Responses to Feedback and Suggestions on Singapore's Long-Term Low Emissions Development Strategy

This Annex was prepared by the National Climate Change Secretariat (NCCS) together with the following agencies: the Ministry of Trade and Industry (MTI), the Economic Development Board (EDB), the Energy Market Authority (EMA), Enterprise Singapore (ESG), the Ministry of the Environment and Water Resources (MEWR), the National Environment Agency (NEA), PUB, Singapore's National Water Agency (PUB), the Singapore Food Agency (SFA), the Ministry of National Development (MND), the Building and Construction Authority (BCA), the Housing and Development Board (HDB), the National Parks Board (NParks), the Urban Redevelopment Authority (URA), the Ministry of Finance (MOF), the Monetary Authority of Singapore (MAS), the Ministry of Transport (MOT), the Land Transport Authority (LTA), the Maritime and Port Authority of Singapore (MPA), the Civil Aviation Authority of Singapore (CAAS), the National Research Foundation (NRF), the National Population and Talent Division (NPTD), the Health Promotion Board (HPB) and the Ministry of Education (MOE).

This document will be updated regularly as the Government continues to study the suggestions further and work with all stakeholders in developing implementation plans to realise Singapore's LEDS.

Contents

A: Energy Use Reduction and Efficiency Improvements

S/N	Feedback & Suggestions	Response
	Industry/Businesses – General	
1.	Factors that impact decisions on improvement projects: - Project economics - Cost of abatement - Larger business environment - Process safety - Personal safety - Product quality - Plant reliability	The Government acknowledges that a variety of factors need to be considered and carefully assessed, and that there are challenges to be overcome, before any efficiency improvement or energy reduction project can be implemented. This is to ensure that the project implemented does not have any negative impact on the company's ongoing operations. Considerations like personal safety, process safety and plant reliability need to be managed extremely carefully. The project proponent, as the owner of the plant facility, is best placed to carry out such an evaluation when considering whether and how best to implement the project. Improving energy efficiency (EE) and prioritising energy reduction will give companies a competitive edge in an increasingly carbon-constrained world. The Government is committed to helping companies overcome these barriers to increase EE in industrial facilities. For example, NEA's Energy Efficiency Fund (E2F)* and EDB's Resource Efficiency Grant for Energy (REG(E))^ (which replaced the Productivity Grant for Energy Efficiency) covers costs for manpower, equipment, technology, and professional services. To better support industrial facilities in being more energy efficient and improving competitiveness, the funding support under REG(E) and E2F was increased in 2018 from a cap of 30% to a cap of 50%. *https://www.e2singapore.gov.sg/programmes-and-grants/incentives/energy-efficiency-fund ^https://www.edb.gov.sg/en/how-we-help/incentives-and-schemes.html
2.	Barriers to implementing improvement projects: - Cost (high upfront capital cost, maintenance cost, opportunity cost) - Low returns-on-investment (ROI) - Man-hours required to implement project - Long payback period - Difficulties of upgrading existing sites (lack of space to do improvement works, extended shutdown requirements for existing facilities, complexities of integrating new infrastructure with old)	
3.	Process-specific efficiency improvements: - Precision control and intelligence - Reliability - Material efficiency - Overdesign - Fouling management, e.g. Modelling heat exchanger fouler rates can help to determine the cause of fouling and assist in planning	

	preventative actions for improved heat transfer and reduced fuel consumption	
4.	Mixed development clusters (industrial, commercial, residential and agriculture) to utilise waste heat.	Industrial processes produce significant amounts of heat, and often, the heat can be reused within the facility. Facilities are encouraged to implement heat recovery systems together with other process specific improvements. With the Government's commitment to help companies improve EE, companies are encouraged to approach NEA and EDB to develop and support these improvements. The E2F* and REG(E)^ administered by NEA and EDB respectively supports companies' investment in energy efficient technologies, and heat recovery systems is one of the categories of energy efficient equipment that can be supported. *https://www.e2singapore.gov.sg/programmes-and-grants/incentives/energy-efficiency-fund ^https://www.edb.gov.sg/en/how-we-help/incentives-and-schemes.html
	Industry/Businesses – Knowledge Sharing	
5.	Lack of awareness on how to quantify existing emissions, which results in a lack of understanding of how to implement emissions reduction measures.	Companies that are required to meet the Carbon Pricing Act (CPA) requirements may refer to the measurement and reporting guidelines for greenhouse gas (GHG) emissions* published by NEA. NEA's E2F and EDB's REG(E) grants also cover costs for professional services such as the costs incurred in engaging an energy service company (ESCO) to help with quantifying existing emissions and planning emissions reduction measures. *https://www.nea.gov.sg/our-services/climate-change-energy-efficiency/climate-change/carbon-tax/measurement-and-reporting-requirements-for-greenhouse-gas-emissions
6.	Make available information on energy saving options/equipment specifications to allow companies to review the potential benefits and ROI for implementing the energy-efficient practices, share industry best practices, and provide guidance and training on how to conduct EE assessments.	The National Energy Efficiency Conference (NEEC) and Energy Efficiency National Partnership (EENP) Awards – Industrial Energy Efficiency Sharing Session* are biennial events under the EENP Learning Network. These events present platforms for companies to share their EE practices and success stories, and hear from industry experts on energy management strategies. NEA also conducts one EENP Sharing Session annually where energy managers are invited to share insights on how they drive EE in their companies. In addition, NEA developed a Food Manufacturing Benchmarking Study Assessment Framework to guide companies in this sector to improve the EE of major energy consuming systems and equipment. Companies may also review study reports on industrial EE on NCCS's and NEA's websites, as well as reference manuals on the Institute of Engineers, Singapore website for additional information. NEA and the Singapore Institute of Technology (SIT) announced in October 2019 a collaboration to set up an Energy Efficiency Technology Centre (EETC) at SIT. The Centre will help companies, in particular SMEs, discover and implement EE improvement measures and build up local industrial EE

		capabilities. Participating SMEs will receive a diagnosis of their energy performance and recommendations on areas of improvement, while at the same time have their staff trained in energy assessment skills for continual improvement. The Centre is set to be launched in Q1 2020. *https://www.e2singapore.gov.sg/programmes-and-grants/training/eenp-awards---industrial-energy-efficiency-sharing-session/iee-sharing-session-2018
7.	Encourage strong partnerships between technology companies and universities to find EE solutions.	In April 2019, the EcoLabs Centre of Innovation for Energy was set up under the Nanyang Technological University (NTU) to work with corporate partners and investors to provide member companies with up to 30 public and private sector test-bedding sites, ranging from high-tech lab facilities to specialised test centres, to pilot projects in a controlled environment. EcoLabs is a collaboration between NTU, ESG and the Sustainable Energy Association of Singapore. NTU professors from various faculties such as material sciences and electrical engineering will also provide mentorship for member companies. The Singapore Energy Centre*, a collaboration between NTU, the National University of Singapore (NUS), and founding members such as ExxonMobil, seeks to create a framework for long-term research partnership that innovates the use of energy and develops the next generation of technologies. Both universities will work with leading corporate members, individually or collectively, on jointly sponsored research projects, with a focus on generating sustainable energy solutions with significant long-term impact on the quality of life. *http://www.sgec.sg/aboutus/Pages/default.aspx
Industry/Businesses – Policy Initiatives		
8.	Simplify the grant process, for example through differentiating criteria for industry assistance project selection and post-project verification for EE and emissions reductions performance.	We agree that the grant process should be a simple and streamlined process. We will continue to find ways to improve the grant process.
9.	Provide higher support rates for industry players who have already implemented significant EE improvements.	The Government will engage in discussions with high performing industry players who request a higher quantum of support to achieve significant carbon abatement.
10.	As part of the grant process, allow companies to self-audit for smaller projects, and increase the number of licensed third party auditors to increase competition and help bring down the cost of third party audits.	Independent third party financial audits are necessary to certify that grant disbursement claims are true and accurate. Nonetheless, the Government will look into ways to increase the number of third party financial audit providers and allow market competition to keep the costs of such audits down.

11.	Grants and incentives are the most effective means of facilitating greater EE improvement; market-based financing may not be suitable as third party financiers require sufficient return on investment to finance a project. Also, ESCOs generally would not support small loans.	Market-based EE financing is a more fiscally sustainable mechanism to facilitate greater improvement, and allows companies to enjoy part of the energy savings without an upfront cost. We will continue to work with industry players to increase the viability of market-based financing. Sustainable Development Capital (Asia) Limited is currently administering the Energy Efficiency Financing Programme*. *https://www.e2singapore.gov.sg/programmes-and-grants/incentives/financing-programme-for-energy-efficiency-projects
12.	Market-based financiers can be attractive investment partners if they: a. are prepared to invest even if IRR is low; b. are prepared to, alongside with the company, take some market risk; c. provide expertise in feasibility studies and share the study cost. A government or government-linked organisation is well suited to take up this role.	
13.	Market-based financing to implement EE projects to be made profitable; low interest loans for high efficiency devices.	
14.	Incentives are not sustainable in the long-term. The Government should intervene in a top-down approach, e.g. enforcing standards, education to change mind-sets.	To phase out the least efficient common industrial equipment and systems, Minimum Energy Performance Standards (MEPS) for motors was introduced in October 2018. More recently, in December 2019, Minimum Energy Efficiency Standards (MEES) was introduced for water-cooled chilled water systems in industrial facilities and will take effect from December 2020 onwards. The biennial NEEC and EENP Awards are existing platforms that create awareness and encourage industrial companies to improve their EE. The EENP Sharing Session is also conducted annually where energy managers and industry experts are invited to share insights on how they drive EE in their companies. NEA also works with training providers such as Sustainable Energy Association of Singapore (SEAS) and the Institution of Engineers, Singapore (IES) Academy to source for and conduct relevant technical courses for the industries to build capability in EE improvement.
15.	Existing grants incentivise EE improvements and abatement measured in absolute reduction of carbon dioxide emissions. The Government could incentivise improvement measured in emissions intensity (absolute CO_2 emissions per unit of production).	Abatement achieved is measured in terms of absolute reduction in CO_2 equivalent emissions to ensure that there is a fair standard of measurement across all companies that apply for the grants. Abatement achieved is used to determine the funding support ratio, which is in $/tonne of CO_2 equivalent emissions.

16.	Expand existing grants to help fund fuel substitution projects in addition to EE projects, to achieve additional carbon abatement.	The Government will explore how we can support emissions reduction projects beyond those concerning EE.
17.	MEPS would allow companies to benchmark their energy consumption against overall industry standards leading to improved EE.	NEA analyses energy data collected from Energy Conservation Act (ECA) companies and benchmarks the energy performance of companies with those in similar sub-sectors. The information is shared during NEA's annual site visits to the respective companies. This spurs laggards to do more in EE.
	The benefit of setting MEPS should be weighed against other considerations like safety and reliability of operations.	
	MEPS would be detrimental to competitiveness and increase costs; companies should be left to independently assess what equipment is most efficient for its operations.	
	Difficult to set MEPS for certain types of equipment that have different operating ranges depending on the process/operation in question.	
	Industry/Businesses – Energy Management	
18.	Independent third party analysis of future energy cost in Singapore could aid companies in making better energy management decisions; actual energy cost information would be extremely useful but could be commercially sensitive.	There are a variety of independent studies and reports by reputable institutes and companies available online, free of charge or for a fee, that provide in-depth analysis of the future energy landscape in the region (Southeast Asia/Asia) and the world, including projected energy costs, energy capacities and investments.
19.	How successful has the ECA 2013 (and its amendment in 2017) been in improving industrial EE? Can the public have access to aggregated information on the improvements?	Overall, Singapore-based companies' annual EE improvement rates have been increasing (0.4% in 2014, 0.6% in 2015, 0.8% in 2016, and 1.4% in 2017). This is due to a comprehensive suite of measures and regulations put in place. The ECA focuses on introducing mandatory energy management practices and minimum EE standards for common industrial equipment and systems, and stipulating the measurement and reporting requirements for GHG emissions. This is part of the comprehensive suite of regulations and policies we have put in place to help the industry sector improve its EE. To achieve our 2030 emissions pledge, we will continue to work towards our aim of achieving annual improvement rates of 1-2% for industrial EE. We will continue to provide updates on our annual EE improvement rates.
20.	Release the quantum of grants out of the various incentive schemes that has been disbursed since the ECA came into effect, aggregated information on ECA's success in improving industrial EE.	

21.	What are the challenges foreseen in carrying out periodic Energy Efficiency Opportunities Assessments (EEOAs)? There are currently only 9 EEO assessors. Is this sufficient to carry out EEOAs in the future? What is needed to ensure a steady pipeline of qualified ESCO professionals to do this?	One of the key challenges foreseen was the lack of local capability to conduct EEOAs. In October 2018, the Energy Efficiency Opportunities Assessor certification scheme, which was jointly developed by NEA and the IES, was launched. This aims to ensure that there is a steady pipeline of engineers specialising in industrial EE to support companies in improving the energy performance of their energy intensive industrial facilities. As of 10 January 2020, there were 32 registered EEO assessors (17 in-house and 15 independent) listed on the IES website*. We expect this number to further increase as existing Qualified Energy Services Specialists (QuESS) convert to independent EEO assessors by 30 June 2020. This will ensure a sufficient supply of independent EEO assessors for ECA companies to tap on to conduct their first EEOAs by 31 December 2021 and to conduct subsequent EEOAs in future. We also aim to build up and sustain a local pool of energy assessment capabilities through the NEA-SIT Energy Efficiency Technology Centre that was announced in October 2019. *http://eeoa.sg/certified-eeo-assessors
22.	The PUB's Water Efficiency Fund was an effective subsidy for the installation of metering solutions for firms with high monthly water consumption. EMA should fund energy metering solutions as well.	Accurate monitoring of energy consumption is key to helping companies identify opportunities for energy reduction and efficiency improvement. In October 2019, NEA launched a new grant under the E2F* to encourage companies to implement energy management information systems (EMIS). EMIS can help companies more accurately monitor and analyse their energy usage using real-time data, to identify performance gaps in a timely manner as well as opportunities for continual performance improvement. *https://www.e2singapore.gov.sg/programmes-and-grants/incentives/energy-efficiency-fund
23.	Mass adoption of energy conservation using technology- and artificial intelligence-driven solutions.	
Power		
24.	Install smart energy monitoring systems in power plants to visualise and analyse energy performance in real time, detect anomalies and deploy instructions for action to be taken to improve energy usage. Government should provide grants to purchase and install such tools even though they are not carbon abatement projects.	Power Plants have installed sensors to monitor operations and these sensors are connected to the Power System Operator. Power generation companies that are considering projects to improve EE could tap on the Energy Efficiency Grant Call that EMA had launched in 2018.
25.	Heat generated from existing power generation units (combined cycle power plants,	Companies are encouraged to implement technologies that can improve the efficiency of utilities generation. For example, pharmaceutical companies such as Pfizer and MSD have installed

	cogeneration plants, Organic Ranking Cycle systems) can be used in adsorption chillers to provide cooling.	trigeneration systems, producing power, steam and chilled water. Trigeneration and cogeneration projects are also eligible for consideration of grant support from EDB.
26.	Potential for efficiency improvements on the supply side are relatively limited, as most of Singapore's electricity is produced using highly efficient combined-cycle gas turbines. EE should be improved on the demand side instead.	The Government implements a comprehensive suite of EE measures across both the power sector and the end-use sectors. EMA launched the Energy Efficiency Grant Call to encourage power generation companies to invest in energy efficient equipment or technologies that can improve the overall generation efficiency of their existing generation plants and reduce their carbon emissions. Agencies are also working together to improve the efficiency of energy usage across various sectors (e.g. industry, households and commercial buildings) to reduce Singapore's overall energy demand and carbon emissions.
Buildings		
27.	Barriers to adopting energy efficient equipment/practices: - tenant not incentivised to reduce energy cost - lack of proven track record for new technologies - lack of technical knowledge - energy costs are relatively insignificant compared to other costs	There is now a shift in awareness and mind-set as green buildings are now regarded as a form of value creation. An independent consultancy study had validated that Green Mark buildings reap nett positive savings throughout their lifecycle, with the energy savings far outweighing the upfront investment cost. The lifecycle cost savings are commensurate with the Green Mark rating. For instance, a Green Mark Platinum non-residential building can attain a lifecycle Net Present Value, or NPV savings of about $225 per sq metre of gross floor area, about 2 times the NPV savings of a Green Mark Gold Plus building and 4 to 5 times the NPV savings of a Green Mark Gold Building. This provides a strong business case for developers and operators to achieve the highest Green Mark rating available.
28.	Split incentives between landlords and tenants to encourage both to adopt energy efficient practices and projects.	
29.	Push older buildings to go green and all new buildings to achieve Green Mark status. Prioritise rollout of aggressive building efficiency-upgrade programmes for residential, office and retail. Tax exemptions for projects that are able to obtain Green Mark Gold Plus certification.	Currently, the Government has greened over 40% of Singapore's total gross floor area in buildings, and is aiming to reach the target of 80% by 2030. All new projects and major retrofitting projects are required by law to meet environmental sustainability standards that are equivalent to the minimum Green Mark certification level. To encourage more owners of existing buildings to green their buildings, BCA provides financing arrangements where building owners can obtain financing from participating financial institutions

		and pay off the loan through the energy savings reaped. The Government will continue to monitor progress and explore additional measures as needed.
30.	Design urban planning and green building policies to impact the overall design of buildings to enable reduced energy demand (e.g. better thermal resilience specifications).	One key feature of the BCA Green Mark Scheme* is that it encourages designers to adopt passive strategies to reduce heat gain into building designs and to improve natural ventilation. For example, simulation modelling is used to identify the optimal building design and layout to achieve effective natural ventilation. Ceiling fans are also highly encouraged, to assist with ventilation where required. This improves overall thermal comfort and minimises the need for air-conditioning. In our tropical climate, effective design for natural ventilation is recognised as one of the best strategies to enhance thermal comfort without resorting to air-conditioning. The built environment industry is responding well – more and more project teams are adopting natural ventilation as part of their design strategies. Buildings designed in such a manner with the appropriate site orientation, layout and effective facade design will do well in the BCA Green Mark certification. *www.bca.gov.sg/GreenMark/green_mark_criteria.html
31.	Raise the standard for building efficiency within the Green Mark Scheme to reflect higher standards (e.g. Zero Energy Building standards): - Higher indoor temperature set points 26-28°C - State of the art insulation, using 2 layers and air gap (U-values in W/m^2 *K - 0.15 walls, 0.45 for windows) - Windows to be designed with smaller area incorporating use of shading - More compact floor densities to minimize total footprint	An outcome-based EE approach is adopted under the BCA Green Mark Scheme in encouraging good passive design and EE by benchmarking the overall EE improvements against the 2005 baseline for the whole building as well as key building systems. Other than key items that reduce the environmental footprint of buildings, BCA also recognises the green building products and materials that are certified by the Singapore Green Building Council (SGBC) and Singapore Environment Council (SEC). In the next lap of Singapore's green building movement, BCA together with industry professionals are working towards realising cost-effective Super Low Energy (SLE) buildings in the tropics. BCA also launched the SLEB Smart Hub in September 2019. This is Singapore's first digital knowledge centre for green buildings in the region. It is an open database that collates and analyses green building technologies such as air-conditioning, lighting, facade and renewable energy. Beyond being a data repository, its Smart Advisor recommends suitable green technologies and predicts the associated costs and energy savings, using cutting-edge big data analytics and artificial intelligence techniques based on a building's current data set and user's requirements. It allows building owners and designers to evaluate and source green technologies to transform buildings to attain high energy performance.
32.	Improved insulation or shading of buildings with plants to reduce air-conditioning energy use.	
33.	Minimise building external surface area to internal volume ratio by limiting the number of floors with larger built-up portion of parcel.	
34.	Use less glass in buildings to minimise greenhouse effect.	

