, low-lying island city-state, Singapore is especially vulnerable to the effects of climate change. Rising sea levels, changes to our rainfall patterns, and increasing temperatures will affect our health, water supply, biodiversity and greenery, and coastline, among other things. It is thus imperative for us to work with the international community to address this urgent global problem. Singapore needs to do our part by further reducing our greenhouse gas emissions and embark on a transition to a low-carbon future.

We invite you to contribute your views on how Singapore can work towards becoming a low carbon global city-state – one with a competitive economy, sustainable environment, and a high quality of life for all.

The Public Consultation Document attached outlines the areas of concern that you can help us with, and you can e-mail us at nccs_contact@pmo.gov.sg with your replies or feedback to any of the questions by 30 September 2019.

Public Consultation Document

Climate change, which refers to the large-scale, long-term shift in the Earth's weather patterns, is caused by the increasing levels of greenhouse gases (GHG) in the Earth's atmosphere.

Over the past 100 years, global temperatures have been increasing faster than ever. According to the World Meteorological Organisation (WMO), the years of 2015, 2016, 2017, and 2018 have been confirmed as the four warmest years on record¹ and the impact of climate change has become increasingly felt around the world. As the Earth gets warmer, rainfall patterns will change, sea levels will rise, and weather events will become more extreme. The Intergovernmental Panel on Climate Change (IPCC), which is the leading international scientific authority on climate change, released its Special Report on Global Warming of 1.5°C (SR1.5) in October 2018, and said that human-induced global warming has already reached 1.0°C above pre-industrial levels, and is increasing at approximately 0.2°C per decade. Without urgent global action to reduce GHG emissions, temperatures could rise to between 3.7°C and 4.8°C above pre-industrial levels by 2100.

It is clear that the international community needs to urgently stem the warming trend to forestall the worst effects of climate change.

How Climate Change Affects Singapore

Singapore is already experiencing the effects of climate change and its impact is expected to worsen. While natural climate variability may have played a part in such events, extreme conditions are likely to become more intense and frequent due to climate change. It is therefore important for Singapore to understand and prepare for climate change.

In recent years, Singapore has experienced record high temperatures, extended dry spells, and intense thunderstorms. Our annual average temperature has risen by 1.7°C from 1972 to 2015, and the last ten years (2009-2018) have been the warmest decade recorded in Singapore². In early 2014, Singapore experienced its longest dry spell since records began in 1869.

According to the 2nd National Climate Change Study³, Singapore is projected to become warmer, experience more frequent and intense heavy rainfall events, and face rising sea levels in the future. Singapore's daily mean temperatures are projected to increase by 1.4°C to 4.6°C by 2100. This will result in approximately 300 days of hot and humid weather annually, compared to 30 days today. Both the intensity and frequency of heavy rainfall are projected to increase, and dry weather periods are expected to be longer and more intense. Mean sea levels around Singapore could rise by up to around 1 metre in 2100.

Singapore is committed to work with the international community to reduce GHG emissions and achieve the long-term temperature goals of the Paris Agreement.

¹ Based on WMO's climate statement released on 6 February 2019

² Source: Meteorological Service Singapore (MSS) 2018 Climate and Weather: The Year in Review

³ Source: Meteorological Service Singapore (MSS), Centre for Climate Research Singapore (CCSR) 2015

Singapore's National Circumstances and Emissions Profile

Singapore is a small low-lying, island city-state with a total land area of about 719.9 km². As of 2018, Singapore's total population is estimated to be 5.64 million, with a population density of about 7,796 people per km².