35.	Mandate that all windows be airtight.	
36.	Use heat reflective paint for buildings; adopt more reflective surfaces.	
37.	Different type of doors (e.g. turnstile) can help reduce heat loss and improve EE in malls and business buildings.	
38.	Green Mark to include more products besides air-conditioning units and fridges.	
39.	Motion sensor lights for offices.	
40.	Amend Singapore's building codes to mandate the use of sustainably sourced concrete and the use of solar panels.	Currently, Singapore's building codes does not mandate the use of sustainably sourced concrete. There are many considerations in Singapore's building codes, including safety requirements, building needs, etc. Therefore, rather than mandating sources of building materials, BCA's Sustainable Construction Manual encourages construction companies to select recyclable and reusable construction materials where non-structural concrete needs to be used. This is also encouraged under the BCA Green Mark Scheme. Going forward, BCA will also encourage the industry to design from a building lifecycle perspective to minimise the environment impact and reduce the carbon footprint of their activities. With regard to renewable energy in buildings, the most promising option is solar photovoltaic (PV) systems on rooftops. There is already a good take-up of such solar PVs today because the costs have come down. The BCA Green Mark Scheme also encourages this by recognising projects that have solar panels on their roofs, or have conducted a solar feasibility study. However, there are physical constraints for some buildings that limit the adoption of solar energy. The Government will continue to explore how to increase the deployment of solar and other renewable energy options in our buildings.
41.	Current grants available are too stringent. For example, the BCA Green Building Innovation Cluster (GBIC) grant applies only if the new and emerging technologies are able to demonstrate a 20% energy reduction from best-in-class level.	The aim of BCA's Innovative Challenge Call is to co-innovate Smart Building Technologies towards Advancing Net Zero in the Tropics, i.e. achieving positive energy, zero energy and SLE buildings in our tropical and urban context. This is an ambitious effort that requires significant energy improvements above the current available technologies in the market. Thus, the minimum requirement of 20% energy savings over best-in-class technologies is consistent and aligned with the ambitious aim of the GBIC Innovation Challenge Call.
42.	Net-positive energy buildings.	
43.	Use sustainable or organic building material like bamboo, attap, ashcrete, hempcrete for structural	The use of building materials needs to comply with Building Control Regulations 2003 and SCDF provisions, such as fire resistance rating and limit to spread of flame. When selecting building

	features like railings, shelters, benches, broad walk.	material, there are various considerations to take into account: quality, safety, durability, structural integrity, strength-to-weight ratio, supply, and cost, amongst others. To help developers incorporate sustainability in their projects, BCA has published numerous Sustainable Construction Series such as "Sustainable Construction – Materials for Buildings" and "A Guide on the Use of Recycled Materials".
44.	Mandate smart energy management systems to allow tenants to manage their energy usage.	To encourage EE amongst tenants, BCA has channelled more efforts to reach out to tenants through building owners with initiatives like the Green Lease Toolkit and the Green Mark Pearl Award. The Green Lease toolkit helps landlords and tenants to work together to improve the environmental performance of the building they manage or occupy over its lifecycle. The Green Mark Pearl Award recognises the strong commitment of building owners/landlords and tenants/occupants of the same project/building working in tandem to achieve greater environmental sustainability for their project/building.
45.	Shopping malls to enforce earth hour, one hour of reduced electricity use at a suitable time.	As shopping malls are commercially owned, such decisions would have to be undertaken by the board of management in question. Many malls already participate in Earth Hour by turning off non-essential lights. Green initiatives and green education can also be recognised and obtain points under the Green Mark scheme.
46.	Increase the temperature of air-conditioning in buildings and data centres; 25°C temperature should be made the benchmark for all buildings; e.g. Japan has decreed that all government agencies set their air-conditioners to minimum 28°C in the summer; air-conditioning in malls to be tailored to flow of human traffic throughout the day.	Guidelines on indoor temperatures were incorporated into Singapore Standard SS553: 2016, Code of Practice for air-conditioning and mechanical ventilation in buildings. Specifically, section 7.1.3 of the SS553:2016 states that the normal design dry bulb temperature for comfort air-conditioning can vary from 23°C to 25°C, with lower temperature applicable to zones with solar load and higher value in all other zones. Credits are awarded under the Green Mark Scheme to encourage higher indoor temperature set points. BCA and NEA are open to suggestions on ways to better encourage building owners and tenants to keep air-conditioning settings within the suggested range. BCA Green Mark for Non-Residential Buildings: 2015 requires the design dry-bulb temperature for comfort air-con spaces to be within 23-25°C. This is in line with the recommended thermal comfort range specified in Singapore Standards. As part of the Public Sector Takes the Lead in Environmental Sustainability (PSTLES) initiative, all air-conditioned public sector premises are to maintain ambient indoor air temperatures at 24°C or higher, as far as comfort level allows.
47.	HDB to adopt such technologies and require disclosure from private developers, nationwide implementation of green and cool roofs (proven to reduce heat gain by 13-15%).	HDB has implemented the Prefabricated Extensive Green (PEG) Roof Tray System on rooftops. Rooftop space has several competing uses, one of which includes the deployment of solar panels. As of December 2019, under the SolarNova programme, HDB has installed solar PV systems at about 2,200 HDB blocks and is installing solar PV systems in another 2,300 HDB blocks. Thus,

		consideration of expanding such green roofs across more rooftops in Singapore would have to optimise across various uses. URA encourages green roofs though landscape replacement requirements, which stipulate how much greenery developments need to provide in relation to the development plot size.
48.	Research and train Operations, Monitoring and Maintenance (OM&M) personnel about how to run a building in the most energy efficient way.	Well-maintained buildings translate to lower lifetime costs of the building and a quality living built environment for the users. For green buildings to have a tangible long-term impact, there is a need to ensure existing green buildings perform optimally through sound facilities management (FM) practices. As part of Real Estate Industry Transformation Map, BCA is working with the trade association & chamber (TAC), building owners and service providers to develop the FM industry by changing the current landscape from an extensively labour-driven industry to a productive one leveraging data analytics, predictive maintenance and smart solutions.
49.	Mandate the engagement of ESCOs in the design of public and private housing projects.	Currently, public sector agencies are encouraged to adopt the Guaranteed Energy Savings Performance (GESP) contracting model when undertaking building retrofit projects. Under the GESP model, an ESCO will carry out an Investment Grade energy audit, implement the energy conservation measures, and guarantee chilled water plant or air-conditioning efficiency and annual energy savings. As of March 2017, 28 large public sector building owners have called GESP contracts for their building retrofit projects.
Households		
50.	Air-conditioners and refrigerators consume the most energy. Set minimum energy performance standards and provide grants to encourage adoption.	NEA has raised the EE of air-conditioners and refrigerators in the market through the Mandatory Energy Labelling Scheme (MELS) and MEPS. MELS helps consumers compare the EE of appliances to make more informed purchasing decisions, and MEPS raises the average EE of these appliances by removing inefficient ones from being sold in the market. Consumers are now switching to more energy efficient air-conditioners and refrigerators. Based on a 2018 sales survey by NEA, about 54% of refrigerators sold were rated 3-tick, and about 45% of air-conditioners sold were rated 4-tick or 5-tick. Since the introduction of MELS and MEPS, the average EE for air-conditioners and refrigerators have improved by about 42% and 46% respectively, and achieved about $270 million in total energy savings for all households in 2018. For new private residential developments, BCA's Green Mark Scheme encourages installation of energy efficient air-conditioning systems, with credits awarded for efficient air-conditioning based on NEA's Energy Labelling Scheme.

51.	Cost of appliances are a key deciding factor – upfront costs weigh more than operational (energy) costs.	Households are encouraged to consider lifecycle costs of appliances; this is a more comprehensive tabulation of actual appliance cost, and a fairer way to compare appliances. To allow households to make more informed decisions, the Energy Label was revised in 2014 to include annual energy costs of operating the appliance. MELS was enhanced on 1 November 2019 for a wider range of lamp types, and to have mandatory display of energy labels in publicity materials for appliances. By comparing the annual energy costs of different models, consumers can determine the annual cost savings of buying a more energy efficient model. On the Energy Efficient Singapore website*, NEA provides estimates on how much households can save annually by switching to more efficient appliances. The annual energy cost also allows consumers to consider the lifecycle ownership cost of their purchases. Households can also use the Life Cycle Cost (LCC) Calculator available online at the Energy Efficient Singapore website and within NEA's myENV mobile application to calculate and compare the life cycle ownership costs of different models of air-conditioners, refrigerators, clothes dryers and televisions. *https://www.e2singapore.gov.sg/overview/households/households
52.	Provide clear information on energy savings arising from the use of energy efficient appliances. Life-cycle approach for electrical appliances to take into account energy savings accumulated over the lifetime of the appliance.	
53.	Phase out inefficient appliances quickly from the market, possibly through enhancing MEPS and MELS.	MELS and MEPS are updated on a regular basis to increase the minimum level efficiency that appliances in the market are required to meet and expand the range of appliances covered. For example, the latest enhancements of MELS and MEPS introduced in November 2019 included introducing MELS for other lamp types, and raising the MEPS for incandescent bulbs. NEA aims for all light bulbs to be as energy efficient as LED bulbs from 2023 onwards. NEA will look at the feasibility of extending MEPS to other appliances and also progressively raise MEPS for these appliances to best-in-class levels.
54.	Reduce wastage (e.g. turn off air-conditioner when not in use).	To increase public awareness on energy efficient measures, NEA has rolled out the "Save Energy Save Money" initiative. It encourages households to reduce their energy use by practising simple energy-saving habits. For example, using a fan instead of air-conditioning, or switching off appliances at the power socket instead of leaving the standby power on. Consumers purchasing energy-intensive appliances such as air-conditioners and refrigerators are encouraged to use the Energy Labels to help them select more energy efficient models by choosing those with more ticks on the Energy Label. More information on energy saving at home, and additional resources and tools can be found at https://www.e2singapore.gov.sg/overview/households.
55.	Provide education programs on household energy saving and on MEPS and MELS.	
56.	Energy labelling should be made more layman to aid in understanding, particularly for the older generation.	

57.	"Utilities Saving Tips" to educate households with higher consumption levels relative to the neighbourhood, campaign on efficient appliances.	NEA provides more than 40 tips to save energy for households. These are featured on the Energy Efficient Singapore website* as well as in the Home Energy Auditor module in the myENV app. *https://www.e2singapore.gov.sg/overview/households
58.	Encourage households to switch to efficient appliances such as induction cooktops and heat pump water heaters rather than electric or natural gas/town gas fired appliances.	Heat pump water heaters and induction cooktops are more energy efficient choices for households. The choice to switch to more efficient appliances is a personal one; for example, households may choose to purchase instant water heaters instead of heat pump water heaters due to the higher costs of the latter. The Government will continue to encourage households to use more energy efficient appliances, where possible.
59.	Implement master switches so that all lights and appliances not needed can be switched off and not left on standby.	Master switches may be a convenient way to turn off all the lights in the house. Currently, the Distribution Board (DB) box has master switches for all power sockets in a house, although it is not fitted to specific appliances. Alternatively, switching off appliances at the power socket instead of leaving the standby power on is one of the several energy-saving tips on the Energy Efficient Singapore website* on reducing home electricity use. *https://www.e2singapore.gov.sg/overview/households
60.	Energy saving appliances such as LED and compact fluorescent light bulbs do not work well with dimmer switches – only incandescent bulbs do.	While LED may have a smaller dimming range compared to incandescent bulbs at the moment, as technology advances, a wider variety of LEDs and other light bulbs may become available.
61.	Smart meters to measure consumption. Organise competitions among households based on smart meter consumption results. Mobile application linked to smart controllers or indicators at home to help consumers and small businesses save energy.	As part of grid infrastructure upgrades, end-of-life analogue electricity meters are currently being replaced with advanced electricity meters. Advanced electricity meters are also being installed in newly built HDB flats. These meters will allow households to track their half-hourly electricity consumption on the enhanced SP Utilities app by SP Group. SP Group also launched the GreenUP initiative in November 2019 for households to earn virtual points that can be used to redeem shopping vouchers when they adopt sustainable habits.
62.	Seed funding/tax rebates for firms developing new technologies that could improve EE of household electric appliances.	ESG focuses on supporting enterprise growth through productivity, innovation and internationalisation. For incentives and financial assistance, ESG offers various types of tools, such as grants, seeds equity and tax incentives: a. For grants, the Enterprise Development Grant (EDG) scheme assists companies in product development, including energy efficient products. b. For seed funding (equity), the Startup SG Equity scheme catalyses investments into high-growth technology startups through public-private co-investments. Such investments are aligned to the

		Research, Innovation and Enterprise (RIE) focused domains such as urban solutions & sustainability, and include technologies that improve EE. For tax, the Investment Allowance (IA) also encourages business to undertake higher value added activities such as the development of new energy efficient electric appliances through investment in new productive equipment.
63.	Subsidise energy efficient appliances to encourage less energy consumption, vouchers to redeem energy efficient products, buy-back or trade-in schemes for old appliances; use a tiered GST system with a lower GST on more efficient appliances.	An example of a buy-back trade-in scheme is the voluntary lamp recycling initiative introduced by South West Community Development Council, which allows households to exchange used lamps for discount vouchers to buy energy-efficient bulbs. 5% of the proceeds from sales of energy-efficient bulbs will go to providing lower-income residents with the same bulbs for free to help save energy costs.
64.	Discourage the use/installation of dryers and washing machine ownership by increasing number of laundromats.	Households may prefer to own their own dryers and washing machines for convenience. Nonetheless, if households prefer to use laundromats, there are a wide variety and number of commercial laundromats available island-wide. An even better energy-saving alternative is to dry laundry in the sun, which does not consume electrical energy at all.
65.	Improve architectural design of housing to allow natural ventilation to reduce air-conditioning and dryer use.	HDB's approach towards passive design has been to maximise building facades towards a North-South orientation, and HDB buildings are designed to be naturally cross ventilated, with good airflow for human comfort. For example in Punggol Eco-Town, Computational Fluid Dynamics wind flow modelling at town and precinct levels was carried out to help optimise orientation and layouts of buildings and enhance thermal comfort.
66.	Restructure HDB housing with centralised air-conditioning like commercial buildings, centralised hot and chilled water supply; harness the heat generated by centralised air-conditioning to heat the water.	In 2018, HDB and SP Group embarked on a joint study on the possibility of the new Tengah town having a centralised cooling system. This led to the implementation of the first centralised cooling system for public housing. Centralised cooling infrastructure will be provided in selected public housing districts in Tengah. Future home-owners can subscribe to have air-conditioning provided from a centralised cooling system. Most HDB homes use electric instantaneous water heaters to heat their water supply, as this remains the most cost-effective option. We continue to encourage households with sufficient space and budget to consider electric heat pump water heaters, which is more energy efficient.
67.	Energy bills should be changed from linear scale to a non-linear scale, with increased per unit costs with higher consumption; energy consumption targets to be set; provide tax	Singapore does not have a tiered electricity rate as the Government does not subsidise the cost of electricity, or make certain groups of consumers cross-subsidise other groups of consumers. Having such a tiered system means the Government decides for households what should be the basic level of electricity consumption, and how much subsidies should be provided. This would lead to inefficient use of resources.

	relief/subsidise utility bills to encourage less energy consumption.	While goods and services, including electricity, are priced to reflect its full cost, targeted help is provided to lower-income households directly, for example, through U-Save rebates and Growth Dividends. This way, every dollar of Government assistance goes to households which genuinely need the help, and these households can then decide for themselves how to spend it on their most urgent needs. This approach does not distort market signals and helps to keep our economy efficient and dynamic. It also encourages all households to save on electricity consumption when prices go up.
68.	Develop consumer-friendly metrics enabling property purchasers to compare eco-friendliness of various properties.	Property purchasers can compare how sustainable various residential buildings are using the Green Mark Buildings Directory*. The directory provides options to search based on specific green features, which include daylighting, extensive greenery, use of energy-efficient features and renewable energy. *https://www.bca.gov.sg/green_mark/
	Others	
69.	District-level efficiency improvement should be considered to tap on economies of scale.	For projects that lend themselves well to district-level implementation, the BCA Green Mark Scheme for Districts promotes and recognises environmentally-friendly and sustainable practices in the master planning, design and implementation of district developments. EE is one of the requirements under this scheme. District-level efficiency improvement is certainly one way to reduce overall costs. At the same time, such improvements require all stakeholders within the same district to buy in on the improvement project. Additionally, not all projects would necessarily allow for district-level efficiency improvement – at times, company-level specific equipment and infrastructure are not compatible with such projects.
70.	Add district cooling as a criteria for BCA Green Mark Scheme; allow GFA freed up by district cooling to be used for multiple purposes.	District Cooling Systems (DCS) are already part of the BCA Green Mark scheme and Minimum Environmental Sustainability Standards where they would need to comply with a minimum system efficiency standard.
71.	Based on NEA's Code of Practice for Control of *Legionella* Bacteria in Cooling Towers, cooling tower shall be located at least 5 m away from air circulating, ventilating inlets, open windows. Propose to amend regulations to allow for a vertical distance to be considered as well (a	The Government has issued a circular* detailing the 5 m radius (including vertical and horizontal distance), from the nearest edge or structure of the cooling towers, including the base/basin/sump, packing, exhaust and outlet point of exhaust hood, as illustrated in Figure 1 in the circular. This circular is in the Corenet to guide Qualified Persons (QPs) for their cooling tower plan submissions.

	study suggests that safety standards will not be compromised).	The Code of Practice for Control of *Legionella* Bacteria in Cooling Towers will be updated accordingly during the next revision. *https://www.nea.gov.sg/docs/default-source/our-services/circular_sp_ct_jan2016.pdf
72.	District/Desiccant-based cooling: a. Benefits: more energy efficient than older or some individual units, centralised management. b. Can be implemented through progressively connecting densely populated areas and areas under development. c. Challenges: risk of system failure and business disruption, difficult to retrofit existing sites, current incentive system for gross floor area does not incentivise moving towards district cooling.	In May 2006, One Raffles Quay was the first development to receive chilled water supplies from Singapore's first district cooling plant. In May 2010, Singapore District Cooling commissioned its second district cooling plant at Marina Bay Sands and increased its total cooling capacity to 60,000 Refrigeration Tons (RT)*. The Punggol Digital District will also have a district cooling system when it is ready in 2023. For households, HDB and SP Group embarked on a joint study in 2018 that led to future residents of the new Tengah town having the option of accessing a centralised cooling system for their flats, as a more energy-efficient solution than conventional air-conditioning systems. *https://www.spgroup.com.sg/what-we-do/cooling-and-heating
73.	Adopt system level cooling at viable greenfield and brownfield sites to ensure long-term EE. Cooling technologies include integrated cooling solutions for a data centre, mechanical cooling and immersion cooling, passive cooling, recycling low intensity heat.	
74.	Better refrigerant management, e.g. proper disposal and recycling of refrigerants. Singapore needs a stringent refrigerant management policy to accurately account for and ensure safe handling, storage and recycling of refrigerants to minimize the potential for negative environmental impact.	The Government is currently studying ways to improve the management of refrigerants from the refrigeration and air-conditioning sector, including the proper disposal of refrigerants.
75.	Government adoption of cloud services, utilisation of cloud-based smart systems for buildings and urban infrastructure can accelerate efficiency improvements and energy reduction. The government can encourage these gains	The Government has begun to move its IT systems to a commercial cloud system, and will continue to do so over the next few years. While the cloud system is more efficient, there are significant considerations of security and data protection to consider.

	through policies and regulations that encourage migration to the cloud.	
76.	Promote and upgrade wet markets as their carbon footprint is lower than those of supermarkets.	MEWR, NEA and the respective Town Councils will continue to promote and upgrade wet markets as they are a key part of Singapore's hawker culture. In doing so, we will take into account the changing preferences of consumers and adapt our wet markets accordingly.
77.	The warehousing industry to adopt the following technologies - Energy-saving lighting - Motion sensors for lighting - New heating/cooling technologies - Modernisation of heating controls - Innovative power generation - Electric-powered equipment	Companies should continue to adopt energy-efficient and energy-saving practices. The Government will continue to work with all parties to improve EE and reduce energy consumption.
78.	Reduce use of Liquified Petroleum Gas (LPG) and switch to Town Gas to significantly reduce emissions.	LPG and Town Gas both have similar emission factors (17.2 and 15.2 respectively). This means that the amount of carbon emitted for every unit of fuel burnt is relatively similar. Furthermore, older buildings may not have the necessary piping infrastructure required to use town gas; it would require significant upgrading works to retrofit a building with the required infrastructure.