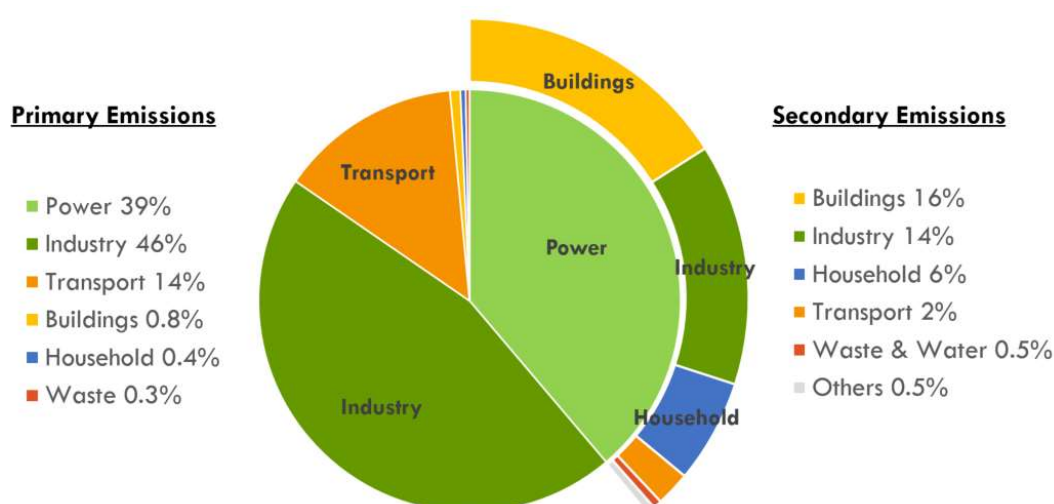
Our country has had a longstanding focus on sustainable development and environmental quality, which has helped to significantly moderate our carbon emissions growth. Although we contribute only around 0.11% of global emissions, we continue to take steps to reduce our carbon emissions.

From 2000 to 2014, our emissions grew at a compounded annual growth rate (CAGR) of 2.0% while our GDP grew at a higher CAGR of 5.5% over the same period. As a result, our emissions intensity decreased by 37% while energy intensity decreased by 33%, highlighting the improvement Singapore has been making on emissions and energy efficiency.

Singapore's GHG emissions in 2014 was 50.9 megatonnes (MT) CO₂-equivalent. The profile of GHG emissions is illustrated below in Figure 1, and shows the share of primary emissions per sector, as well as a breakdown of secondary emissions from each sector's electricity usage.

The extent to which we can reduce our emissions however depends on our national circumstances, geographical constraints, and our potential for alternative energy sources. Given our small size and dense urban landscape, there are challenges to using alternative energy sources such as solar energy on a wide scale. Singapore's land constraints, geographic and climatic conditions pose challenges in tapping on geothermal resources, hydroelectricity, wind, tidal, and wave power.

Figure 1: Singapore's GHG Emissions Profile (2014)



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Charting the Way Forward to a Low-Carbon Future

As our commitment to advance global climate action under the Paris Agreement, Singapore has pledged to reduce our emissions intensity by 36% from 2005 levels by 2030, as well as to stabilise emissions with the aim of peaking around 2030.

To achieve this pledge, Singapore aims to improve energy efficiency, reduce GHG emissions from power generation, develop and deploy cutting-edge low-carbon technologies, and encourage collective action among Government agencies, individuals, businesses, and the community.

Even as we work towards meeting our 2030 pledge, we also need to chart our long-term emissions pathway, building on these efforts. The Paris Agreement calls for global peaking of GHG emissions as soon as possible and to undertake rapid reductions thereafter to achieve collective carbon neutrality in the second half of this century. According to the SR1.5 report, to limit global warming to 1.5°C, global net human-caused emissions of carbon dioxide (CO₂) would need to fall by about 45% from 2010 levels by 2030, and reach 'net zero' around 2050.

As the global community embarks on this transition, we need to chart our own sustainable path forward towards a low carbon future. This requires hard work and long-term commitments from all countries. This document outlines some key strategies Singapore is considering to develop our long-term low-emissions strategy.

Key strategies in developing Singapore's long-term low emissions strategy

A) Improving Energy Efficiency across all Sectors

Improving energy efficiency in all sectors of the economy will continue to remain one of our key strategies to reduce GHG emissions.

We have several measures to facilitate improvements in energy efficiency, ranging from regulations to grants and incentive schemes. We passed the Energy Conservation Act (ECA) in 2013, which mandates energy intensive industrial facilities in Singapore to appoint an energy manager to monitor and report energy use and greenhouse gas emissions, and to submit energy efficiency improvement plans annually. The ECA was enhanced in 2017 to strengthen energy management practices. New energy intensive industrial facilities are required to have their designs reviewed for energy efficiency, and to meter major energy consuming systems. All ECA regulated facilities are required to implement Structured Energy Management System (EnMS), and to carry out periodic Energy Efficiency Opportunities Assessments (EEOA). In addition, mandatory standards are being introduced to improve the energy efficiency of common industrial equipment and systems such as motors and chilled water systems.

To encourage companies to implement EE improvement projects, we have increased the grant quantum of incentive schemes such as the Resource Efficiency Grant for Energy (REG(E)), Energy Efficiency Fund (E2F), and Genco EE Grant. For buildings, we have the Green Mark Scheme, which is the Building Construction Authority's (BCA) green building rating tool, tailored for the tropics and sub-tropics. BCA also offers financing schemes to encourage building owners to green existing buildings, such as the Building Retrofit Energy Efficiency Financing (BREEF scheme). We have developed the BCA-IMDA Green Mark Scheme for Data Centres (DCs) to encourage the adoption of energy-efficient design, operation and management of DCs.

For households, we have implemented the Mandatory Energy Labelling Scheme (MELS) to encourage households to purchase more energy-efficient appliances. We have also introduced Minimum Energy Performance Standards (MEPS) to raise the average energy efficiency of products in the market. Only appliances that meet the minimum energy efficiency standards are allowed for sale. This helps consumers so they do not end up paying more for electricity consumption as a result of using energy-inefficient appliances.

To further improve energy efficiency, households and businesses need to make adjustments to their daily activities, choices, and processes such as choosing to use more energy-efficient appliances. The Government will continue to raise awareness and facilitate the adoption of energy-efficient practices and technologies. These efforts to improve energy efficiency however, need to also be complemented by a conscious effort by households and businesses to use energy wisely, and minimise energy wastage and over-consumption. Reducing energy consumption and improving energy efficiency will be integral to Singapore's efforts to further reduce GHG emissions.

<Questions>

Households:

- How can households in Singapore be encouraged to purchase and use more energy-efficient appliances?
- What are some of the more effective energy-saving practices we can adopt around the home?
- What are the main barriers that are stopping households from adopting more energy-saving practices?
- Please share any other comments or ideas you may have on energy-saving practices.

Businesses:

- What are the challenges faced in reducing energy consumption and adopting energy-efficient practices (EE) in your company?
- How might businesses be further encouraged to adopt EE practices?
- Do you/your company have the information you require to make better energy management decisions? What kind of information would be useful and through what platforms can this information be made available so that your company can easily access them?
- What are your/your company's views on setting minimum energy performance standards to raise the average efficiency of industrial equipment?
- What are the barriers stopping your company from partnering other companies to adopt energy-efficient practices at an industry-wide or district level? What can be done to overcome these barriers?
- How strongly does your company prioritise EE improvements and energy reduction, in relation to other business needs, such as manpower, production efficiency, etc? What are the key considerations in deciding whether your company will implement energy efficiency practices?
- What would help your company consider market-based financing to implement energy efficiency projects, e.g. loans, third party financiers?
- Please share any other comments or ideas you might have on measures, regulations or policies that will drive EE improvements in your company?
- Please share any other feedback you might have on improving EE across all sectors in Singapore.

B) Encouraging Responsible Climate Action through Carbon Pricing

Carbon pricing is among the most economically efficient ways to reduce emissions by making consumers and businesses aware of the cost of the negative effects arising from their GHG emissions on the world's climate and Singapore. Pricing carbon can promote behavioural change, encourage investments in energy efficiency and low carbon technologies, and stimulate growth in green industries.

From 2019, Singapore implemented an economy-wide carbon tax of \$5 per tonne of CO₂-equivalent (tCO₂e) of GHG emissions on all facilities emitting 25,000 tCO₂e or more of GHG emissions per year, without exemptions. We have chosen a simple carbon tax with no

exemptions, to maintain a transparent, fair, and consistent price signal across the economy and incentivise emission reductions in the most economically efficient way.

The carbon tax complements and enhances our suite of mitigation measures. The carbon tax revenue will support worthwhile projects that would improve energy efficiency and generate carbon abatement. For example, existing energy efficiency incentives have been enhanced to provide funding support of up to 50% of qualifying costs, an increase from the previous 30% maximum funding.

The carbon tax rate will be reviewed by 2023, taking into consideration international climate change developments, our economic competitiveness and the progress of our domestic emissions mitigation efforts. We intend to increase the tax rate to between \$10 and \$15 per tCO₂e by 2030.