B: Decarbonising the Transport Sector

	Public Transport	
1.	A "car-lite" Singapore should still be promoted through encouraging the use of public transport and pedestrian transport. Public transport remains the most carbon-efficient means of transport, since electric vehicles are also powered by electricity from the grid (powered using majority fossil fuels). Increasing pedestrian walkways can help to increase the public transport share, Personal Mobility Devices (PMDs) and bicycles to be encouraged.	As laid out in the Land Transport Master Plan (LTMP) 2040, we aim to enable Singaporeans to enjoy 20-minute towns and a 45-minute city on public, active and shared modes of transport. Our land transport improvements should enable all journeys to the nearest neighbourhood centre to be completed in less than 20 minutes, and 9 in 10 of all peak-period journeys to be completed in less than 45 minutes. We have introduced easy, convenient and safe options to Walk, Cycle and Ride to create a car-lite society in Singapore. For shorter journeys, walking or cycling is encouraged as active modes of travel. Wider footpaths, dedicated cycling paths, and an additional 150 km of linkways will be built by 2040. For longer journeys, mass public transport like buses and trains are encouraged as preferred modes of transport, as well as shared transport like taxis and car-sharing. To increase the use of public transport, we will increase the rail network, extend the bus network and service levels. Public buses and taxis will run on cleaner energy by 2040. We will continue to prioritise public, active and shared modes of transport, and build a seamlessly integrated shared transport network.
2.	Besides public transportation, Singapore's highly urbanised landscape is very suitable for short-medium ranged two-wheeler vehicles for people's daily commute.	
3.	Increase public messaging to encourage people to use cleaner transport options.	
4.	Enhance existing plans for a "car-lite" society to a "post-car" society.	
5.	Invest in a High Speed Train to reduce the use of short distance flights.	A high speed train, while potentially emitting less emissions compared to an airplane for the same distance, would be subject to bilateral or even regional agreement (if the train passes through multiple countries). Notable progress has been made on the ASEAN Highway Network which aims to establish efficient, integrated, safe, and environmentally sustainable regional land transport corridors linking all ASEAN Member States and neighbouring countries. The implementation of the Singapore-Kunming Rail Link (SKRL) sections from Singapore to Phnom Penh is on schedule. However, the SKRL sections from Cambodia to Viet Nam as well as those in Lao PDR are still seeking funding for implementation.

		We will continue to support efforts to improve regional land connectivity, which will provide a good alternative to short distance flights.
6.	Replace buses with trams or rail transport.	Singapore is committed to having a cleaner energy public bus fleet by 2040. We rolled out 50 diesel-hybrid buses in December 2018 and plan to introduce 60 new fully electric buses progressively in 2020. We will complement our public bus network with an expansive rail network. As mentioned in our LTMP 2040, the completion of the Thomson-East Coast Line, Jurong Region Line and Cross Island Line, extensions to the North East Line and Downtown Line, and the closing of the Circle Line Loop in this decade will create a rail network that spans 360km by 2030. By then, 80% of households will be within a 10-minute walk from a train station.
7.	Make public transport more appealing through more consistent bus times, campaigns for more considerate commuters.	Commuters may wish to use the MyTransport.SG application or other third party applications using bus arrival time data from LTA's data sharing platform, DataMall. The LTA system takes location data provided by global positioning devices mounted inside 4,700 buses, which is transmitted wirelessly to the system, and predicts bus arrival times based on the real-time bus location data, bus route information, bus schedules and historical travel times. As part of efforts to encourage commuters to be more thoughtful to fellow passengers, LTA has rolled out a series of initiatives under this year's Graciousness campaign, which aims to foster a culture of graciousness on public transport. Together with Public Transport Operators, LTA has launched a refreshed series of publicity materials, which feature stronger elements of inclusiveness to encourage commuters to pay extra care to those in need. The vibrant campaign visuals, featuring the Thoughtful Bunch (Stand-up Stacey, Move-in Martin, Give-Way Glenda, Bag-Down Benny and Hush-Hush Hannah), have been rolled out at our public transport nodes, including sheltered walkways, bus stops, MRT stations, and even on theme trains.
8.	More affordable concession prices for adults. Public transport to be made free at peak hour. Institute tax incentives for businesses who give paid MRT cards to employees, to be capped at $50-100 per month.	All commuters can enjoy lower morning pre-peak rail fares if they start their train journey before 7.45 am on weekdays (excluding public holidays). The aim of having lower pre-peak fares is to distribute the peak-hour passenger load over a longer time period, allowing all passengers to enjoy a less-crowded commute, and to utilise the public transport system more efficiently. For those who need additional help with public transport fares, the Government will assist them through various community-led initiatives and work support schemes under the MSF/Community Development Councils and the Citizens' Consultative Committee (CCC) ComCare Fund.
9.	Promote car sharing (especially for cleaner vehicles like EVs); adapt ERP to account for	While the Electronic Road Pricing system will not be able to account for the number of occupants in the vehicle, we do encourage car sharing.

	number of occupants in the vehicle to promote this.	There are multiple car sharing services in Singapore, including the electric car-sharing firm BlueSG which is appointed by LTA to operate the National EV Car-Sharing Programme. As of January 2020, BlueSG has deployed 660 EVs and rolled out 1,259 charging points, 239 of which have been made available for public charging.
10.	Mobile app to provide information on different ERP prices at various times, encouraging them to take public transport instead of driving during those times.	The MyTransport.SG app is a mobile application that provides useful travel information and features to help commuters get around Singapore. One of those features is a map of all ERP gantries, operation times and rates. There are many other mobile applications that help to make public transport journeys hassle-free for commuters. The DataMall webpage on MyTransport.sg is a marketplace of land transport applications developed by LTA and third parties. These applications provide useful transport-related services, such as live bus timings, real-time journey planners, and live traffic conditions.
11.	Older and less efficient vehicles to be phased out or scrapped from public transport fleets.	Singapore is committed to having a 100% cleaner energy public bus fleet by 2040, and will gradually replace its current diesel public buses with cleaner fuel vehicles.
Private and Commercial Vehicles (Ownership, Usage, Emission)		
12.	Can the Government, having already implemented the zero-growth cap in COEs, seek to reduce the COEs to reduce vehicle population over the next few years?	The vehicle growth rate (VGR) controls the annual growth of the vehicle population. The current VGR for categories A, B and D (cars and motorcycles) is set at 0% until 1Q 2021. As businesses will need more time to adjust their operations, we have maintained the vehicle growth rate for commercial vehicles (category C) at 0.25% per annum until 1Q 2021. We will review the VGR again in end 2020.
13.	Ban high performance cars.	Singapore has a progressive Road Tax and COE system which imposes higher tax rates for high performance vehicles.
14.	Create separate classes of taxes for vehicles with higher emissions of PM2.5 and other pollutants, and tax them heavily.	The Vehicular Emissions Scheme (VES) was implemented in 2018 to incentivise the purchase of car and taxi models which are more environmentally-friendly and disincentivise more pollutive ones. The rebates or surcharges are determined by the worst performing pollutant. Since VES was implemented, about 25% of cars and almost all taxis have been registered in the rebate bands, which has cleaner models overall. We are also seeing greater adoption of cleaner electric vehicles (EVs).
15.	Additional levies on highly polluting/carbon heavy vehicle models to be used in Singapore based on mileage and tailpipe emissions. Older vehicles to be inspected and levied accordingly.	Singapore regularly reviews its policies on vehicular emission. Under LTA's current policy, the frequency of mandatory vehicle inspection frequencies is based on the age of the vehicle.
16.	Car owners to be encouraged to keep their car as long as the model meets certain standards in	Singapore manages the growth of the vehicle population through the COE system. This system is separate from the statutory lifespan of a car, as car owners do not need to scrap their car once their COE expires, but can extend their COE as long as the vehicle is assessed to be roadworthy.

	terms of efficiency and emissions instead of simply scrapping once the COE expires.	Policies such as the Preferential Additional Registration Fee (PARF) ensure that the vehicle population remains young, and also encourage the adoption of more efficient and cleaner vehicles when they become available.
17.	In its current form, the Early Turnover Scheme (ETS) does not differentiate between diesel, petrol, hybrid or EVs in terms of discounted Prevailing Quota Premium (PQP). Planned changes to these policies should be communicated early to Original Equipment Manufacturers (OEMs) to prepare them to bring in the right vehicles.	The ETS encourages the turnover of older and more polluting commercial vehicles to newer cleaner ones. Singapore will review the ETS at regular intervals, taking into account the need to provide sufficient lead time for the industry to adapt to changes, if any.
Cleaner Fuel Vehicles (e.g. Electric Vehicles, Hybrid) Adoption		
18.	Clear articulation of government direction on EVs, including regulatory approvals, public communications as well as a coordinating agency.	The Government has committed to work towards Singapore's public buses and taxi fleet being cleaner energy vehicles by 2040. Singapore will continue to support the adoption of cleaner fuel vehicles.
19.	Increasing availability of "turnkey" end-to-end solutions to use EVs.	There are publicly accessible charging stations at a variety of locations, for example BlueSG (at selected carparks), SP Group, Greenlots (at selected malls and carparks), and Shell petrol kiosks. The Government will continue to work with companies to enable the deployment of end-to-end EV solutions.
20.	Suggestions to increase vehicular electrification in Singapore: a. Subsidies, tax reductions, reform import taxation system for vehicles, larger VES rebate, demand-side grants (follow example of Norway: https://elbil.no/english/norwegian-ev-policy/). b. Use lifecycle costs of vehicles (ICE vs EV) accurate comparison. c. Alter COE to have more COEs for EVs as opposed to ICE; raise COE on ICEs; have lower COE price for EVs.	EVs are a part of the national strategy to reduce Singapore's overall carbon footprint and make the transport system a future-ready, sustainable one. The global industry has also begun to move in this direction, with an increasing number of OEMs declaring their intentions to electrify the models they offer. Singapore is developing plans to support greater adoption of EVs and will explore some of these suggestions.

	d. Increase charging infrastructure (have charging points in homes). Work with private companies to provide electric charging points in parking lots (HDB, commercial etc.); points can be pay-per-use. Strengthen Green Mark requirements to incentivise property developers to include more EV charging facilities. e. Adoption of fast charging technologies to reduce charging time. f. Electrical infrastructure of existing buildings needs to be compatible with the increased load from EVs. g. Bring in more models with higher battery capabilities and high mileage threshold (particularly for Light Goods Vehicles where only one model is available). Ensure that OEMs provide sufficient warranty for vehicle expected lifespan. h. Improve EV regulatory framework (including fire safety) in Singapore, establish international standards for charging requirements. i. Help companies build capabilities for EV maintenance (increase manpower, skills training).	
21.	Review the power output >10kW limit on Electric Two-Wheelers (E2W) to encourage greater adoption of Electric Vehicles (EV) and E2W in Singapore for regular use in commuting or urban delivery.	The Government is currently reviewing the standards and regulations for high-powered Electric Motorcycles.
22.	BCA Green Mark to take into account the benefits of using EVs for logistics delivery; e.g. EV charging may increase building energy	As part of BCA Green Mark, buildings can receive points for the provision of electrical vehicle charging and parking infrastructure. The availability of such charging points in buildings will encourage EV adoption by freight and private vehicles. We will study ways to implement this in a feasible manner.

	consumption marginally, but can greatly reduce overall transport/freight emissions.	
23.	Smart charging: plugged-in EVs and home based battery storage to serve as battery banks, delivering energy balancing and ancillary services.	The Government will continue to engage technology providers to testbed and deploy smart charging solutions and energy storage systems. Technology providers can use EMA's regulatory Sandbox programme to test such innovative solutions. More information on the regulatory sandbox can be found at EMA's website*. Singapore aims to deploy at least 2 gigawatt-peak (GWp) of solar by 2030. Commercial arrangements could be structured to allow the electricity generated from solar deployment to be supplied to the EV charging station. The possibility of EVs running fully on solar power will depend on the electricity demand from vehicles and the available electricity generated from solar deployment. There may also be other competing uses for the electricity generated from solar. *https://www.ema.gov.sg/Sandbox.aspx
24.	Tie the installation of new solar systems to a license to import duty-free EVs that would consume the electricity produced by these solar plants.	
25.	Can electric vehicles run fully on renewable or solar power in Singapore?	
26.	TR25 Technical Committee 1 (TC1) to include industry participants, leverage associations to aggregate feedback from industry partners.	The Technical Reference (TR) was prepared by the Technical Committee (TC) on Electric Vehicles under the purview of ESG. The TC consists of various industry participants and stakeholders, including academics, government agencies and OEMs. Interested parties with the relevant expertise can come forward to offer their service and participate in the Technical Committee. Information could be found at ESG's website*. *https://www.enterprisesg.gov.sg/quality-standards/standards/for-partners/standards-development
27.	Need to consider end of life management – disposal of EV batteries can be pollutive. Upstream production may also be pollutive.	NEA will be implementing an Extended Producer Responsibility (EPR) framework for E-waste management from 2021, which will cover EV battery disposal. The EPR extends the responsibility of producers to the proper end-of-life management of their products. NEA has supported the NTU Singapore-CEA Alliance for Research in Circular Economy (SCARCE) under the Closing the Waste Loop (CTWL) Research and Development (R&D) Initiative to develop innovative and environment-friendly solutions for the recycling of Lithium Ion Batteries including those from EVs.
Others		
28.	Explore adoption of autonomous vehicles and fuel cell vehicles.	Autonomous vehicles (AVs) could radically transform our land transport system by enabling more efficient dynamically-routed or on-demand forms of shared transport. While AVs are not yet ready for large-scale deployment, they are increasingly being tested worldwide. The Government is already carrying out several trials in this space and has also issued a call-for-collaboration on the

		pilot deployment of autonomous buses and shuttles in Punggol, Tengah, and the Jurong Innovation District in the early 2020s.
29.	What are emissions implications on PMDs, since they run on electricity?	PMDs and other active mobility devices are environmentally-friendly modes of transport. While these run on electricity, they are more efficient and less pollutive compared to private motor vehicles.
30.	Number of lanes for cars should be reduced to discourage people from driving. Instead, lanes could be reserved for pedestrians, cyclists and PMD users, EVs, and more lanes can be dedicated to buses.	The Government is exploring additional ways to prioritise Walk Cycle Ride modes of transport over private vehicles. Road reclamation is one possible method. As the cycling path infrastructure is being developed, the Government will also explore opportunities to repurpose road space for other uses.
31.	Increase in EVs will result in a reduction in fuel excise duties collected. To address this, road use charges could be enacted e.g. by using proposed ERP system to monitor road usage.	The Government regularly reviews our vehicle and fuel regulatory policies, taking into account vehicle usage patterns and the externalities that vehicle usage imposes.
32.	Create ultra-low emissions zones in areas with high pedestrian usage, starting with Orchard Road and the CBD.	The Government will take into account such possible policies when reviewing appropriate levers to encourage cleaner vehicle/EV adoption at regular junctures. This will also depend on the EV adoption level at that time.
33.	Consider a telecommute day every Friday or a plausible switch to a four day work week, so as to prepare workers for accelerated automation and reduced production of goods and services Reduce the number of working hours to reduce emissions from commuter travel and takeaway food.	To incentivise companies to implement and sustain flexible work arrangements (e.g. allowing employees to carry out their work at a location away from the conventional office (Flexi-place)), the Ministry of Manpower (MOM) offers the enhanced Work-Life Grant. This would make it easier for employees to work from a location that is convenient to them or their customers, reducing the need for commuting. The use of alternatives to travelling for meetings are contingent on the operational requirements, and companies are best placed to determine the option that works best for them. The Government adopts an integrated land use and transportation planning at the strategic level to ensure key development areas are well supported by public transport. High density housing and commercial activities have been intensified around MRT stations to encourage maximum use of the public transit systems. URA will continue to plan for new growth centres island-wide around sustainable mobility, to bring jobs and amenities closer to homes.
34.	Provide support for firms investing in advanced remote conferencing facilities/remote hiring practices to reduce need for travel.	