The Paris Agreement also provides for jurisdictions to cooperate in achieving their climate pledges, such as through the use of international carbon credits. To enable the possibility of using credits in the future, we have implemented a Fixed-Price Credit Based (FPCB) tax mechanism whereby companies pay a carbon tax by surrendering carbon credits representing the equivalent amount of emissions generated. The current system provides the infrastructure to enable the purchase and surrender of carbon credits issued by the Government. The benefit of the FPCB system is that it puts in place key building blocks which help regulatory bodies and companies build up necessary capabilities to operate in a linked market, should we decide to do so in the longer term. We recognise that there may be benefits in linking our carbon tax framework to other price jurisdictions, and will continue to monitor international developments, and consult companies here before making any policy changes.

<Questions>

Households

- Would you be willing to pay more for products or services from a business that is taking responsible climate action by reducing emissions and/or purchasing carbon credits to offset its carbon emissions?

Businesses

- Does your company have a corporate policy or position on the issue of climate change?
- In reviewing the carbon tax rate, how should the Government strike a balance between addressing the competitiveness concerns from emissions-intensive trade-exposed sectors, with the need to reduce emissions to meet current and future emissions targets?
- To meet emissions targets, would you prefer to have an economy wide carbon tax or a range of targeted measures such as regulations and mandates? What should be the balance between the two approaches?
- What are some key considerations that influence whether your company will choose to reduce emissions in order to reduce the carbon tax payable?
- What are the challenges your company faces in implementing emissions reduction measures?
- How can the Government further support businesses in implementing emissions reduction measures?

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- Is your company familiar with the carbon credits available in the market that can be used to offset your emissions? Some examples include Certified Emissions Reductions, Verified Carbon Standard, Gold Standard etc.
- Does your company employ the use of shadow or internal carbon prices in your decision making? If yes, how is the carbon price or range of carbon prices decided?

C) Reducing Emissions from Power Generation

With limited alternative energy options, Singapore meets most of our electricity needs through the combustion of fossil fuels. We have already switched from fuel oil to natural gas - the cleanest form of fossil fuel. The proportion of Singapore's electricity generated by natural gas has risen from 26% in 2001 to around 95% today. The grid emission factor of our power system has improved in tandem. We are also encouraging the adoption of best-in-class power generation systems to increase efficiency. To further reduce our GHG emissions from power generation, we are increasing solar deployment, and considering other alternative energy sources such as green electricity imports.

Solar Deployment

Solar energy is currently the most technically and economically viable renewable energy option for Singapore. Singapore's installed solar capacity was 203 megawatt-peak (MWp) in 2018, and we aim to increase this to 350 MWp by 2020, and 1 GWp beyond 2020, enough energy to power the equivalent of about 210,000 4-room HDB apartments. To facilitate this, the Government has created lead demand through the SolarNova Programme to catalyse the growth of the solar industry in Singapore. To place this in context, our latest peak electricity demand was 7.4 GW in May 2019.

Singapore's high population density and highly urbanised landscape necessitate the creative use of space to deploy solar photovoltaic (PV) systems. We are deploying solar PV systems on temporarily vacant land and on rooftops of industrial buildings through the SolarLand and SolarRoof Programmes respectively. We are also studying how to incorporate building integrated PVs (BIPV) on building facades. Research on next generation solar PV cells and materials with improved efficiency are being conducted by our Research Institutes such as the Solar Energy Research Institute of Singapore (SERIS).

Given our land constraints, Singapore is also deploying solar PVs in innovative ways such as floating solar PV systems on water bodies. In 2016, we launched a 1MWp floating testbed at Tengeh Reservoir to study the economic and technical feasibility of deploying floating solar PV systems on reservoirs. With favourable results from the testbed, we are deploying two 1.5 MWp floating solar PV systems at Bedok and Lower Seletar Reservoirs by 2020, and a 50MWp floating solar PV system at Tengeh Reservoir by 2021. We are also exploring the deployment of two more floating solar PV systems at Kranji (100MWp) and Upper Peirce (6.7MWp) Reservoirs. Beyond reservoirs, a 5MWp pilot project for offshore floating solar PV system off Woodlands waterfront park was also launched in 2019. All these initiatives serve to maximise our solar deployment, and increase the share of renewables in our energy mix.