C: Clean Energy

	Clean Energy Sources	
1.	The most viable renewable energy is solar. Singapore could look into other forms of renewable energy like geothermal, tidal, and wind. Develop capacity to use tidal energy, since we have accurate tide and weather data.	Solar remains our most viable renewable energy source, as Singapore has limited alternative energy options due to low wind speeds, low tidal range, lack of geothermal resources, and lack of large river systems for hydropower. Our limited land resources also make it challenging to deploy solar power on a large scale. Despite Singapore's limited access to alternative energy options, we have undertaken a wide-ranging and careful study of what is feasible for Singapore to do. Singapore will continue to promote renewable energy deployment through: a. Research Development and Deployment (RD&D) efforts where EMA partners the industry and research communities to build sustainable energy solutions and capabilities, and test-bed innovative solutions (e.g. in smart grids and energy storage technologies); b. Streamlining our regulations and processes to facilitate solar deployment; and c. Raising demand with government taking lead to aggregate public sector demand for solar PV.
2.	Import electricity from neighbouring countries (including Australia, Indonesia); become part of a future regional power grid (e.g. ASEAN grid). RE-powered electricity could be imported from large solar farms overseas. However, various issues need to be overcome: potential energy losses, interconnection costs, heavy capital investment.	Singapore will explore tapping on regional power grids to access cost-competitive energy that will help us decarbonise power generation and overcome land constraints. This could be realised through bilateral cooperation or regional initiatives. However, we will need to balance this with potentially higher electricity costs and higher energy security risk. Nevertheless, EMA has launched a technical study to assess electricity imports as a supply option and identify measures needed to ensure the security and reliability of our power system.
3.	From whom does Singapore plan to import clean energy in the region? Does this come at a cost, domestically?	
4.	On waste-to-energy (WTE), what are the implications of a zero waste nation on WTE contribution to Singapore's energy mix? Can the Government clarify its stance on plastics incineration, given that the document cites its contribution of 7% of total carbon emissions from all power generation for electricity?	WTE incineration plants reduce the volume of waste efficiently to minimise the amount of landfill space required. Nonetheless, we will continue to work towards becoming a Zero Waste Nation by producing and consuming sustainably, and adopting a circular economy approach to close resource loops and to reduce the need for incineration. This includes adopting the 3R (i.e., reduce, reuse and recycle) strategy to reduce plastics incineration, as laid out in the Zero Waste Masterplan launched in 2019. Some initiatives include the introduction of the Resource Sustainability Act (RSA) to legislate measures targeting the three priority waste streams including packaging waste including

		plastics, developing local recycling capabilities, as well as new labels for blue recycling bins as effort to reduce contamination of the recycling bins. NEA is also currently studying recycling solutions and technologies for plastics, and assessing their suitability for adoption in Singapore. This may include mechanical recycling to turn waste plastics into plastic pellets for manufacturing new products, or chemical recycling to turn plastic waste into chemical feedstock or fuel. The Government will work with industry stakeholders to explore how these technologies can be applied to Singapore, such that it is both environmentally and economically sustainable.
5.	Nuclear energy is a possible clean source of energy for Singapore to explore. Expand nuclear safety research programmes. Despite land requirements for safe zones, it is feasible to build nuclear power plants at nearby unpopulated islands or floating/underground sites. Facilities may be set up in remote areas with international partners such as Australia.	A two year Pre-feasibility Study (Pre-FS) on Nuclear Energy concluded in 2012 that available nuclear energy technologies are not yet suitable for deployment in Singapore. Newer nuclear power plant designs that are being developed and tested have the potential to be much safer than many of the plants that are in operation today. However, the risks to Singapore, given that we are a small and dense city, still outweigh the benefits at this point. Since the conclusion of the Pre-FS, agencies have been monitoring the development of safer nuclear energy technologies. Most of these newer technologies are still at the testing phase and have not been operationally proven. As the Government is planning for the long term and not for immediate energy needs, we will continue to monitor the progress of these nuclear energy technologies to keep our energy options open for the future.
6.	Towards a safe nuclear-powered region: Maintain active cooperation among ASEAN members through the ASEANTOM platform; Joint development of nuclear power research and manpower training in ASEAN e.g. Allowing for ASEAN students to enrol in the Singapore Nuclear Research and Safety Initiative (SNRSI)'s scholarship programme**;** house and establish adoption of a unified code of conduct and safety/operations standards in ASEAN e.g. the International Atomic Energy Agency (IAEA)-recognised certification for procedures and processes; Establish an independent body that fosters industry self-regulation in the nuclear power industry, like	Singapore is a member of the ASEAN Network of Regulatory Bodies on Atomic Energy (ASEANTOM), which was established in 2013 to enhance regulatory activities and further strengthen nuclear safety, security and safeguards within the ASEAN community by enhancing cooperation and complementing the work of existing mechanisms at the national, bilateral, regional and international levels. ASEANTOM is intended to serve as a framework for cooperation amongst nuclear regulatory bodies or relevant authorities within ASEAN. Singapore remains committed to ASEANTOM and supports ASEANTOM's efforts to collaborate with the international community and regional partners to strengthen regional regulatory and operational practices. We work closely with them on initiatives such as the sharing of best practices, as well as through various training courses and technical collaborations.

	the Institute of Nuclear Power Operations (INPO) in the U.S.A.	
7.	Import or domestically generate biogas, bamboo biomass, gasified biomass and burn methane or syngas in combined cycle power plants. Need to set up supply chain, and ensure that the source of biofuel does not have adverse environmental impact.	Singapore's scarce land area limits the potential for sustainably grown domestic biomass. For any potential imports of biofuel, Singapore will also need to consider the reliability and sustainability of the supply sources. There is also R&D activity taking place in the various research institutes in Singapore on next generation biofuels such as Jatropha, marine algae, ligno-cellulosic ethanol and biomass. Much of the R&D takes place in the Institute of Chemical Engineering and Sciences (ICES-A*STAR), the Institute of Environmental Sciences and Engineering (IESE-NTU) and Temasek Life Science Laboratory (located in NUS).
8.	Generate electricity from waste heat and waste cold energy (from LNG plants) using thermoelectric modules.	EMA is working with Singapore LNG Corporation (SLNG) to explore opportunities to harness cold energy from the regasification of LNG.
	Energy Policy	
9.	Commission an electricity decarbonisation masterplan to develop the design basis and resource requirements - land, materials, labor, funding for the infrastructure projects.	As laid out in our Energy Story, the Government will harness "4 Switches" to guide and transform our energy supply. The "4 Switches" will comprise: 1. Natural gas – the cleanest fossil fuel today. We will help power generation companies improve the efficiency of our natural gas power plants as we scale up on our other switches; 2. Solar – we are working towards achieving a new solar target of at least 2 GWp by 2030, and an energy storage deployment target of 200 megawatt (MW) beyond 2025; 3. Regional power grids – we will explore ways to tap on regional power grids to access energy that is cost-competitive; this could be realised through bilateral cooperation or regional initiatives; and 4. Emerging low carbon alternatives like carbon capture utilisation and storage (CCUS), and hydrogen.
10.	Integrate regional renewables investment as a top priority in foreign policy and ASEAN regional diplomacy. Aim for targets to at a minimum achieve current pledge of 23% renewables mix by 2030 and 50% by 2050, and to push for more ambition to match IPCC recommendation of 65% by 2030 and 87% by 2050. Consider direct financial support for overseas land-based renewables investments in neighboring countries, and commit to grid infrastructure and transmission linkages investments.	
11.	Publicly commit to shifting our national energy grid to be at least 70-85% renewable-based by 2050. Aim to make our energy production 50% renewable by 2025.	

12.	Tax relief for facilities that generate their own electricity and do not draw from the grid (e.g. Ireland) to encourage facilities generating their own power.	The Government believes in pricing energy right and does not provide subsidies (e.g. feed-in-tariff (FiT) policies) to solar electricity generators. By sending the right market price signal, industry can evaluate the value and viability of each energy technology when making their investment decisions. This will encourage a more sustainable growth of renewable energy in Singapore on a commercially viable basis. Ensuring users pay market prices for energy also incentivises consumers to use electricity efficiently and avoid wasteful consumption. Today, solar consumers can use solar generated electricity to offset their electricity consumption and sell back any excess solar electricity to the grid through various payment schemes.
13.	Implement tax incentives for consumers switching to sustainable energy providers in the open electricity market. Government grants could be upfront to lower the initial risk on corporations.	
14.	Send price signals to encourage long-term investment direction towards clean energy. Price of power could accurately reflect long-term marginal costs.	
15.	Facilitate renewable energy frameworks – e.g. fostering commercial tools like power purchasing aggregation.	We will proactively enhance our market and regulatory framework to facilitate the deployment of renewable energy sources. Our approach can be summarised into the following: a. Right Pricing: We believe in pricing energy right to ensure a sustainable growth of renewable energy and incentivise efficient use of energy; b. Progressive Regulations: We will continue to streamline our existing regulations and processes to facilitate solar deployment; c. Catalysing Demand: We are taking the lead with the SolarNova initiative aggregating public sector demand for solar PV d. Research and Development: We are partnering with industry and the research community to test-bed solutions that will enable us to better manage the intermittency challenges posed by renewables.
16.	Facilitate a renewable energy crediting policy. However, there is currently a lack of a market due to the lack of rules on Renewable Energy Credits (RECs), and the market separates responsibilities for generation, transmission, retail, making it difficult for players to operate across multiple markets.	Singapore currently does not have a renewable energy crediting framework or policy mechanism. We are monitoring international and regional developments, and will continue to study possible frameworks that would be compatible with Singapore's energy market structure.
17.	Replace our spinning reserves with battery storage to increase flexibility and resiliency of our energy systems. Battery prices are dropping rapidly. However, our current large	To facilitate the adoption of Energy Storage Systems (ESS), EMA has been working with government agencies and industry to implement test-beds, build local capabilities and develop technical standards to safely deploy ESS in Singapore's hot and humid environment.

	spare capacity discourages adopting alternatives.	
18.	While higher prices for energy produced from clean sources may be tolerable up to a certain percentage (10-25%), impact of rising costs on the poor will need to be addressed.	With technological advancement in solar PV panels, the cost of solar has fallen significantly and this trend is expected to continue. Singapore will ensure a sustainable growth of renewables while maintaining energy cost competitiveness and energy security. To help households adjust to the increase in electricity and gas expenses arising from the carbon tax, eligible HDB households will receive an additional $20 GST Voucher – U-Save rebate on top of the regular U-Save rebate payment each year from 2019 to 2021. The Government will continue to support households with their cost of living in other ways, such as through the GST Voucher – Cash and Service and Conservancy Charges rebates. Lower- and middle-income households will receive more support.
19.	Provide information on how to switch to 100% renewable energy electricity suppliers with the lowest cost to reduce individual research needed.	Consumers may refer to the Price Comparison Website* or the retailers' websites to choose the electricity price plan that best suits their needs. *www.compare.openelectricity.sg
20.	Increase consumer information available to educate the public on the benefits of switching to renewable energy.	
Energy Research and Development		
21.	Invest in research and development in other forms of renewable energy (other than solar) to be deployed in Singapore.	Although research in solar energy is prioritised in Singapore as other forms of renewable energy are currently not scalable in Singapore, the Government will continue to look into potential alternative energy sources. There are ongoing research efforts to test renewable energy solutions. These are enablers to help integrate larger amounts of renewable energy into the energy system. For instance, Renewable Energy Integration Demonstrator – Singapore (REIDS) is a platform dedicated to designing, demonstrating and testing solutions for sustainable and affordable energy access-for-all in Southeast Asia. REIDS integrates solar, wind (onshore and offshore) and tidal energy. In 2017, as part of the REIDS initiative, Singapore's first long-span wind turbine was installed at Semakau Landfill.
22.	Treatment of the grid as a system and integrating different supply options, storage technology and demand management will be an important part of Singapore's energy future.	Transforming the grid is a crucial part of Singapore's energy future. Under the Energy Grid 2.0 Programme, the Government is studying how to integrate several types of energy sources into a single intelligent network.
23.	Support research to implement virtual power plant system to integrate several types of	Under the Sembcorp-EMA Energy Technology Partnership, a grant was awarded in mid-2019 to NTU to develop Singapore's first Virtual Power Plant, which can optimise power output from a

	power sources flexibly, including prosumers of PVs. In conjunction with batteries/energy storage systems.	variety of Distributed Energy Resources (DERs) such as solar PV and Energy Storage Systems. This would contribute towards Singapore's efforts to meet its climate change commitments by allowing for more clean and distributed energy resources to be integrated into Singapore's energy mix while keeping the power system stable.
24.	Strategically co-locate utility scale energy storage with data centres. These 'batteries' can strengthen the grid when necessary and at the same time remove layers of UPS/back-up power within large data-centres.	To maximise space, co-locate ESS with other infrastructures safely and bootstrap deployment of ESS solutions, EMA is working with various government agencies and industry partners to establish a set of deployment guidelines, which covers issues such as fire safety and technical standards.
25.	Improve the ease/speed of companies installing grid connected battery systems to balance the intermittency of solar power generation and demand fluctuations.	EMA has reviewed the policies and regulations relating to ESS and published a policy paper in 2018 on Energy Storage Systems for Singapore. The paper provides clarity to industry and consumers on the current regulatory framework for ESS and guidance on the potential applications for ESS in Singapore, such as helping to integrate higher levels of solar and managing solar intermittency. EMA continually reviews the landscape and monitor developments to ensure that the regulations are continuously updated to recognise the fast-paced advancements in ESS.

D: Solar

1.	On power generation, is solar displacing fossil-fuel power generation? What can be done to nudge our energy mix towards having a greater share of renewables?	Solar is our most viable renewable energy source, and the government has prioritised R&D efforts to maximise the deployment of solar PV systems, given Singapore's land constraints. Our stretch target is to deploy at least 2 GWp of solar by 2030. This would generate about 10% of Singapore's current peak daily electricity demand. Singapore's fossil-fuel power generation has shifted over the past 2 decades to rely almost entirely on natural gas, the cleanest fossil fuel. The Government has also guided the adoption of more high-tech generator sets, which have higher efficiency and less emissions/MWh of electricity produced. Besides solar, we are also exploring other clean energy sources, such as the potential to import hydrogen as an alternative fuel, or tapping on regional power grids, through which we may access imported green electrons.
2.	Challenges of deploying solar in Singapore include the limited land area and the intermittency associated with highly varied cloud cover in Singapore over time.	For Singapore, we do not have many alternative energy options and solar energy is presently the most technically and economically viable. However, as solar energy generation is dependent on surface area, Singapore's land and space constraints remain a challenge. As such, we are looking to harness solar energy in more innovative and efficient ways, such as floating solar PVs on our reservoirs, and building integrated PV, so as to help us achieve our solar deployment plans. Solar energy is intermittent, and impacted by weather conditions (e.g. cloud cover). Grid-scale ESS is a game-changing technology to support Singapore's solar ambition, due to its ability to store electricity on a large scale for use later. Beyond ESS, EMA is also working with Meteorological Service Singapore (MSS) and NUS to develop an accurate multi-timescale solar forecasting solution customised to Singapore's tropical weather conditions. This project would allow Singapore to more accurately forecast solar power output to mitigate the effects of solar intermittency and ensure grid reliability.
3.	Place solar panels on facades, sidewalks, MRT station rooftops, more on reservoirs, HDB rooftops, on top of walkways, airport buildings, sound barriers, roads, top of buses, government buildings, schools, public transport infrastructure, sheltered walkways, lamp posts, park connectors, large structures like stadium	The Government is already working with companies, researchers and the public to deploy at least 2 GWp of solar by 2030. This would generate about 10% of Singapore's current peak daily electricity demand, and increase solar adoption in Singapore by about 8 times from 2019's installed capacity. To facilitate greater solar adoption, Singapore will deploy and maximise solar panels across various spaces such as rooftops, reservoirs, offshore spaces, vacant land, infrastructure and even building facades. For example, PUB would be deploying a 50 MWp floating solar PV system on Tengeh

	grandstands and multi-storey carparks, and coastal floating structures.	reservoir by 2021, which will be one of the largest of its kind in the world. The Government will also extend and scale-up the SolarNova programme to maximise solar in the public sector. In the coming years, HDB aims to deploy solar PV on half of all HDB rooftops. In addition, the Government will also continue to support solar by reviewing and streamlining our regulations to facilitate higher solar adoption. To make this vision a reality, the Government will work with all stakeholders, including industry and businesses, research communities, and the public.
4.	Free solar panel charging for smartphones and power banks at airports, taxi stands or bus stops.	Changi Airport has installed solar panels at T3 which harvest 300 MWh of solar power a year, and plans to increase solar deployment. The electricity generated helps to power airport infrastructure and services, which includes the numerous USB ports and universal sockets that are available at the airport. As bus stops are generally shaded by our surrounding greenery and buildings, and taxi stands are located within the drop-off points of buildings, the amount of solar energy that can be harnessed from solar installations on bus stops and taxi stands would not be cost efficient. There are already commercially available portable solar power bank chargers available for consumers.
5.	Geostationary Space Solar Power System (SSPS) to produce energy; also to block solar radiation from Singapore, reducing the ambient temperature.	Various Space-Based Solar Power (SBSP) proposals have been researched since the early 1970s but at present, none are economically viable with present day space launch infrastructure, though this might change in the future. Besides the cost of implementing such a system, SBSP would need to address several technological hurdles such as the wireless transmission of energy from orbit to Earth's surface. Despite concerns over the safety of laser or microwave beam transmission, it is not harmful to humans. However, the SBSP proposals have yet to address inefficiencies in energy conversion and the vast size of the receiving antennas that would require large areas of land (up to 10 km in diameter, equivalent to the length of 90 soccer fields). Singapore will continue to monitor the developments of such technologies/innovation that will support our mitigation efforts and will assess the feasibility and implications if their prospects improve in the future.
6.	Encourage use of solar-vacuum tubes for water heating in landed homes and for seawater desalination. Develop a combination of solar panel and solar water heating systems to be implemented on rooftops.	Solar domestic hot water heaters are commercially available in Singapore. PUB's Tuas Desalination Plant rooftop is fitted with solar panels that generates 1.4 million kWh of energy a year, enough to power more than 300 four-room flats for a year. In addition, PUB continually invests in research and technology to find more efficient ways to desalinate seawater. PUB aims to at least halve the desalination energy used in the future through a combination of

		technologies such as electro-deionisation, ultra-permeable membranes, Pressure Retarded Osmosis and other process improvements.
7.	Promote solar energy use by demonstration and advertising, such as adopting a mall, fuelling it with solar energy and presenting a breakdown of power savings and the positive impact on carbon emissions.	It is important to promote solar deployment by demonstration. Solar deployment should also be complemented with energy efficient and energy conservation practices. As BCA's flagship R&D project under its Green Building Masterplan, an existing building at the BCA Academy was retrofitted into a Zero-Energy Building. In addition to solar deployment powering all appliances and lighting in the building, green features include low-emissivity glass, which has a special low emissivity coating. This increases the EE of windows by reducing the transfer of solar radiation through glass.
		Policy Initiatives
8.	Technological potential of solar could be pushed further, particularly through the improvement of solar efficiency through solar panels. Invest in solar energy production and R&D (such as increasing manufacturing efficiency).	The Government will continue to push the bounds of our solar deployment by investing in research, development, demonstration and deployment (RDD&D) efforts to improve the efficiency of PV panels, explore innovative urban solutions (e.g. Building Integrated Photovoltaics (BIPVs)), and look towards better integration with our grid. To accelerate these efforts, we have built up our capabilities in solar research in institutes such as: a. Solar Energy Research Institute of Singapore (SERIS) – which conducts R&D activities including the development of cost-effective high-performance PV modules; and b. The Energy Research Institute @ NTU (ERI@N) – which conducts world-class industry-oriented R&D on grid systems and a range of energy topics. SERIS has developed several low-cost high-performance PV modules, including the world's first bifacial module with solar energy solutions provider IBC Solar's solar cells. In 2017, SERIS developed a 21.5% efficient n-type monocrystalline silicon solar cell that represents one of the world's best compromises between high performance and low-cost processing. This type of solar cell is expected to gain significant market share in the coming years. In addition, SERIS and ERI@N have been working closely with international research institutes and companies to develop ultra-high efficiency solar technologies such as multi-junction tandem solar cells, and have worked with industry stakeholders on the deployment of solar systems in Singapore.
9.	Incentives/subsidies should be provided to commercial and private owners for solar power generation. Impose penalties or increase regulation for solar adoption e.g. increase the scoring points for BCA Green Mark submissions to incentivise the use of solar energy.	Singapore believes in pricing energy right and does not provide subsidies (e.g. FiT policies) to solar electricity generators. By sending the right market price signal, industry can evaluate the value and viability of each energy technology when making their investment decision. This will encourage a more sustainable growth of renewable energy in Singapore on a commercially viable basis. Today, solar consumers can use solar generated electricity to offset their electricity consumption and sell back any excess solar electricity to the grid through various payment schemes.