To further guide our country's push for increased solar deployment, the Solar Photovoltaic (PV) Roadmap for Singapore published by SERIS in 2014 is currently being updated. The 2014 SERIS study had earlier concluded that assuming (i) full utilisation of the effective area that is available for solar deployment in Singapore (45 km²), (ii) accelerated growth in PV area efficiency and yield, (iii) accelerated reduction in cost - Singapore could support up to 10 GWp of solar PV systems in the long term, providing approximately 15 TWh of energy (or about 30% of today's total electricity demand). Since the 2014 PV Roadmap, the diversity of the underlying technologies, their economics, the size of the industry, and modes of deployment have advanced considerably. The update will guide future research directions, and give clearer long-term perspectives to guide our ambitions.

We are transforming our national power grid to support a future where intermittent energy from solar PV and other systems contribute to a higher proportion of our energy mix. We are test-bedding and deploying Energy Storage Systems (ESS), as well as developing our solar forecasting capabilities to enable Singapore's future grid to integrate more solar energy while maintaining our grid stability and reliability.

Electricity Imports

Electricity imports have the potential to reduce emissions from power generation as it allows us to tap on other clean energy resources not currently available in Singapore. They might also improve the cost competitiveness of Singapore's energy market, depending on the source of electricity imports. There are various ways to import electricity, such as establishing direct grid connections with neighbouring countries, or laying long distance cable connections with countries which have renewable energy deployment potential, and the ability to export green electricity.

On the regional front, ASEAN is enhancing energy connectivity through the ASEAN Power Grid (APG) initiative. As of January 2019, ASEAN member states have completed power interconnections with a total capacity of 5,502MW. ASEAN has also an aspirational target to increase the share of renewable energy in the ASEAN Energy Mix to 23% by 2025. Hence, there is potential for Singapore to import clean energy from within the region.

Additionally, there are also emerging technologies using energy carriers other than electricity, which can enable renewable energy to be moved over large distances more economically than long distance submarine power cable connections. For instance, research is being carried out in major global research centres on the use of hydrogen as a renewable energy carrier.

Singapore will continue to monitor developments that could enable the possibility of electricity and green energy imports from other countries.

<Questions>

- How many percent more would you as an individual or your company be willing to pay to purchase electricity generated from clean and renewable sources?
- How can the private sector be encouraged to further accelerate the deployment of solar energy?

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- How can Singapore increase our solar power deployment? What other innovative forms of solar deployment could Singapore explore, beyond floating solar, BIPV solar and deploying solar panels on the tops of walkways and vacant land?
- What are other alternative energy sources or technologies that Singapore can consider? Please share your views.

D) Deploying Emerging Low-Carbon Technologies

Singapore recognises that technological innovation will play a significant role in helping us address our long-term climate change and energy challenges. We will continue to study technologies that can increase energy efficiency and support higher adoption of alternative energy sources. For instance, Singapore concluded in our 2012 nuclear energy pre-feasibility study that current nuclear technologies were not yet suitable for deployment in Singapore. Nonetheless, we will monitor the progress of nuclear technologies and build capabilities to understand nuclear science and technology. Even as we continue to invest in research development and demonstration (RD&D) to develop innovative solutions to our climate and sustainability challenges, we will closely monitor global technological advancements that can significantly reduce our GHG emissions.

Electric Vehicles (EV)

Singapore continues to invest heavily in public transport, to build a sustainable land transport system that can conserve land space and is more energy efficient. This also helps us reduce reliance on private vehicles. We have also enforced strict standards on vehicular emissions, and are looking to encourage the adoption of cleaner technologies such as electric vehicles.

As outlined in the Land Transport Master Plan (LTMP) 2040's objectives, all public buses and taxis will run on cleaner energy sources by 2040. Several private hire car operators and rental companies have also committed to using cleaner vehicles by 2040.

As early as 2011, Singapore embarked on the electro-mobility journey starting with the EV Phase 1 test-bed which involved 89 electric vehicles from four different manufacturers. This demonstrated the technical feasibility of EVs in Singapore. Building on the Phase 1 findings, Phase 2 of the EV test bed focused on fleet electrification, and saw the launch of Singapore's first large-scale electric car-sharing programme under which a total of 1,000 EVs and 2,000 charging points will be deployed nationwide by 2020. LTA also started trialling electric buses in 2016 on operational service routes to determine their performance in a tropical environment. Tenders were awarded to three firms for 60 electric buses in 2018, for the fleet trial of e-buses in Singapore. In addition to this, a private taxi company launched their first fleet of 50 electric taxis for trial in February 2017 and were subsequently awarded a full taxi service operator license in August 2018. They will increase their fleet size to 800 electric taxis by July 2022.