		Solar feasibility studies, solar-ready roofs and deployment of solar panels on building rooftops are also highly encouraged through BCA's Green Mark Scheme where points are awarded towards Green Mark accreditation.
10.	Incentives for households to install solar panels; allow households to install small solar farms, such as at the clothes drying area given clothes are often dried indoors or in dryers.	Consumers interested to install solar panels may refer to the Guide to Solar PV on EMA's website to find out more about the process of installing solar PV, including selling any excess solar generated electricity to the grid. More information can be found at https://ema.gov.sg/Guide_to_Solar_PV.aspx.
11.	Reduce risk and upfront cost of solar panels through Public Guarantees and other risk-reducing instruments; feebates; and interest rate subsidies and tax breaks for low-carbon investments.	Adopting subsidies such as FiT distorts the energy markets and increases costs for consumers. Hence it is important to price energy correctly and send the right price signals to both consumers and investors. Instead of subsidies, Singapore has taken proactive steps to introduce regulatory enhancements to facilitate the entry of renewable energy when such technologies become commercially viable. The Government's support for renewables also comes in the form of funding for R&D to develop capabilities within the industry.
12.	Establish a second-hand market for solar panels already installed on HDBs for landed property owners who might want to commit to solar panels but are not willing to pledge the full sum of new solar panels.	With the continual increase in efficiencies and strong reduction in cost for solar modules over the past five to eight years, it may not make economic sense to install second-hand solar PV systems. Newer PV systems would generate more solar energy more cost-effectively. In the case of tropical Singapore, second-hand solar PV would also have increased system losses from degradation or soiling. It is important to consider the end-of-life management of PV panels. When the EPR) framework for e-waste is implemented in 2021, it will also cover PV panels.
13.	Provide information on which solar technologies are suitable for businesses.	Singapore has a National Solar Repository website* which helps to raise awareness among building owners of the cost effectiveness of solar electricity and the associated economic opportunities. For example, it hosts the Solar Economics Handbook of Singapore, which describes the global solar market, the Singapore energy landscape, the current solar deployment rate in Singapore, and the economic viability of solar PV for various types of rooftop owners and investors. *https://www.solar-repository.sg
14.	Government regulation constrains solar deployment. Look into easing non-cost factors that hinder solar adoption e.g. regulatory barriers. Create an enabling regulatory	The Government will proactively enhance our market and regulatory framework to facilitate the deployment of renewable energy sources. Our approach can be summarised into the following:

	environment for "prosumers" and encouraging households and institutions (like universities) with the ability to become "prosumers" of solar PVs, able to sell excess energy to others for income.	a. Right Pricing: We believe in pricing energy right to ensure a sustainable growth of renewable energy and incentivise efficient use of energy b. Progressive Regulations: We will continue to streamline our existing regulations and processes to facilitate solar deployment. Today, solar consumers can use solar generated electricity to offset their electricity consumption and sell back any excess solar electricity to the grid through various payment schemes. More information can be found at https://ema.gov.sg/Guide_to_Solar_PV.aspx. c. Catalysing Demand: We are taking the lead with the SolarNova initiative aggregating public sector demand for solar PV. d. Research and Development: We are partnering with industry and the research community to test-bed solutions that will enable us to better manage the intermittency challenges posed by renewables.
15.	Allow occupants of private properties to sell excess solar generated electricity to the grid and be paid a rate based on regulated tariff minus transmission charges (such as before Open Electricity Market was introduced) rather than wholesale prices.	Non-contestable consumers buying electricity at the regulated tariff can sell excess solar electricity through the Simplified Credit Treatment Scheme and be paid based on the regulated tariff minus transmission charges. Contestable consumers buying electricity at retail price can sell excess solar electricity through the Enhanced Central Intermediary Scheme, or as a Market participant, and be paid based on wholesale price. More information can be found at https://ema.gov.sg/Guide_to_Solar_PV.aspx.
16.	Improve coordination amongst government agencies on solar deployment, e.g. in building rooftops.	The SolarNova programme was launched in 2014 and is a Whole-of-Government effort led by EDB and HDB to accelerate the deployment of solar PV systems in Singapore. The programme helps to promote and aggregate demand for solar PV across government agencies to achieve economies of scale, as well as drive the growth of Singapore's solar industry. EDB and HDB also provide funding for government agencies to conduct feasibility studies and determine their solar PV requirements. At the inception of the SolarNova programme, the original target was 350 MWp, of which 220 MWp will be on HDB rooftops. In January 2020, HDB announced that it will increase its solar target from 220 MWp to 540 MWp. This will increase the annual solar energy generated from an estimated 420 GWh to about 805 GWh. In the coming years, HDB aims to deploy solar PV on half of all HDB rooftops.
17.	Leverage increasing demand for solar energy to raise demand for circuit components, boosting the semiconductor industry.	While EDB and HDB leads public agencies' solar deployment through SolarNova, SERIS at NUS plays the key role of creating supply through industry-level efforts such as driving low cost high-performance solar cells, modules and systems, building industry capability, and spurring innovative solar PV solutions (e.g. floating PV, BIPV). From 2017 to 2019, SERIS developed several low-cost high-performance PV modules, including the world's first bifacial module with solar energy

		solutions provider IBC Solar's solar cells. In 2017, SERIS developed a 21.5% efficient n-type monocrystalline silicon solar cell that represents one of the world's best compromises between high performance and low-cost processing, which is expected to gain significant market share in the coming years. Such efforts to drive low cost high-performance solar cells, modules and systems would in turn translate into significant reductions in the levelised cost of energy (LCOE) for solar PV.

E: Carbon Pricing

	Carbon Tax Rate	
1.	a. The following priorities have to be considered – fostering economic development, ensuring international competitiveness, as well as maintaining international credibility. b. A variety of suggested tax levels for the post-2023 carbon tax regime were put forward, ranging from: - Gradual increases of \$5/tCO_2e every few years - IPCC-recommended levels of \$185 by 2030. c. The current price of \$5/tCO_2e is too low to encourage the decarbonisation required. - The International Energy Agency (IEA)'s Sustainable Development Scenario suggests carbon prices between US\$43/tonne and US\$140/tonne. - Global average of US\$30/tonne - World Bank's recommended US\$40-80/tonne - Sweden's carbon tax (US\$127/tonne) - Switzerland's carbon tax (US\$96/tonne) - \$80-100/tCO_2e - \$190/tCO_2e by 2030 - US\$50/tCO2e in 2030 (\$65-70) according to the World Bank's High-Level Commission on Carbon Prices to reach the 2 degree Paris Agreement target.	<u>Role of carbon tax</u> The Government is heartened to see broad support for the carbon tax as a cost-effective way to reduce emissions, and for its role in our long-term emissions reduction strategy, and acknowledges concerns from businesses that the carbon tax should be calibrated to foster sustainable economic development and maintain international competitiveness. <u>Carbon tax rate</u> The initial carbon tax rate of \$5/tCO_2e is for a transition period of 5 years to give companies time to adjust to the impact of the tax and implement EE measures. The Government intends to increase the carbon tax rate to between \$10/tCO_2e and \$15/tCO_2e by 2030. In doing so, we will take into account international developments, the progress of our emissions mitigation efforts, and our economic competitiveness. It is important to embark early on our transition to a low carbon economy so that our companies and workforce have sufficient time to adjust. The range of suggested carbon prices put forward by different international organisations reflects different assumptions on what other policy interventions are in place. Singapore's carbon tax is not a stand-alone measure but is part of a comprehensive suite of emissions reduction efforts, including improving EE, increasing public transport use and deploying more renewable energy. Our carbon tax level cannot be directly compared with that in other jurisdictions. Jurisdictions that have higher headline carbon prices often also have significant exemptions or free allowances to particular sectors they deem as emissions-intensive and trade-exposed. This means that the companies which receive exemptions in these jurisdictions effectively pay a lower carbon price than what has been published. Instead of having differentiated carbon prices for different companies and sectors, we have chosen a simple carbon tax with no exemptions for covered facilities, to maintain a transparent, fair, and consistent price signal across the economy to incentivise emission reductions. Our carbon tax covers around 40 companies that contribute about 80% of Singapore's emissions. Singapore has one of the highest coverage in the world.
2.	The carbon price must be set at a point consistent with relatively rapid decarbonisation	

	to achieve the long-term goal of net zero emissions soon after 2050.	Beyond 2030, it is expected that carbon would become an increasingly constrained resource, and more jurisdictions would implement market-based carbon pricing systems that are linked via the use of international carbon credits. The carbon tax rate would take reference from the prevailing carbon markets dynamics, while taking into consideration our carbon pricing mechanism, domestic mitigation outcomes and impact on our economic competitiveness.
3.	On the carbon tax rate review by 2023, what international climate change developments does NCCS deem important to take into consideration? Will NCCS consider a science-based approach where IPCC reports are factored in? Is there a transparent matrix or criteria that NCCS can share with the public on how the doubling or tripling of the carbon tax rate will result in emissions reductions?	
Carbon Tax Coverage		
4.	Coverage of carbon tax - Carbon tax should also apply for small emitters below the current 25kt threshold. - A border tax adjustment is needed to account for our import consumption emissions which are twice as high as our territorial emissions. - Some respondents felt the tax should cover 100% of emissions rather than 80%. - Some respondents felt that companies that were already achieving high levels of EE should be exempted from the existing carbon tax regime.	The emissions threshold of 25 $ktCO_2e$ per annum allows the Government to maximise the coverage for the carbon tax, without increasing the compliance burden disproportionately. The carbon tax is applied to the direct GHG emissions of the largest emitters, around 50 facilities to date, which account for around 80% of Singapore's total GHG emissions and more than 90% of industry sector's GHG emissions. We have chosen a simple carbon tax with no exemptions for covered facilities, to maintain a transparent, fair, and consistent price signal across the economy to incentivise emission reductions. The remaining 20% of Singapore's total GHG emissions are mainly due to the combustion of transport fuels such as petrol and diesel. These fuels are already subject to excise duties which encourage reduction of the use of these fuels, and therefore reduce GHG emissions.
Carbon Tax Mechanism		
5.	a. Ensure that emissions intensive trade exposed industries are not unfairly exposed compared to competitors. This could be in the form of free permits or compensation for a portion of the total liability exposure. b. Carbon tax should index the differential between cleaner fuel source and polluting fuel to discourage utilization of heavy oil and coal. Industry carbon footprint per unit	The Government's position of having a carbon tax with no exemptions for covered facilities remains as a clean and simple carbon tax will help to preserve a fair, uniform and transparent price signal on all units of emissions, to incentivise emissions reduction where it presents the lowest cost. A system with benchmark-based exemptions, where different facilities pay different prices, would erode the price signal of the carbon tax and make it less transparent. Also, setting such benchmarks can be a contentious process, and implementing them could increase administrative and compliance costs.

	cost of production such as per tonne, per m^3 or per unit basis in comparison with industry norm or government imposed standards. c. Institute a carbon tax on marginal emissions based on a performance reference level set by the government that takes into consideration industry energy benchmarks. d. Export rebates are necessary to maintain our competitiveness (emission intensive exports). This rebate will constitute a lower effective tax rate. e. Institute a tiered tax system where companies that emit less would pay a lower tax. f. Carbon tax should be specific to the type of industrial activity, since the energy profile and possible solutions to reduce emissions varies from one type of activity to another.	
6.	Simple taxation scheme based on actual emission amount instead of pre-emptive purchase of credits due to difficulties in estimation/use of less efficient technology to finish using credits.	Under the current carbon tax, companies need not purchase fixed-price credits pre-emptively but can do so after the submission of their third party verified emissions reports.
	Suggestions to the Carbon Pricing Act	
7.	Standing Government Advisory Panel with leading experts to be consulted for all amendments and repeal of regulations, definitions and guidelines adopted.	The Government will consult all relevant stakeholders and experts before introducing or making any changes to the legislation and regulations. For instance, on the technical measurement and reporting requirements under the CPA, from 2016 to 2019, NEA had consulted and engaged the industry continually through briefing sessions. Likewise, for future amendments, NEA plans to continue with the practice of consulting the industry prior to implementing the new amendments.
	a. Tax should be accompanied by incentives to promote cleaner energy sources.	The Government is prepared to spend more than the expected revenue of about $1 billion from the carbon tax in the initial five years to support companies, including SMEs and gencos, to improve their energy and carbon efficiency by adopting greener and cleaner technologies and practices. These will

	b. There should be more detail between the linkage between carbon pricing and the reduction in GHGs, i.e. whether carbon pricing is used to support investment in clean energy technologies, or other emissions reduction projects. c. Subsidise green industries. d. Fund experimental processes in low carbon and renewable energy not yet ready for commercialisation. e. Channel revenue to a Special Footprint Fund to be combined with other funds (e.g. Productivity Grant, Energy Efficient Fund) to fund schemes tackling carbon emissions.	be done through enhanced grant schemes. For example, funding support for companies to adopt energy efficient technologies is available under NEA's E2F, EDB's REG(E), and EMA's Genco Energy Efficiency Grant. We have increased funding support to up to 50% of qualifying costs. Other than providing enhanced support for companies to improve EE, the Government will provide assistance to households and fund other measures to reduce emissions. These include initiatives to make buildings more energy efficient, switch to cleaner sources of energy and R&D efforts to test-bed low carbon technologies.
	There are no measures to prevent firms passing the additional cost to consumers, which may harm lower-income households. The carbon tax revenue should be redirected to help the lower income families of society in the form of lump-sum transfers, monthly dividends and other social cushioning measures, or to subsidise appliance efficiency upgrades.	Carbon tax revenue is only collected from taxable facilities rather than households. The impact of the carbon tax on households is expected to be small. To help households adjust to the increase in electricity and gas expenses arising from the carbon tax, eligible HDB households will receive an additional $20 GST Voucher – U-Save rebate on top of the regular U-Save rebate payment each year from 2019 to 2021. This is expected to cover the expected average increase in electricity and gas expenses arising from the carbon tax. We also encourage households to conserve energy and consider more energy-efficient models when making purchase decisions on household appliances. Today's electricity retail market is a competitive one that discourages retailers from raising their electricity rates excessively. Nevertheless, EMA will continue to ensure fair and efficient conduct of market players. Government agencies will also work closely with the Consumer Association of Singapore (CASE) and Competition & Consumer Commission of Singapore (CCCS) to monitor the market for unfair pricing and coordinated price hikes which are anti-competitive.
		Carbon Credits
8.	Carbon credits/offsets will allow some flexibility in the way in which companies acquit their tax liability and is in line with the overarching concept of pursuing least cost abatement/emissions reduction.	The Government is exploring whether, and how, to allow carbon tax-liable entities to fulfil part of their carbon tax obligations through the use of international carbon credits. The Government understands that companies welcome the use of international carbon credits, and is currently studying the key design features, such as environmental integrity criteria, as well as required implementation options.

9.	The type and amount of credits allowed should be addressed through regulation.	We also recognise that there may be benefits in linking arrangements between carbon pricing jurisdictions, and we are still studying the feasibility of linking. We participate actively in ongoing international negotiations and other parallel carbon market dialogues on the post-2020 architecture for carbon markets, including detailed carbon trading rules and guidance for credits to meet certain environmental integrity criteria. We will continue to monitor international developments, and consult companies before we make any policy changes.
10.	Carbon credits from nature-based solutions.	
11.	Support initiatives that enable consumers to buy carbon offsets for carbon intensive activities such as aviation. Existing guidelines to be made clearer.	
12.	Release information on which carbon markets Singapore plans to link up with (under Emissions Trading Schemes).	
13.	Any credits used should have robust verification mechanisms and meet certain requirements.	

F: Emerging Low Carbon Technologies

Carbon Capture Utilisation and Storage (CCUS)		
1.	Government to check the feasibility, restrictions and limitations of current technologies, and provide information on how CCUS technologies would be implemented and used to generate profit.	CCUS is one of the emerging low carbon technologies that Singapore is exploring to ensure the sustainability of Singapore's energy system and industries. A study on CCUS was first commissioned by the government in 2013, and an updated study was recently completed in 2019. The studies examined the readiness, cost and benefits of CCUS technologies across the RDD&D spectrum. The 2019 study found that the use of CO_2 for the production of building aggregates has near term potential, while the conversion of CO_2 to fuels and chemicals is feasible with the availability of imported hydrogen. The region also has significant potential for CO_2 storage, including the use of CO_2 for enhanced oil recovery.
2.	CCUS is a key part of the low-carbon future, particularly in sectors that cannot fully decarbonize.	
3.	Considerations: - Maturity level of the technology/proof of reliability - Reference of other companies adoption - Economic analysis for adoption - Operating philosophy - Investment costs - Efficiency - Carbon/energy footprint - Supply/supplier companies	
4.	The key technical and cost challenge related to carbon capture has been the separation and concentration of CO_2 emissions from industrial facilities and power plants. Combustion in conventional power production produces not only CO_2, but also other gases like nitrogen. Nitrogen is a major constituent in the post-combustion exhaust of conventional power plants. This makes capturing the low concentrations of CO_2 prohibitively expensive, such that the breakeven carbon price required to make a CCS project worthwhile is greater than most carbon prices in place globally.	The government recognises that emissions from Singapore's natural gas-fired power plants contain relatively low concentrations of CO_2 (3-4% CO_2), which are comparatively costly to capture. On the other hand, industrial processes, such as hydrogen production, produce emissions with higher levels of CO_2 (>8%), and can potentially be captured with commercial or close-to-commercial technologies, at lower costs than the capture of gas-fired power plants. Further research is needed to reduce the cost and energy requirements of capturing CO_2 emissions from low-concentration streams, such as from gas-fired power plants, as well as for converting the captured CO_2 into in-demand products. Singapore will leverage and continue to build on its strengths in areas such as material science and chemical engineering to develop RIE initiatives and develop the cost-effective CCUS technologies for Singapore.

5.	In improving adoption of CCUS technologies, concentrating/liquefying of CO_2 must first become cost-competitive. The more concentrated the CO_2 input is, the higher yield each of these technologies can produce, therefore improving its overall profitability.	
6.	The most significant target emission sources in Singapore (for power and heat) are low concentration CO_2 (3-8%); these could be the target technology research for scalable carbon capture solutions.	
7.	Collaborate with Malaysia for large-scale deployment of CCS technology, leveraging its large land area and geological rock formations.	Singapore does not have any known suitable geological formations for the permanent storage of CO_2 underground. However, the region has significant long-term capacity for sub-surface CO_2 storage in saline aquifers and depleted oil and gas fields, where enhanced oil recovery using CO_2 may be feasible. Partnership with countries and companies in the region will be crucial to realising the CCS potential in the region. Use of CO_2 for EOR can potentially improve the economic feasibility of CCUS. While a portion of the CO_2 injected will return to the surface, this CO_2 can be recovered and reinjected for subsequent EOR.
8.	Enhanced oil recovery (EOR) and potential CO_2 sequestration in aquifer and saline formations. However, while CCUS can be used to increase recovery rate in ageing oil fields, the process will still result in about two thirds of CO_2 used in EOR returning to the surface, making it unsuitable for long-term CO_2 storage.	
9.	In improving adoption of CCUS technologies, Green hydrogen and its transportation must first become cost-competitive: Hydrogen is a key feedstock for above technologies, and carbon capturing effect of CCUS may be diminished if hydrogen feedstock is not derived from renewable sources.	Significant energy, land and hydrogen resources are needed to further process the CO_2 into useful products. Hydrogen, in particular, is needed to convert CO_2 to chemicals and fuels. The Government is carrying out a study to study to examine the technical and economic feasibility of importing and using hydrogen in Singapore in the long-term.
10.	Limited applications: Some of the key outputs from CCUS technologies (i.e. fertilisers) have limited applicability in Singapore due to lack of agricultural activities, and the economics of exporting these fertilisers do not work out	We are mindful that market demand for CCU-products needs to be present for CCU to be commercially feasible. The demand can be domestic or regional depending on the product. For example, CCU-building materials produced through mineralisation can supply Singapore's domestic construction & reclamation needs, while synthetic fuels can be produced for the aviation and maritime transport sector, which may be challenging to electrify.

	today (high carbon footprint of exporting, limited storage space, etc.)	
11.	Carbon capture must be paired with a commercially viable use of CO_2 for it to work. The amount of carbon available as CO_2, if turned into other products, is so great that existing markets are dwarfed by the potential production via the CO_2 utilisation route.	
12.	E-fuels and synthetic fuels for transportation and shipping, specifically methanol blending for ICE fuels; for fuels such as jet fuel (where battery solutions are not yet feasible), consider synthetic kerosene mixed with biofuel. Its economic viability would largely hinge upon the price of carbon.	
13.	Electrochemical reduction of carbon dioxide to other chemicals that can serve as fuel.	Electrochemical reduction of CO_2 is an emerging group of technologies that has the potential to use renewable electricity to convert CO_2 to fuels and other useful chemicals. It is an active area of research internationally and in Singapore, advanced materials are being studied to be developed into the next generation of CCU systems.
14.	Electrochemical CO_2 reduction.	
15.	Seaweed farming as carbon sequestration, and use as feed for farmed fish.	The rate of CO_2 conversion by microalgae is significantly lower than that of non-biological processes, and is thus unlikely to be suitable for deployment in Singapore.
16.	Use algae farms to convert CO_2 to biofuel, following the example of Japan, Indonesia, Canada etc.	
17.	Use the mineral olivine to sequester carbon dioxide.	Minerals such as olivine and serpentine can be used as raw materials in a process called mineralisation to convert CO_2 to carbonates. The resulting material has the potential to be used as a construction material. Researchers at the Agency for Science, Technology and Research (A*STAR) have demonstrated the feasibility of the concept and are working to scale up the process.
18.	Supercritical CO_2 (derived from liquid CO_2) can be used as extracting flavours and fragrances, reaction media, processing agent, polymer foams, semiconductor cleaning, dyeing of textiles, CO_2 turbines for energy etc.	Supercritical CO_2 has a wide range of proven applications, such as extraction and purification in the food industry, in chemical reactions, polymer production and processing, semiconductor processing, and powder production. However, the volumes of CO_2 required for these processes are small relative to the amounts of CO_2 emitted by stationary point sources in the industrial and power generation sectors. For example, a typical application using supercritical CO_2 for polymer production would use an amount in the order of 300 tonnes supercritical CO_2, while Singapore's industrial sector produced 20 million tonnes of CO_2 from the direct use of fuels in 2012.