The global stock of EVs has been increasing over the years as EVs are becoming more cost-competitive. Most car manufacturers have also said that they will be producing more EVs in the coming years, with some indicating that they will stop producing cars powered by internal combustion engines within the next two decades. This provides greater impetus for Singapore to electrify our vehicular fleets. The benefits of EVs go beyond reducing our GHG emissions.

Vehicle electrification has the added environmental benefits of reduced air pollution, lower background noise, and reduced urban heat island effect.

We will continue to explore ways to further reduce emissions from all vehicles to contribute to cleaner air and safeguarding the well-being of our population.

<Questions>

Households

- What would encourage you to purchase an EV?

Businesses

- What would encourage businesses to adopt EVs in their vehicle fleets?
- What can Singapore do to drive the development of EV technologies and widespread electrification of vehicle fleets?
- What other opportunities are there to further deploy smart/intelligent technologies to increase the efficiency of our transport systems? Please cite other benefits, if applicable.
- Please share any other comments or ideas that you may have to create a cleaner and greener transport system in Singapore.

Carbon Capture, Utilisation and Storage (CCUS)

Carbon capture, utilisation and storage (CCUS) has the potential to reduce emissions by capturing and converting the captured CO₂ from the emissions of industrial facilities and power plants into usable products (e.g. building materials, chemicals and synthetic fuels), or storing the captured CO₂ in natural sub-surface underground geological formations. This prevents CO₂ from being emitted into the atmosphere at the source.

Singapore is currently studying the potential for CCUS pathways to reduce Singapore's carbon emissions. Although preliminary findings show that the potential is significant, we are mindful of the challenges that come with adopting CCUS as Singapore does not have any known suitable geological formations for the permanent storage of CO₂ underground. Carbon capture costs are also high at the moment, although these are projected to come down in the future as the technology matures. In addition, currently a substantial amount of energy is required to separate and concentrate the CO₂ from emissions of industrial facilities and power plants. Significant energy, land and hydrogen resources are also needed to further process the CO₂ into useful products.

Researchers and companies around the world are also actively working to reduce the costs by developing new catalysts and novel chemical pathways. As such, we are looking very closely into the potential deployment of CCUS technology in Singapore.

<Questions>

Businesses

- What would it take for your company to adopt CCUS technologies (e.g. absorption, adsorption & membrane-based capture technologies, and utilization technologies leading to chemicals production, mineralization and other commodities)?

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- Would your company consider adopting CCUS technologies at this stage when the technologies are still nascent, and what would be the key considerations?
- What information would your company need to make an informed decision with regard to the adoption of CCUS technologies?
- What are the CCU technologies or pathways that Singapore should be considering, and how best could the Government work with industry to better prepare for the potential adoption of these technologies (e.g. joint test beds)?
- Products (e.g. building material, chemicals, fuels) made from CCU are likely to be more expensive than products made by conventional means. How much more would you be willing to pay as "green" premium for these products?

Use of Hydrogen as an Alternative Energy Source

Hydrogen gas is a versatile energy carrier and industrial feedstock, derived primarily by splitting water or by reacting fossil fuels with steam or controlled amounts of oxygen. While hydrogen has served mostly as feedstock for a range of industrial processes (e.g. refining, chemicals etc.), it also has the potential to add diversity to our fuel mix across a number of applications, such as electricity generation and in transport. With the highest energy density of any common fuel, hydrogen, when produced from renewable energy sources overseas and imported to Singapore, is an energy carrier that has the potential to ensure the supply of reliable, renewable electricity and decarbonise emissions-heavy sectors.

Singapore is currently studying the technical and economic feasibility of importing hydrogen and its use in potential downstream applications in the longer term. Recent technological advancements have made it possible for hydrogen to be used as a replacement fuel in applications such as direct heat generation in the industrial and household sectors, hydrogen fuel cells in the transport sector, and power generation. Internationally, emissions-heavy sectors such as maritime and aviation are also exploring low-carbon hydrogen as a replacement fuel for ships and aircraft.