19.	Many CCUS pathways are still in early phases of the technology development and will therefore need ample funding from both the public and private sectors for research and development in order to progress towards commercial deployment.	Studies on CCUS commissioned by the government have identified CCUS pathways across the research, development, demonstration and deployment spectrum. Singapore will build on its strengths in material science, chemical engineering and computer science to develop R&D initiatives with the goal of developing cost-effective CCUS for Singapore in the long-term. We also encourage companies to work closely with the government to further develop both pre-commercial and deployment-ready technologies and the business models that will enable the large-scale adoption of CCUS.
20.	Policy would be required to encourage investment; this could involve co-investment in potential projects, de-risking projects for proponents and in investment in storage facilities.	
21.	Critical success factors for CCUS include: - Strong incentives through carbon policy and mechanisms (explicit CO2 pricing, grant support); - Direct and indirect Government funding through tax incentives, as well as Government guarantees; - A clear signal that CCU is of strategic national/regional importance; - A CCU definition and accounting methodology. Policy framework should not obstruct intersectorial and international CCU projects as well as projects combined with geological storage.	
22.	In industrial plants, CO_2 emission sources are scattered over a wide area. As such, CCUS would be a very big engineering challenge that could affect plant operations.	
23.	Countries globally must move together to pay a premium for CCU-produced "green" products because it will affect the competitiveness of those that adopt such sustainable practices.	

Responses to Feedback and Suggestions on Singapore's Long-Term Low Emissions Development Strategy

	Hydrogen	
24.	Benefits: - Clean energy produced (green hydrogen) - Higher efficiency over conventional generation technologies	To meet Singapore's long-term climate targets, Singapore is exploring multiple options to reduce emissions across our economy. Hydrogen is one such option. In order to understand viable long-term hydrogen deployment pathways, the government has commissioned a study to examine the technical and economic feasibility of importing and using hydrogen in Singapore in the long-term. The study is expected to be completed in July 2020. It will assess potential sources of hydrogen imports to Singapore, suitable ways to transport hydrogen, suitable downstream applications of imported hydrogen, identify R&D opportunities to advance hydrogen technologies in Singapore, and recommend solutions to address hydrogen-related policy and regulatory challenges.
25.	Key barriers to adoption: - High costs compared to conventional fuel - Dangerous to store and transfer in large quantities - Poses additional risks to power plants considering personal protection, storage, explosion risk, maintenance etc. - Liquid hydrogen requires cryogenic storage and cooling causes energy inefficiencies - Relying on hydrogen may raise emissions if it is not from a clean source. - Durability of hydrogen fuel cells - Substantial investment to upgrade infrastructure	
26.	Considerations: - Producing hydrogen through the use of fossil fuels would still result in emissions. Need to use renewable energy - Combustion of hydrogen produces water and heat; could have an "environmental" impact on humidity and the urban island heat effect. - Stable and adequate quantity of hydrogen is necessary to enhance energy security	
27.	Hydrogen mixed with natural gas (and ideally displacing natural gas in the long term) for power generation can potentially have a significant impact in reducing emissions. Key challenges are cost and the technology required	

	(e.g. next-generation turbines) to accommodate the mixture of fuels.	
28.	Refineries can be encouraged to increase the adoption of clean hydrogen in their processes. This can contribute towards generating greater demand and scale thereby improving the commercial viability of clean hydrogen.	
29.	Conversion of hydrogen into other forms such as methanol may be a more practical alternative for the case of imported energy.	
30.	Hydrogen imports are unnecessary, as interconnectors with Australia would have a lower levelised cost of energy (LCOE) than hydrogen imports for power generation. They are needed only as a source of fuel for combustion processes that cannot be electrified.	
31.	In terms of the local distribution infrastructure, consider repurposing existing gas infrastructure (e.g. pipelines) and transport refueling stations (e.g. Shell/Esso).	
32.	Safety and technical handling on the supply side: the government can focus on putting in place policies, procedures (e.g. SCDF), and infrastructure to ensure the safety of using hydrogen.	
33.	Investigate how existing LNG infrastructure and expertise can be modified to support the logistics of importing hydrogen.	
34.	Explore the possibility of powering portable electronic devices with small hydrogen fuel cells.	
35.	Convert gas power stations to renewable power sites and hydrogen distributors.	
36.	Import hydrogen from Johor using pipeline.	

37.	Store hydrogen as methylcyclohexane (MCH), following the example of Japan in Brunei.	
38.	Work with the private sector to consider installation of suitable infrastructure to support the use of hydrogen as fuel.	
39.	Become a pioneer in hydrogen fuel usage; invest early in clean hydrogen production projects and companies in Australia, United Kingdom, Canada etc.; increase funding for hydrogen fuel cell research.	
40.	As power generated directly from hydrogen fuel cells is direct current, it can eliminate conversion equipment required and losses from transformers and switchgears in data centres.	
41.	Likely to be an industrial reagent, an industrial or power plant heat source instead of natural gas. Hydrogen's role in transport may be limited to large users such as shipping, aviation and long-range road and rail.	
42.	Due to the current high cost of fuel cell vehicles (FCVs), Government could play a role to catalyse adoption by test-bedding with public transportation (e.g. next generation bus fleet). Lessons can be drawn from China and Japan who started introducing fuel cell buses. R&D in fuel cell vehicles should also be supported to further develop the technology and drive costs down. Both EVs and FCVs can co-exist and should be explored to displace internal combustion engines. Hydrogen used in power generation can play a role to reduce the upstream emissions of EVs.	
43.	Direct adiabatic cooling from expansion of highly-pressurized hydrogen from storage or	

	transmission system or hydrogen powered chillers can be used for cooling in data centres.	
44.	The data centre sector may be keen to explore the use of hydrogen as a source of energy for backup power for data centres, or as a primary source of electricity, either as a local generation plan within a data centre or by converting existing power stations to a hydrogen-powered one.	
Other Green Technologies for Development		
45.	Geoengineering such as ocean fertilisation, afforestation, and stratosphere sulphur injection.	Research on costs, benefits and various types of risks of most climate engineering approaches is at an early stage and their understanding needs to be improved to assess their feasibility and potential implications.
46.	Switching from thermal to electrical energy operating modes in manufacturing: - Membrane separation, - Coil outlet pressure for steam cracker ethylene (plastic pre-cursor) production, - Desiccant-evaporative cooling (DEP).	Use of non-conventional industrial processes (e.g. membrane separation in place of distillation) has the potential to reduce the energy demand of carbon intensive industries.
47.	Explore using renewable solar energy to power fired-heaters (boilers and furnaces) using electric firing which will result in a significantly lower carbon footprint. It requires close working partnership with process licensors and industries as such technologies are not proven yet and involve a phased approach of pilot studies by 2030 before possibly wide-scale commercial production by 2050.	Due to physical constraints and the current yield of solar energy technology, Singapore is only able to produce a limited amount of renewable electricity. Therefore, the electricity produced in the near-term will only be sufficient for existing and conventional uses of electricity. As the yield of solar energy technologies improves over time, it may become possible for Singapore to generate sufficient renewable electricity that can be used to generate heat and steam.
48.	Use of phase-change materials for energy storage.	Research is underway in Singapore by NUS, Keppel Data Centres and Singapore LNG Corporation to study the potential to make use of the energy storage properties of phase-change materials to cool data centres more efficiently. At the same time, BCA's Super Low Energy Building Technology Roadmap has also highlighted the potential for phase-change material to be used in paints on building facades to reduce the rate of heat gain by the building. NEA has also awarded a research

		project to ERI@N on the use of phase-change material to store and release thermal energy to minimise fluctuation of steam production from the waste incineration process.

G: Green Growth

	Green Growth Opportunities: Sustainable Finance	
1.	Adjust capital requirements to incentivise green investments over brown investments.	MAS is working with Financial Institutions (FIs) to build financial system resilience to environmental risks. MAS will issue Environmental Risk Management guidelines across the banking, insurance and asset management sectors, which will set standards on governance, risk management and disclosure. - These include developing tools and metrics to assess FIs' exposure to environmental risks, and exploring the use of scenario analysis to assess the impact of environmental risks on a forward-looking basis. MAS is also working with FIs to enhance their environmental risk analysis, including assessing their exposure to sectors with higher environmental risks, and incorporating environmental risks into our stress testing scenarios. - The guidelines will further encourage FIs to take reference from international reporting frameworks, including the TCFD's recommendations, in their climate disclosure. MAS recognises that methodologies for assessing, monitoring and reporting environmental risks continue to evolve, and will work closely with our international counterparts to evaluate and mitigate the risks, including through our participation in the Network for Greening the Financial System and the Sustainable Insurance Forum.
2.	Climate-related financial disclosure should be mandatory under the TCFD (Task Force on Climate-related Financial Disclosure) framework. This could apply to all listed companies through the Singapore Exchange (SGX), and all Financial Institutions (FIs) headquartered in Singapore through the MAS.	
3.	Standardise sustainable reporting and regulate private companies towards sustainable disclosure.	
4.	Set mandatory standards for risk assessment that factor in long-term climate risk.	
5.	Climate-related financial disclosure should be mandatory under the TCFD framework. This could apply to all listed companies through SGX, and all FIs headquartered in Singapore through MAS.	
6.	Singapore can continue to encourage sustainable investments and the development of financial vehicles and green bonds through supportive policy frameworks and things like the MAS green bond grant scheme to reduce the barriers to entry for proponents, develop more stringent environmental, social, and governance regulation and deepen its	Singapore has taken early action to promote the integration of green priorities into financial practices, and is working on a comprehensive, long-term strategy to make green finance a defining feature of Singapore's role as an international financial centre. Our goal is to be a leading centre for Green Finance in Asia and globally. There are three key thrusts that we will take: build financial system resilience to environmental risks; develop green finance solutions and markets; and leverage innovation and technology. We are seeing a steady shift among businesses and governments to adopt greener practices, and Singapore sees the scope for deeper collaboration in green finance.

	integration, expand green finance products, and establish responsible financing guidelines.	MAS is committed to developing green finance solutions, such as bonds, loans and funds, that can be used to deploy private capital that support the greening and transitioning towards a low carbon economy. • MAS has taken steps in developing these green solutions. This includes introducing a Sustainable Bond Grant Scheme, which provides an offset to the cost of obtaining external reviews that are necessary to ensure that the green and sustainable bonds are aligned with internationally accepted standards. To encourage an increase in green and sustainable bond issuances in ASEAN, MAS had supported the development of the ASEAN Green and Sustainable bond standards, which reference the International Capital Market Association (ICMA) Green, Social and Sustainability Bond Standards. We will continue to explore other initiatives, including working with potential issuers to grow the green bond market. • Besides bonds, MAS will develop incentive schemes to support the mainstreaming of green and sustainability linked loans that similarly look to defray the additional expenses of external review incurred for such instruments. Concurrently, MAS will also support the expansion plans of these providers that conduct certification, assurance, second party opinions and ratings, in Singapore through grants and incentives. These providers play a crucial role in supporting FIs' efforts to mainstream green finance, and will enhance the diversity of our green ecosystem. • MAS is also deploying up to US$2 billion from our official foreign reserves to green investments. This is achieved through a US$2 billion Green Investments Programme that aims to place funds with asset managers that offer public investment strategies with a strong green focus and are deeply committed to drive regional green efforts out of Singapore and anchor their green technical experts and activity here.
7.	Align the finance sector to the goals of the Paris Agreement. Institutions need to align their financial flows with the Paris Agreement, by setting emission reductions targets for their financing portfolios through the SBTi, including Singapore-headquartered banks, asset owners such as insurance companies and sovereign wealth funds.	
8.	Increase the green bonds and other securities to invest in. MAS to create a robust sovereign green bond framework to issue green bonds on behalf of the government of Singapore.	
9.	Provide incentives for sustainable bonds and loans issuances.	
10.	Create a Green Investment Bank of Singapore to provide low-interest loans for green projects.	Companies have the option of obtaining a sustainability-linked loan (SLL) from local or overseas banks. SLLs offer a lower interest rate to the company upon meeting its sustainability-related performance targets set forth within the SLL. While such loans do not have to be used specifically to fund green projects, the proceeds can be used by companies to improve their sustainability profile. MAS will develop grant schemes to support mainstreaming of green and sustainability linked loans. This will defray the costs that firms incur to develop sustainability frameworks and engage external reviewers.
11.	What is the climate risk to Singapore's national reserves (GIC) and Temasek Holding's investment portfolio? Can NCCS or MAS clarify if the TCFD should be made applicable	GIC and Temasek undertake investment activities to generate long-term returns on a sustainable basis. Both GIC and Temasek emphasise and integrate sustainability considerations holistically into their investment processes. These considerations include climate-related risks.

	to GIC and Temasek Holdings, at least internally to Government if this is too sensitive to disclose publicly?	
12.	Stop providing financial services (e.g. loans) to industries that are highly pollutive (e.g. coal mining); restrict the ability of businesses to fund fossil fuel developments or deforestation in other parts of the world.	FIs' efforts in sustainable financing have to be understood within the regional context, where energy needs are increasing, and coal continues to be a part of the energy mix for the region, even as use of low-carbon energy increases.[1] Alongside directing financing into green activities, it is equally important for FIs to identify activities that support the transition into carbon neutral outcomes. Financial institutions in Singapore have been taking active steps to make their financing practices more environmentally responsible. • For example, our local banks have implemented policies aligned with the Guidelines on Responsible Financing issued by The Association of Banks in Singapore, to evaluate their borrowers' environmental risk, and help borrowers improve their sustainability profiles. All three local banks have also announced their decision in April 2019 to cease the financing of new coal-fired power plants. • Asset managers in Singapore have signed the UN Principles for Responsible Investment and developed the Singapore Stewardship Principles for Responsible Investors. MAS will work with the asset management industry to focus on stewardship roles as they expand their environmental, social, and governance capabilities, as these roles are key in engaging companies to drive positive environmental outcomes.
13.	Increase engagement with the business and financial community on sustainable finance.	To spur the innovation of more Green FinTech solutions, Green Finance will feature as a key horizontal theme for the 2020 FinTech Hackcelerator. Through the FinTech Hackcelerator, MAS will gather and publish problem statements around green finance, for FinTechs to develop solutions that can help FIs and corporates manage the transition to a low carbon footprint business model.
14.	Increase sustainable finance offerings within tertiary institutions.	MAS will be establishing Centres of Excellence (COEs) in collaboration with local and international universities to contribute to Asia-focused climate research and training programmes on green finance. The COEs will support the development of innovative green finance solutions, deepen our understanding of climate risks, and enhance climate risk management in Singapore. The COEs will also train and groom talent in green finance.

[1] The International Energy Agency (IEA) noted in its 'Southeast Asia Energy Outlook 2019' published in October 2019 that strong growth in energy demand would prompt the region to mobilise all fuel and technologies in response. While renewables would play a larger role in power systems, coal is set to retain a strong position in the region's power generation mix, accounting for about 40% of the share of power generation, based on today's policies and plans. However, IEA projections are highly subject to change, and dependent on developments in international climate negotiations.

Green Growth Opportunities – Others		
15.	Singapore is already a trading hub for many different commodities. With this strong history, there is an opportunity to build on this and become a trading hub for carbon abatement.	Singapore recognises the potential of the carbon market to drive greater climate action, and will continue to study the potential of becoming a carbon services hub.
16.	Tapping on both the research capabilities of Singapore universities and the robust entrepreneurial and tech-based start-up industry could yield many opportunities for commercialization and the sale of technology outcomes to the world.	Research, innovation, and enterprise are cornerstones of Singapore's national strategy to develop a knowledge-based innovation-driven economy and society. Since 1995, the government has set out 5-year plans to develop Singapore into a global R&D hub. Public investment in R&D has grown from $2 billion through 1995-2000 (National Technology Plan), to $19 billion through 2016-2020 (RIE2020). NRF is working with partner agencies and stakeholders on the next five-year plan (RIE2025). Through continued commitment to research, innovation, and enterprise, we aim to build up the innovation capacity of our universities and companies to drive economic growth and address national challenges.
17.	Responsible consumption and production transformation of products and business models to allow for more reuse, remanufacture and repair – long before recycling and waste reduction.	To continue to grow sustainably, Singapore must adopt a circular economy approach where resources are used for as long as possible. To promote sustainable waste management and catalyse the transition to a circular economy, the Government introduced the landmark RSA in 2019, which gives legislative effect to establishing a systems-level approach to enable nationwide re-using and recycling of our three priority waste streams: e-waste, packaging waste including plastics, and food waste. To promote the repair trade, NEA has allocated space in some hawker centres for businesses which repair small household appliances or clothing, and will continue to explore new ways to make it more convenient for people to repair their goods. This includes compiling a list of repair options in Singapore. NEA also supports NGOs and corporates, such as Repair Kopitiam, to promote repair workshops and courses in the community.
18.	Revive karang guni man culture to encourage recycling.	
19.	Recycle discarded tires as running tracks in stadiums.	
20.	Use recycled plastic to build roads.	
21.	Green Chemistry; chemical recycling for plastics.	
22.	Review Intellectual Property (IP) regulations to prevent firms from keeping information on how to repair their products proprietary, enabling self-repair.	
23.	Continue to invest in research and development of green growth with industries inputs on urban	One of the domains in RIE2020, Urban Solutions and Sustainability (USS), focuses on enhancing our living environment and address our resource constraints. This includes devising new urban