However, there are several challenges to be overcome before hydrogen can be more broadly adopted in our economy. For instance, a global and diverse supply chain for hydrogen has yet to be established. In addition, hydrogen imports may incur high costs to develop hydrogen transportation, storage and utilisation facilities.

Nonetheless, we are actively studying developments in hydrogen, given their potential to help Singapore decarbonise our emissions-intensive sectors.

<Questions>

- What benefits, concerns and/or constraints would your company have in adopting hydrogen into your processes?
- What downstream applications for hydrogen should we be looking at, in addition to industrial feedstock, power generation, and transport?
- What should Singapore's considerations be when making a decision between (i) investing early in the development of relevant policies and infrastructure to adopt

- hydrogen and (ii) waiting for the global production and use of hydrogen to be more established?
- What are the areas that your company would be keen to collaborate on (with the Government and/or other companies) to assess the feasibility of using imported hydrogen for the relevant applications?
 - What are your views on Singapore importing hydrogen for power generation to diversify our fuel supply and ensure greater environmental sustainability? To what extent would you be willing to pay a premium for “greener” electricity options?

E) Encouraging Collective Climate Action

Tackling climate change requires everyone to do their part. This is why Singapore designated 2018 the Year of Climate Action, to highlight the urgency for climate action and the need for a whole-of-society effort. Together with the 3P (People, Private, Public) sectors, over 800 climate action related events were organised, and to date, we have received an encouraging response from over 340,000 individuals and organisations pledging to take climate action.

Organisations can play a larger role by adopting sustainable business models, and start planning for the longer term to ensure that they can continue growing in a carbon-constrained world. Climate-friendly practices can be adopted, such as conducting energy audits, developing eco-friendly products, improving operational efficiency through better supply chain management, and establishing environmental management plans where resources and waste streams are reduced. Businesses can also plug into the circular economy whereby resources are recycled and re-used. By being more resource-efficient, businesses stand to gain by reducing cost, and becoming more cost-competitive and profitable.

Members of the public can also do their part for climate action. We can help to reduce our impact on the environment by committing to take public transport, cycling or walking instead of driving. As part of our 2040 Land Transport Master Plan, we aim to increase the modal share of public, active, and shared⁴ transport to 9 in 10 of all peak-period journeys by 2040. This vision will be facilitated by seamless connections between transport modes and supported by continued investment in our bus, rail, and active mobility networks, to help the public reduce reliance on private cars.

Reducing energy usage is another way members of the public can help to drive collective climate change action. Individual measures include:

- setting air-conditioner temperatures to no lower than 25°C;
- changing incandescent light bulbs and compact fluorescent lamps to LED bulbs;
- not leaving electrical appliances on standby; and
- purchasing energy-efficient appliances.

⁴ This includes public transport such as trains and buses; active mobility such as walking, cycling, and use of Personal Mobility Devices; as well as shared transport such as taxis, Private Hire Cars, and car-sharing.

To raise public awareness on energy efficient practices, the Energy-Saving Challenge was rolled out in 2017 and 2018 to challenge households to adopt simple energy-saving habits, and win attractive prizes.

Members of the public can also reduce the generation of waste and adopt sustainable consumption practices. 2019 has been designated as the Year Towards Zero Waste, and the Zero Waste Masterplan will be launched in the second half of 2019. This Masterplan will chart Singapore's adoption of a circular economy approach towards a Zero Waste Nation. It will detail the key policies and strategies that the Government will be implementing in the next few years, supported by industry transformation, and research and development. This will set an example for the wider community to adopt sustainable practices. These include using re-usable bags, minimising the use of disposables, choosing products with minimal or recyclable packaging, buying only what we need, and practising good 3R (recycling, reduce and re-use) habits. As plastic incineration produces significant carbon emissions, reducing our use of plastics will also help to reduce our emissions. For example, our Waste-To-Energy (WTE) plants generate approximately 2% of Singapore's total electricity needs. However, plastics incineration produces about 7% of the total carbon emissions from all power generation for electricity.

While the Government continues to implement measures and policies to reduce our emissions and improve our standards of living, these need to be complemented by whole-of-society climate action to enable Singapore's transition to a sustainable, low-carbon economy.

< Questions >

- What other actions can you as an individual or a member of the community undertake to drive climate action?
- What are the challenges individuals face in taking climate action in their daily lives?
- How can we further encourage individuals to reduce, re-use, and recycle?
- What would encourage you to take up active, shared, and public transport for your journeys, especially peak-period journeys?
- Are you prepared to bear some additional costs/inconvenience to contribute to a low carbon Singapore? For example, higher utility bills from switching to greener fuels or methods of generation, paying more for waste disposal, paying more for products that have been produced in a carbon neutral way etc.?
- How can we encourage businesses and organisations to take climate action and practice 3Rs within their operations?

F) Tapping on Green Growth Opportunities

While climate change poses significant challenges to Singapore, it also provides strong impetus for entrepreneurship, R&D, and creative problem-solving to help us reduce GHG emissions while exploring new economic opportunities. To facilitate this, Singapore has positioned itself as a Living Lab where businesses, Government agencies, and research institutes can collaborate and test-bed clean technologies under real world conditions. This puts us in a better position to not only address our own national challenges, but also provide green technologies and solutions that we can potentially export to other countries.

An opportunity we can capitalise on is green financing which will play a crucial role in channelling capital to low-carbon solutions. To mainstream sustainable financing practices and to facilitate growth of green finance investments, we are deepening Environmental, Social, and Governance (ESG) integration in financial institutions and expanding the scope of green finance products. As early as 2015, guidelines on responsible financing were introduced by The Association of Banks in Singapore (ABS). These guidelines set out minimum standards on responsible financing practices to be integrated into banks' business models and risk management functions. Major Singaporean banks have also announced in April 2019 that they would cease financing new coal power projects, and will continue to pursue renewable projects. The Monetary Authority of Singapore (MAS) is now working closely with the industry to develop guidelines on environmental risk management for financial institutions across the banking, insurance and asset management sectors. Each sector's guidelines will include MAS' supervisory expectations on governance, risk analysis, and disclosure of environmental risk. MAS will also continue to encourage financial institutions to take reference from the recommendations of the Task-force on Climate-related Financial Disclosures (TCFD) in their climate-related disclosures.

The Singapore Exchange (SGX) issued sustainability reporting requirements in 2016 on a "comply or explain" basis for all listed companies. This disclosure requirement is the first step in providing investors with the necessary information to incorporate the companies' management of ESG issues into their investment decisions. MAS also launched a Green Bond Grant Scheme in June 2017 aimed at encouraging the issuance of such bonds by defraying the costs of obtaining an external review for green bonds.

Economic development does not have to equate to an increase in carbon emissions. Given our skilled labour force, conducive business environment and strong financial sector, Singapore is well-positioned to become a green growth leader that provides green solutions to the world. As the global demand for clean technologies is expected to increase, there is an opportunity for Singapore to develop and demonstrate new low-carbon technology and solutions for use domestically and globally. For instance, the potential transition to a hydrogen-based economy would provide opportunities to develop a technically skilled workforce with deep expertise across the energy and industrial sectors. We will continue to identify new green growth areas that create high-value jobs for Singaporeans and drive Singapore's economy.

<Questions>

- How can Singapore be a global leader in green growth?
- Which existing green growth sectors (e.g. clean energy, waste, water) have potential for greater growth? How can this potential be harnessed?
- What other green growth opportunities and industries should Singapore be looking at?
- Does your company consider the low-carbon economy aspiration as an opportunity or a challenge to your sector?
- What are some green technologies you would like to see being tested and developed in Singapore?
- How can the Government help to upskill workers to prepare them for a green economy?
- What are the key components required to build a green growth ecosystem in Singapore?
- How can the Government and private sector work together to develop this green growth ecosystem and grow the green economy?

Background Information

For further reading material, please refer below to the information and links of the following publications.

Singapore's Climate Action Plan

Singapore's Climate Action Plan: Take Action Today, for a Sustainable Future comprises two complementary publications on Singapore's mitigation and adaptation plans.

The first publication, "Take Action Today, for a Carbon-Efficient Singapore", contains information on how Singapore intends to reduce GHG emissions and increase energy efficiency to meet our 2030 climate pledge.

The second publication, "A Climate-Resilient Singapore, for a Sustainable Future", explains how Singapore may be affected by climate change and our strategy to prepare for them.

Find out more about Singapore's Climate Action Plan below:

- ["Take Action Today, for a Carbon-Efficient Singapore"](#)
- ["A Climate-Resilient Singapore, for a Sustainable Future"](#)