	solutions and sustainable sector which encourage piloting, test-bedding and accelerating adoption of green technologies, e.g. Water hub.	mobility solutions and building the next generation smart grid, and lowering the energy consumption of used water treatment, seawater desalination, and NEWater production. USS will take an integrative approach to reap synergies at the intersection of the energy-water-land nexus. Government agencies in the USS domain will continue to collaborate with industry partners to create economic value and establish Singapore as an international hub for sustainable urban solutions. The government provides support for companies in embracing innovation through equity co-investment schemes, and research consortia formed from industry and research centres to co-create and commercialise these solutions. For example, the GBIC integrated R&D hub at the BCA Academy, and Waste-to-Energy Research facility in Tuas South will serve to accelerate the translation of R&D to commercial use and encourage greater industry adoption in the areas of green buildings and waste-to-energy.
24.	Food waste recycling – adopt widespread food recycling solutions in hotels, hawker centres, residential units.	To tackle this issue, from 2024, owners and operators of larger commercial and industrial premises (such as hotels and malls, large industrial developments housing food manufacturers and food caterers) will be required to segregate their food waste for treatment from 2024. These premises can choose a treatment method that best suits their operations. From 2021, it will also be mandatory for developers of new premises to allocate space for on-site food waste treatment systems during the design phase, starting from 2021. Besides recycling food waste, it is also important to tackle the food waste challenge at the source. Guides to minimising food waste have been developed for consumers, food retail establishments, supermarkets, and food manufacturers, along with various campaigns to raise awareness about reducing food waste. As part of the Year towards Zero Waste, the Food Waste Reduction campaign was re-launched in February 2019, in partnership with hawker centres, supermarkets, and schools to engage consumers at points-of-consumption.
25.	Agriculture, especially agri-business and agri-tech to hedge against future shortages; investigate methods such as permaculture, silvopasture, regenerative agriculture, tree intercropping, Climate-friendly food industries.	Singapore imports more than 90% of our food needs, making us vulnerable to the global fluctuations. To ensure that Singapore's food security continues to be resilient, SFA takes a multi-prong approach comprising: i) diversification of import sources, ii) grow local and iii) grow overseas. In 2019, we announced the '30 by 30' goal, where we aim to transform our agri-food sector to produce 30% of our nutritional needs by 2030. Key to this is for our farms to harness technology and innovation to grow food in a productive, climate-resilient and sustainable way. We have some first movers in our midst. Sustenir produces vegetables and fruits such as kale and strawberries in an indoor, high-tech vertical setting, using IoT and sensors. Such climate-resilient solutions make

		farming more like manufacturing – where production takes place within a controlled environment with a defined input. The result is an assured and consistent output, and a predictable way to address the effects of climate change and extreme weather.
26.	More flexible zoning classifications (industrial, agriculture, residential) that welcome agriculture in a wide range of technology and methods	SFA has been working with agencies such as HDB, SLA to avail more spaces for farming and bring food closer to homes. Urban farming in alternative spaces such as vacant multi-storey carparks, vacant state buildings and rooftops is gaining interest. This involves innovative use of spaces in the urban environment to farm. It reduces carbon footprint and raises awareness on the importance of food security by involving the community directly in food production. An example of farming in alternative spaces is the urban farm pilot by Citiponics in Ang Mo Kio. Citiponics is the first commercial farm on the rooftop of a multi-storey car park. The practice of urban farming has picked up both in scale and sophistication globally in recent years. In Singapore, we facilitate rooftop farming, which potentially enhances our food supply resilience, and also introduces more greenery into the built environment. On a broader scale, Singapore is looking to develop a model of urban indoor food production that can help Singapore become a leading urban agriculture and aquaculture technology hub. This will also help to improve the productivity of local farms and buttress our food security. The Agri-Food Innovation Park (AFIP) is a pilot cluster to catalyse innovation in the agri-tech ecosystem by bringing together high-tech urban indoor farming and associated R&D activities. AFIP will be part of the larger Northern Agri-Tech and Food Corridor together with synergistic elements such as industries in Senoko Food Zone, farms in Lim Chu Kang and Republic Polytechnic.
27.	Waste management and disposal.	Everything we produce, consume and dispose of has an impact on the climate. The 'take-make-throw' economy is unsustainable in an increasingly resource-constrained and carbon-constrained world. However, this dilemma also presents an opportunity to rethink how we deal with waste and forge new paths for growth. To produce and consume sustainably, we need to adopt a circular economy approach, where materials are retained and reused in the value chain for as long as possible. This complements and supports our climate agenda. Extracting fewer raw materials from the ground, designing products that last, and repurposing our waste all help to reduce emissions. One example of how waste can become a green growth opportunity is NEWSand, which refers to residues from waste treatment that are environmentally safe for use in construction applications. Just like NEWater, NEWSand is born out of our determination to overcome constraints and create a precious resource from what would otherwise have been thrown away. NEWSand will help Singapore to close our waste loop, and extend the lifespan of Semakau Landfill. NEA will soon
28.	Waste has no potential for green growth, as greater waste is produced by greater consumption and production of unnecessary goods and services.	

		conduct a field trial on the use of treated incineration bottom ash (IBA), one of the possible forms of NEWSand, as a road base and sub-base material in road construction projects.
29.	Energy Hub – Energy Storage Systems for export internationally; clean energy, nuclear, tidal power, shift Singapore's manufacturing base towards related capital equipment (e.g. solar PV, electrical grid storage monitoring and distribution, turbines, carbon capture catalysts, nuclear power plant and rail).	Leading companies such as REC Solar and Neste, which produce solar PVs and biofuels respectively, have chosen to set up operations in Singapore. This is testament to our efforts to grow our industry. Singapore will continue to attract and anchor world-class investments in related fields, to capitalise on green growth opportunities.
30.	Recycling industries especially glass, plastic and paper. Recycling of solar panel which require safe disposal, is a potential growth area.	Recycling is one of the ways where we can work towards zero-waste, and cut down on the amount of raw resources that we use. Companies can tap on NEA's 3R Fund to implement waste minimisation and recycling projects. Projects with new and innovative processes and concepts, and which target waste streams with low recycling rates such as food, plastic and glass will be given higher priority. Given that solar power remains Singapore's most viable renewable energy option, and we are prioritising R&D efforts in maximising the deployment of solar PV systems, it will be important to consider the end-of-life management of PV panels. When the EPR framework is introduced for e-waste by 2021, it will also cover PV panels.
Requirements to build a green growth ecosystem		
31.	EDB to develop partnerships internationally to identify high potential direct foreign investment channels for green industries and jobs growth, and to identify export markets for new green technology IP.	Recognising the need to develop Singapore's economy in a sustainable manner, the Government is working closely with both local and foreign enterprises to develop decarbonisation options and to catalyse investments in such technologies. These include technology areas listed in the other sections such as solar (see Section C on Clean Energy), low carbon technologies (see Section F on Emerging Low Carbon Technologies) etc. EMA and Sembcorp are collaborating on the Sembcorp-EMA Energy Technology Partnership (SEETP), a $20 million initiative to encourage the translation and commercialisation of energy research into technologies and solutions to address Singapore's energy needs. Thus far, one of the awarded R&D projects will develop solutions to recover low-grade waste heat and enhance EE at industrial plants. The development of decarbonisation options will enable Singapore's industry and economy to grow while still meeting our national climate change commitments. This will enable continued growth in GDP and good jobs.
32.	EDB to research the new jobs creation potential in at a minimum each of the following green sectors: a. CCUS b. Solar, PV, and wind c. Circular manufacturing d. Dynamic, intelligent electricity grid e. Net positive buildings f. Sustainable walkable urban design g. Vertical farming h. Plant-based protein i. Soil carbon sequestration	

	j. Next generation nuclear k. Coastal protection	The Government will continue to work together with all stakeholders to continue growing our economy. We are constantly looking into other initiatives to lower our carbon footprint, which include partnering the industry to harness the potential of low carbon technologies such as CCUS, and studying the opportunities in a circular economy.
33.	Common green growth targets need to be fixed to allow the government and private sector to work together to build a green ecosystem in Singapore.	
34.	Efficient power generation, cogeneration plants, energy storage systems, waste heat recovery systems and carbon capture storage systems are key components required to build a green growth ecosystem in Singapore.	
35.	Setup transition fund to provide financial support for industries that chose to voluntarily decommission and transition out of certain sectors via M&A, spin-off, write-off via a state facilitated buy-out programme.	
36.	The Government must take the lead to create the awareness, and create the policies to support it. Set up governmental committee for the greening of Singapore's economy with a task force to ensure the just transition of affected workers. The key components are the market users, suppliers, technology, funding, training, and public awareness.	
37.	Put together a group of experts with a track record of helping companies go green from various sectors, form a board and have them spearhead green growth in applicable sectors.	
38.	Need to increase the transparency of data on energy pricing, consumption and resource use. Increase public access to information about when and where energy demand is high and energy supply is plentiful, and what sources are the most efficient, cleanest, and affordable to accelerate clean energy development.	Most of this information can be found on the EMA website, and in the Singapore Energy Statistics published annually. Other information on location and timing of energy demand and supply is sensitive, and cannot be released publicly.

Reskilling Workers for a Low Carbon Economy		
39.	Provide workers/executives in heavily polluting industries a way out by reapplying their skillsets in green growth efforts; use of regulations and tax incentives can develop a green growth ecosystem and pressure companies to naturally invest in upskilling their workers (e.g. through Accessible Bridging Courses, collaboration with tertiary education providers); follow the example of China.	The Government will continue to work with industry and our institutes of higher learning, to ensure that our workers and students have the necessary skills and qualifications to tap on the opportunities of a green economy. The A*STAR Graduate Academy provides scholarships and fellowships to enable young aspiring scientific talent to pursue their passion in science, and prepare them for a rewarding career in R&D. Besides scholarships and awards for undergraduate, PhD, and post-doctoral studies at top universities and laboratories locally and overseas, A*STAR also offers awards and attachment opportunities for pre-university students.
40.	Leverage on technical knowhow of workers in the oil and gas sectors (e.g. adapting their knowledge of safe handling of combustible fuels for the pivot to hydrogen; utilising oil rig platforms expertise to develop offshore solar and wind products).	
41.	Grow local talent to conduct R&D in clean energy innovation, promotion of STEM subjects, to give people more ownership of the country and innovation.	
42.	There could be a Green Economy Career Roadmap Plan for the workers so that businesses can be better prepared on the future training needs planning for their staff. MOM to map the skills requirements for each shortlisted industry and create the necessary education programs through partnerships with polytechnics and universities	
43.	Ensure that education course curriculum is up-to-date with the government mid-to-long term green economy plans.	
44.	Incentivise Singapore-based green companies to train students and young professionals or to requalify experienced energy professionals	

	with a different background (e.g. from the conventional power sector).	
Others		
45.	Adopt green technology as the central focus of A*STAR.	A*STAR is Singapore's lead public sector agency that spearheads economic-oriented research to advance scientific discovery and develop innovative technology. They specialise in biomedical sciences and physical sciences and engineering research, with research focus including Chemicals, Material and Energy, and Pharmaceuticals & Biologics. Many of these disciplines are key sustainability enablers and provide answers to many challenges that we face today. A*STAR established the Urban and Green Technologies Office (UGTO), which coordinates, guides, and directs development of urban and green technologies in A*STAR. Besides green technology, there are also many other areas of research which contribute to the well-being of lives in Singapore and beyond, improving outcomes in sustainability, urban living, and healthcare. It is important that we keep developing innovation and continue R&D in these areas as well.
46.	Develop a strategic plan to shift the economy away from petrochemical, oil and gas and other emissions-intensive industries, as well as fossil fuel projects.	The energy and chemicals (E&C) sector is currently emissions-intensive. At the same time, even as the world decarbonises, the energy and chemicals sector will continue to be important. Collectively, they produce many products that remain critical to the needs of businesses and households, such as pharmaceuticals and plastics for a variety of products, including lightweight composite materials for electric vehicles. The Government will work with these sectors to decarbonise as we move towards a low carbon economy. Emerging low carbon technologies such as CCUS and use of hydrogen can enable the decarbonisation of Singapore's E&C sector.
47.	Set legal barriers for entry of new carbon pollutive business entities and processes; Create legal responsibility for the highest carbon polluters to develop decarbonisation plans.	
48.	Give Sembcorp, Shell and other emitters a 10-year window to shift energy production to renewables, providing them with the resources to shift to renewables.	
49.	Convert Jurong Island into a large floating solar panel and electricity storage complex	

H: Collective Climate Action

Responsibility for Climate Action		
1.	The onus to reduce energy consumption and switch to renewable energy should be on industries as they produce ten times more emissions than households do. Individual actions on the household level are negligible in reducing overall carbon consumption compared to industry.	A whole-of-nation effort involving individuals, businesses and industries is needed to achieve our carbon-reduction goals. Individuals can contribute to sustainable development by adopting sustainable consumption as a lifestyle. Actions such as saving electricity, and taking public transport may seem small but can collectively make a difference. The Government is also committed to working with businesses and the community to take climate action, and has put in place a comprehensive suite of measures to reduce our carbon emissions.
2.	The public has become desensitised to the generic 'save the environment' message and feel that individual actions matter very little.	
3.	Consumers are more likely to embrace a systemic change to lifestyle (effected by policies like centralised air-conditioning or a mandatory waste segregation culture) than to practice recycling/austerity on an ad hoc basis.	
4.	The latest expansion of Jurong Island renders individual environmental protection efforts negligible and commits Singapore to more carbon intensive infrastructure while creating more stranded assets.	New and existing refineries and chemical plants in Singapore will have to upgrade over time in order to meet future environmental regulations such as Euro VI specifications on transport fuels and IMO regulations on bunker fuels. This will allow the petrochemical and refinery facilities to contribute towards the demand for cleaner fuels. The energy and chemicals sector will continue to be important. Collectively, they produce many products that remain critical to the needs of businesses and households, such as pharmaceuticals and plastics for a variety of products, including lightweight composite materials for electric vehicles. We are ensuring new energy-intensive investments are best in class and existing industrial facilities improve their EE by mandating the implementation of energy management systems, and periodic energy audits, in addition to current annual reporting of improvement plans.

Climate-Friendly Diets		
5.	Encourage people to eat less meat, particularly beef. Recommend plant-based foods with high nutritional value. Meat (exclude chicken) and dairy tax. Revenue can be used to subsidise vegetarian products and research into other alternatives. Stipulate that school canteens must have vegetarian providers that sell mock meat to assist in meat-lovers' transition to vegetarian diets.	Dietary preference, specifically the choice of adopting a plant-based diet, is a personal one. Both plant- and animal-based diets can help us meet our nutritional needs. The Health Promotion Board's (HPB) recommendation is to maintain a balanced and varied diet, and to eat across all food groups. This can be achieved through a variety of eating patterns. A simple guide is to fill half our plate with fruit and vegetables, a quarter with wholegrains such as brown rice and wholemeal bread, and the last quarter with protein foods such as bean products (e.g. tofu and legumes), seafood and meat. Should individuals prefer a plant-based diet, there are a variety of quality protein food such as dried peas and beans, other than tofu, available in the market, and there can be diverse ways to prepare them and add interest to our diet. Similarly, children are encouraged to maintain a healthier, well-balanced diet, consisting of food from different food groups, to ensure they receive the right nutrients necessary for their growing needs. HPB partners with all schools to ensure students have access to nutritionally balanced meals which include a variety of plant-based options.
Ways Businesses Can Encourage Climate Action		
6.	Encourage companies to prioritise sustainability in marketing and service differentiation (e.g. not displaying disposable cutlery as a selling point for self-checkout stations).	The Government, businesses and consumers need to work together to create a sustainable business environment. More companies are going green, with initiatives to reduce the use of plastic bags or disposable cutlery. There is also growing consumer support for such initiatives. As consumer demand for sustainable practices increases, brands will continue to put more focus on green efforts. The Government launched 3R Awards for Shopping Malls to recognise shopping malls and mall retail tenants in Singapore that have made notable contributions to waste minimisation through the implementation of the 3Rs (reduce, reuse, recycle) at their premises. The 3R Awards for Hotels also recognises efforts by hotels to reduce, reuse and recycle waste, and promotes sharing of best practices to improve collective 3R efforts within the hotel industry. The choice to apply for these international certifications is a business decision, and may be motivated by the brand's consumers who demand sustainable products. ESG supports companies' capabilities building effort through Enterprise Development Grant. Companies are encouraged to adopt certifiable sustainability standards such as ISO 50001 – Energy Efficiency Management System, ISO 14064 – Greenhouse Gas Management, ISO 46001 – Water Efficiency Management System and SS 587 – End of Life ICT Management Systems. These standards will help them to set up a systematic process to manage their resources. More information is available
7.	Incentivise businesses and organizations to adopt management systems such as ISO 26000 (Guidance on Social Responsibility) and ISO 14001:2015 (Environmental Management System) so that businesses will take a systematic approach in practice of 3Rs. Regulation to ensure clothing/fashion businesses use sustainable practices (recycled materials, ethical labour, etc.).	

		at https://www.enterprisesg.gov.sg/financial-assistance/grants/for-local-companies/enterprise-development-grant/market-access/standards-adoption. In general, adoption of ISO 14001:2015 has not been supported since June 2017 as it is deemed as matured and baseline. However, ESG may offer support to applicants if there is a strong business case to do so. ESG will evaluate the supportability on a case-by-case basis. Note: ISO 26000 is a guideline and non-certifiable. ESG can work with a certification body (CB) to explore reviewing this into a certifiable standard if there is a lead demand driver who is keen to work with ESG to promote this. The addressable pool will allow CBs to decide if there is a business case for it.
8.	Supermarkets to have stations where products like cooking oil and detergent can be refilled as opposed to buying a new container.	There are some wholesale centres and supermarkets that offer consumers the choice to buy loose products (e.g. toiletries, pantry staples, dried food, etc.) in bulk or in small volumes. Consumers can choose to bring their own containers / bags for their purchases. These types of supermarkets are not yet as widespread as typical supermarkets, and will take time to become more mainstream. Their growth will be encouraged by increasing demand from consumers who support such initiatives in an effort to reduce packaging consumption.
9.	Suppliers of fresh fruits and vegetables, meats and eggs to reduce Styrofoam and plastic packaging.	While packaging helps to extend the shelf-life of food and facilitates the handling of food, there is potential to reduce packaging at the supply side of food products. For example, the Singapore Packaging Agreement (SPA) is a joint initiative started in 2007 by the Government, industry and non-governmental organisations (NGOs) to reduce packaging waste. Since its inception, more than 200 organisations in Singapore have worked together to cut down on packaging waste. As of 2019, they have cumulatively reduced about 54,000 tonnes of packaging waste, resulting in estimated packaging material cost savings of $130 million for locally consumed products.
Climate Action Through Reducing Single-Use Plastics		
10.	Ban/reduce single-use plastics or switch to more sustainable options at F&B and grocery stores, public events, government venues, restaurants for the following items: straws (cardboard) cutlery (wood) containers (cardboard) bags (paper), biodegradable polymers.	The Government is taking a long-term, holistic approach to tackle excessive consumption of disposables, including single-use plastics. NEA launched the "Say YES to Waste Less" campaign in June 2019 as part of the Year Towards Zero Waste movement to drive awareness of the impact of excessive consumption of disposables and the need for reduction. Some 1,600 premises, ranging from retailers, food and beverage establishments, supermarkets, hotels, Community Development Councils, grassroots organisations, schools and non-governmental organisations have participated. We have also disallowed the use of disposables for dine-in meals in several hawker centres.
11.	Prevent supermarkets or businesses from giving out gifts or souvenirs made of plastic.	

12.	Plastic bag tax/convenience tax to charge for single-use plastics like bags and cutlery at F&B and supermarkets (European nations charge about $1).	Moving upstream, NEA will require brand owners, manufacturers and importers of packaged goods, as well as supermarkets with an annual turnover exceeding $10 million to report information on the packaging they place on the market, and their plans for reducing, reusing or recycling packaging annually. This will increase companies' awareness of the potential for waste reduction in their business operations. The mandatory reporting framework will lay the foundation for the EPR framework for managing packaging waste including plastics no later than 2025, or even earlier. We also encourage supermarkets and retailers to implement their own initiatives to reduce excessive use of disposables. This include, for example, the implementation of a plastic bag charge trial by retailers such as NTUC FairPrice and BreadTalk. This year, we will also convene a Citizens' Workgroup for Singaporeans from diverse backgrounds to come together to discuss how we can collectively reduce disposables.
13.	Penalties for companies using excessive plastics.	
14.	Mobile app for store customers to accumulate points when using their own bags instead of plastics – points can be exchanged for gifts.	
15.	Provide comprehensive information to compare the carbon footprints of single use plastics and their alternatives; incorporate carbon footprint costs into product prices.	There are many considerations and various calculation methods used for estimating the carbon footprint of any product or activity: country of origin, transport modes and distances, etc. It would be difficult to impose a single way of pricing a product's carbon footprint globally. There are many carbon footprint calculators available online, some of which can be customised to people living in different countries and with various lifestyles. They provide an approximated carbon footprint of the average person, and are a good way for individuals to estimate their carbon footprint. These calculators may also provide information on which aspect of an individual's lifestyle contribute the most to their carbon footprint, and thus inform the individual on alternative choices they can make to reduce their carbon footprint.
16.	Implement an island-wide system of reusable takeaway boxes with a deposit fee, with boxes to be dropped off at collection machines to be washed and reused.	We support ground-up initiatives that encourage consumers to choose reusables instead of disposables. For example, NEA has provided funding support to Zero Waste SG for its Bring Your Own/Bring Your Own Bag campaign to encourage consumers to use reusable bags and containers when they buy takeaway food, beverages and groceries. Companies such as barePack (in operation) and Muuse (starting from February 2020) are starting to provide technology-enabled rental services at F&B outlets for reusable containers and cups, in order to provide convenience for consumers while eliminating the use of disposables. Consumers can also make a conscious effort to bring their own reusables for takeaway meals, such as lunchboxes, cutlery, and cups. Many eating establishments also charge a fee for using disposable takeaway boxes, which also encourages patrons to bring their own reusables.

17.	Implement enclosed waste disposal containers at HDBs to eliminate need for plastic bags.	Our waste collection infrastructure, such as refuse chutes, bin centres and waste collection vehicles, has served us well in maintaining high environmental public health standards by ensuring that waste is properly collected and sent for disposal. Changes to infrastructure requires careful planning. It also requires us to take into consideration our unique urbanised, high-rise living context. As such, we will take a pragmatic approach and find an inclusive solution to address excessive consumption of disposables that works for Singapore and Singaporeans.
Climate Action Through Waste Reduction/Disposal		
18.	Require supermarkets, grocery stores, hotels and hawker centres to monitor and declare food wastage from expired goods.	To encourage the sale of perishable or slightly blemished products, NEA encourages supermarket operators to consider the promotion of these goods. For example, supermarkets are encouraged to set up a marked-down section where consumers can purchase food products nearing their expiry dates or slightly blemished fruits. Furthermore, visual reminders can be placed to prompt consumers to handle food with care, avoid squeezing or prodding fruits and remind consumers that slightly blemished produce is still fit for consumption. Alternatively, excess food may be donated to the needy instead of discarding it. As part of NEA's ongoing 3R (Reduce, Reuse, Recycle) outreach effort, NEA encourages businesses and members of the public to donate their unsold or excess food to food distribution organisations. Food manufacturers, food retail establishments and supermarkets can directly contact food distribution organisations to arrange for the donation of their unsold or excess food. Similarly, members of the public can donate safe and edible food items at various collection points. A non-exhaustive list and contact details of food distribution organisations can be found on NEA's website: https://www.nea.gov.sg/our-services/waste-management/3r-programmes-and-resources/food-waste-management/food-distribution-organisations-local-recycling-facilities-and-suppliers. Organisations or individuals who are donating food bear the responsibility of ensuring the safety and quality of the food as they have the greatest control over the handling of the food items before they are donated and are in a better position to ensure that they are safe to eat. Guidelines to ensure food safety of distributed food are provided by NEA in partnership with Singapore Food Agency and are available on NEA's website.
19.	Require supermarkets, hotels, restaurants, shops to give away/resell at lower price items which have passed their best-by dates instead of throwing; waive the shop's responsibility for these as takers should check for spoilage.	
20.	Local food branding and certification to support a range of grades of "ugly" local produce to reduce wastage.	
21.	Government to work with third party organisations to collect best-by items for soup kitchens like in the UK.	
22.	Change consumer behaviour around food intake to minimise carbon footprint and food waste.	To raise awareness on Singapore's food waste situation, and to encourage the adoption of food waste reduction habits, NEA has been running the Food Waste Reduction Publicity and Outreach Programme to engage the public since 2015. The programme uses informational advertisements and educational videos to showcase practical ways to reduce food waste. These ads and videos are featured on various mass media platforms to

		reach the public. A comprehensive handy guide comprising of tips on reducing food waste in various scenarios was also developed, made available online and distributed at community events. Since 2015, NEA has been ramping up engagement efforts, such as talks, food waste reduction demonstrations and other activities with support from the Food Waste Reduction Ambassadors (FWRAs) programme. To date, more than 400 ambassadors have been trained to help spread the word on food waste reduction to their communities, families and friends. As part of the 2019 Year Towards Zero Waste, NEA collaborated with 25 Hawker Centres and organisations such as Dairy Farm Singapore, NTUC Fairprice, Prime Supermarket and Sheng Siong Supermarket, as well as schools and Institutes of Higher Learning, to engage consumers at point-of-consumption through publicity and initiatives to reduce food waste. 2019's campaign highlights three key actions that consumers can adopt to reduce food waste: order only what you can finish, ask for less if you can't finish the food, and say "No" to extra dishes that are unlikely to be consumed. Hawkers and patrons were encouraged to "buy, order or cook just enough". Visual reminders were also placed at high-visibility locations in hawker centres to provide behavioural cues. NEA also partners with organisations such as Food from the Heart, and Community Development Councils (CDCs) engage schools through activities to promote food waste reduction. NEA supports these organisations through funding and/or provision of resource kits to aid in outreach.
23.	Impose a tax on waste disposal.	Currently, the refuse collection fee (inclusive of GST) for flats and landed residential properties is $8.25/month and $27.47/month respectively. Waste collectors also pay a gate fee of $77/tonne to dispose waste at the incineration plants. While there are currently no plans to implement a tax on waste disposal, we will continue to explore ways to encourage waste minimisation among businesses and households.
24.	Underground Anaerobic Digesters to process organic waste, including in schools, switch from abiotic to biological processing.	There have been two food waste digester pilot projects funded through the Public Sector Takes the Lead in Environmental Sustainability (PSTLES) Demonstration fund. These aerobic digesters are being piloted at Republic Polytechnic and Pioneer Junior College, and can recycle at least 26 tonnes of food waste annually. The compost produced is used as fertiliser on the school grounds. Through such projects, the Government aims to encourage the adoption of innovative solutions for some of the sustainability challenges Singapore faces. If the projects are successful, they will be rolled out to more public sector buildings. To further promote source-segregation and food waste recycling, NEA also supports companies in implementing food waste minimisation projects, such as on-site food waste treatment systems under NEA's 3R Fund. NEA has so far co-funded 24 on-site food waste

		treatment systems at premises such as Resorts World Sentosa, Parkway Parade and InterContinental Singapore Robertson Quay under the 3R Fund. The public sector aims to set an example in the adoption of food waste recycling through the PSTLES initiative. MEWR and NEA will work with large public sector building owners with canteens to implement food waste segregation for treatment. NEA has also identified suitable hawker centres to install on-site food waste treatment systems under the Public Waste Collection (PWC) contracts. Apart from on-site food waste treatment, co-digestion of food waste and used water sludge will also be implemented at Tuas Nexus, which is scheduled to complete in 2024. Results from a trial project have shown that the co-digestion process can triple biogas yield, compared to the treatment of used water sludge alone.
Climate Action Through Recycling		
25.	Public education for correct use of recycling bins, comprehensive list of what items can be recycled and the products made from recycled waste: e.g. roadshows (elderly), posters (general public) and school campaigns (youths).	As part of the 2019 Year Towards Zero Waste campaign, MEWR and NEA launched the #RecycleRight movement to encourage Singaporeans to recycle correctly. One of the approaches is to educate Singaporeans on recycling right to reduce contamination. The four key messages under the #RecycleRight Campaign are: a. Only place the right recyclables into the blue bins, not general trash – follow the labels on the blue bins on what can be put inside. b. Make sure the recyclable items are clean and free from food and liquid waste. c. No need to sort different types of recyclables for the blue bins – they will be sorted centrally before being recycled d. Separate reusables (clothes, shoes, stuffed toys) from recyclables – reusables that are in good condition should be donated. To further support this messaging, NEA has redesigned the labels on the blue recycling bins to make information clearer on what can and cannot be deposited in the bins. We also recognise that it is important to make recycling convenient and to make it a habit in order to boost household recycling. Therefore, since August 2019, NEA has been in partnership with IKEA

		Singapore to provide residents of Build-to-Order flats in new HDB precincts with a free household recycling bin to make it easier for residents to recycle in their own home.
26.	Mandate or encourage the segregation of waste (like in Taiwan, Korea, Germany and Japan) in tandem with community level campaigns.	Singapore adopts a commingled approach for the collection of household recyclables under the National Recycling Programme. The public does not need to sort their recyclables according to material type. All recyclables are collected in the same bin and transported to material recovery facilities where they are sorted, baled and sent for recycling. The commingled approach makes recycling more convenient for the public, takes up less space and facilitates more efficient collection of recyclables.
27.	Promote onsite composting of suitable waste with facilities provided close to residential estates (e.g. on each floor/block of HDBs) and parks; use methods like mulching to compost leaf litter.	Composting requires considerable effort to ensure that the right balance of moisture and waste composition is maintained at all times; the wrong composition would attract pests or emit a bad odour. The compost would also need to be channelled towards gardens or farms for use. Thus, public composting facilities may not be the most suitable. As part of efforts to encourage community gardening, NParks provides advice on DIY composting methods. More information can be found at: https://www.nparks.gov.sg/gardening/gardening-resources/caring-for-plants/composting. Various community gardeners recycle food waste from the kitchen via various composting methods, such as vermicomposting and bokashi composting, to produce fertiliser for their plants.
28.	Install Reverse Vending Machines for recycling.	Under the 'Recycle N Save' initiative launched in October 2019, NEA and F&N are working towards deploying 50 Reverse Vending Machines (RVMs) at various locations across Singapore by March 2020. These machines will give rewards to users who deposit plastic beverage bottles or aluminium drink cans and aim to encourage and reward an eco-conscious lifestyle. For more information on this initiative, please visit RecycleNSave.sg.
29.	Promote thrift shops and clothes swapping events to promote reuse of items, provide support for repair, recycling and maintenance companies and organisations, showcase ground-up efforts.	The Government currently supports activities such as clothes swapping by Swapaholic, collection of pre-loved items by City Developments Ltd through their EcoBank project and Food from the Heart through their Toys Buffet project and projects promoting repair by Sustainable Living Lab. They are supported by ongoing 3P grants such as Partnership Fund and Call for Ideas Fund, which the community and corporate organisations can tap into, as well as the Towards Zero Waste Grant (TZWG). TZWG was created in 2019, in line with it being the Year Towards Zero Waste, to support ground-up initiatives that drive waste reduction and recycling in any of the three key waste streams – packaging waste, food waste and electrical and electronic waste, or encourage households to recycle more and/or right. The grant was open to individuals, interest groups, non-governmental organisations, grassroots organisations and corporations from 1 February 2019 to 31 January 2020.
30.	Incentives for recycling such as exchanging washed plastic bottles for useful items, green tax rebates. Companies could reconsider collecting back the product bottles. E.g. "Pay with Plastic" events.	

31.	Increase the ease of recycling e-waste, place 1 bin in every cluster of housing blocks/condo development.	NEA will be implementing an EPR framework for E-waste management by 2021. Under the EPR system, NEA will be appointing a Producer Responsibility Scheme (PRS) operator to organise the collection and recycling of consumer products, and the operations of the PRS will be financed by the producers of regulated consumer products. The PRS operator will be required to develop programmes to encourage the public to recycle e-waste and provide avenues for e-waste collection (e.g. scheduled collection drives and set up a network of e-waste bins in publicly accessible areas), collect and transport the e-waste to NEA-licensed e-waste recyclers, and report the tonnage of e-waste collected to NEA. In addition, retailers of regulated consumer products will be required to provide free one-for-one take-back services during delivery. Large retailers with floor area of 300m^2 and above will also be required to set up in-store e-waste collection points for ICT equipment, lamps and batteries, and ensure that the e-waste is collected by the PRS operator.
32.	Start SkillsFuture courses on upcycling or creative reusing.	SkillsFuture currently provides a variety of professional courses related to waste management and recycling. Interested participants may wish to learn more at https://www.myskillsfuture.sg/.
		Others
33.	Implement measures to halt population growth (e.g. Stop At Two policy, encourage families to factor climate impact into account when having children) and reduce the population to reduce consumption.	Both climate change and population trends are critical to Singapore's survival and sustainability over the long term. A sustainable citizen population is necessary to maintain our sense of national identity as Singaporeans, keep our economy vibrant and ensure that Singapore continues to survive and succeed into the future. Fertility rates are already declining globally and Singaporeans fall far short of replacing ourselves. In the medium term, there will be fewer young Singaporeans entering the workforce even as the larger cohorts of baby boomers retire. As a result, the number of Singaporeans aged between 20 and 64 years will peak around 2020 and gradually decline thereafter. The majority of young Singaporeans still want to get married and have children. We must continue to support them by making Singapore a great place to raise families. Our objectives in addressing both climate change and low fertility are not irreconcilable. Each of us can do our part to reduce emissions by making environmentally-sustainable life choices and consumption patterns that reduce our carbon footprint. We have a responsibility to bring up our children with the right values and with a strong environmental consciousness, so that they too can be part of the solution to address climate change.

I: Climate Change Awareness and Education

Communicating the Severity of the Crisis		
1.	Declare climate defence as the 6th Pillar of Total Defence, subsuming related campaigns (e.g. Reduce Plastic, Reduce Waste, Use less Water, Save Electricity).	PM Lee discussed the issue at length in the 2019 National Day Rally because the Government recognises that climate change is an existential issue for Singapore. As mentioned by PM Lee, climate change defences should be treated like the SAF is – with utmost seriousness. This underscores the salience that is placed on this issue.
2.	Declare a national climate emergency.	
Increasing Awareness and Driving Climate Action		
3.	Collaborate with influencers to champion green efforts.	In 2019, in conjunction with the Year Towards Zero Waste, MEWR released a set of #RecycleRight videos in four languages featuring celebrities such as Denise Keller, Joanna Dong, Atyy Malek and Udaya Soundari. In the behind-the-scenes videos, the celebrities also shared their personal recycling and waste reduction tips. Moving forward, the Government will continue to study ways to encourage climate action through the engagement of influencers/celebrities.
4.	Campaigns to emphasise personal values and the social responsibility of environmental protection. Values are what motivate Singaporeans, not financial figures. Emphasise concern for the future, the future of their children as well as what could be impactful are key motivators.	The Year of Climate Action (YOCA) organised by MEWR emphasised the need for collective climate action for a sustainable future. Across the MEWR family, YOCA saw about 800 climate action-related events initiated and organised; these efforts were a result of ground-up support, with green initiatives championed by individuals, schools, businesses, non-profit organisations and more. NEA also launched the "Energy-Saving Challenge" in 2017 and 2018 to demonstrate how easy it is to save energy and have an impact on the future through a fun campaign calling households to practise simple energy-saving habits as a way of life to reduce their electricity consumption and contribute to a sustainable environment as well as to increase awareness of how our energy-saving efforts could also contribute to climate action. NEA also works closely with partners to reach out to school students. For example, Panasonic runs an initiative to coach students to increase their awareness of environmental measures adopted by industries. Girl Guides Singapore and Singapore Scouts Association, run a Uniformed Group Badge Programme, where students complete quizzes and carry out projects to earn the Resource Conservation badge. NEA also developed an EE-themed Virtual Reality game unit aimed at teaching school-going children about energy saving practices at home, such as setting the air-conditioner at 25°C or more, identifying energy-efficient appliances, etc.

		In line with 2019 being designated as the Year Towards Zero Waste, the "Say YES to Waste Less" nation-wide campaign was launched by NEA to drive awareness of the impact of excessive consumption of disposables and the need to reduce their use. It also called for more sustainable consumption and production of resources, and the adoption of circular economy initiatives. The campaigns' visuals and creatives emphasised the individual's responsibility in making the right choice for the next generation's future. In 2020, MEWR will be running another campaign to raise awareness of the need to take climate action, and to encourage all stakeholders to play a part for our future generations.
5.	Engage communities to educate them on small gaps in areas of decarbonisation. For instance, most food waste that biodigesters process is dehydrated, but requires an additional step to become useful as a fertiliser in which local communities can play a part.	There are a variety of not-for-profit and non-governmental organisations in Singapore that regularly engage communities on ways and means to reduce the carbon footprint in various aspects of life. More information about the various groups in Singapore can be found at https://www.towardszerowaste.sg/green-groups-in-singapore/.
6.	Certified labelling system for products from "greener" businesses (like Healthier Choice Symbol).	The Singapore Environment Council (SEC) administers the Singapore Green Labelling Scheme (SGLS) and Project Eco-Office. To date, over 3,000 products have been certified across 28 countries. SEC regularly reviews the criteria and categories for green labelled products to drive producers and consumers to adopt greener practices. The Singapore Green Building Council administers the Singapore Green Building Product (SGBP) certification scheme, which assesses green building products and materials, and sets benchmarks for a building product's environmental performance. The SGBP scheme complements the Building and Construction Authority (BCA) Green Mark scheme by identifying and helping the industry select environmentally-preferred products and materials to achieve environmental sustainability for Singapore's built environment. The support of such efforts, as well as green products, requires a concerted effort by all segments of society.
7.	Design regulation to support the entry of low-carbon or carbon-neutral products in the market.	
8.	Introduce a "sustainability index" for organizations operating in Singapore, like MELS for firms.	In 2016, SGX joined the global trend of stock exchanges requiring listed companies to report on their environmental, social and governance (ESG) issues by introducing the comply-or-explain sustainability reporting requirement for listed companies. SGX requires listed companies to produce an annual guidance on ESG as a sustainability report or explain why they are not doing so. This incentivises companies to disclose information on their operations and efforts related to

		sustainability and allows consumers to make informed choices based on a better understanding of the sustainability practices of these companies.
9.	Bring more visibility to NEA videos on recycling, show the public how trash in recycled bins is actually recycled.	In 2018, NEA released a video named "Recycle Right!" on how trash in blue recycling bins is recycled in Singapore. The video follows a recycling truck to a Materials Recovery Facility and shows how trash is processed in the facility. The video, along with other videos on recycling are available on NEA's YouTube channel. In 2019, as part of the #RecycleRight movement, MEWR produced and made available video and visual resources to educate the public on what can or cannot be recycled. The NEA also revised the label on the blue recycling bin in consultation with stakeholders, to provide clearer information to members of the public so as to reduce contamination in our blue bins. MEWR also collaborated with National Geographic on a series of #RecycleRight engagements to highlight the potential of a circular economy approach, and showcase innovative products that can be created when we recycle right.
10.	Inculcate a culture of sorting trash (like Taiwan and Japan) through NGO-held workshops at CCs, interactive activities (e.g. beach clean-up, low carbon workshops).	NEA works with various partners to promote a "reduce and reuse" mind-set and culture. Non-governmental organisations such as Tzu Chi run regular sorting and recycling events for the community to promote bonding amongst neighbours, and to raise awareness on the need to recycle and to keep recyclables clean, Zero Waste SG runs donation bins for reusuable bags and Public Hygiene Council with their partners organise clean-up activities. NEA also grooms ambassadors to share messages within their community and social circles to promote the "reduce and reuse" mind-set. Interactive activities (activations at community events) that run through our various campaign roadshows also serve to build understanding and consciousness to change mind-sets.
11.	Resources for event organisers to ensure that their practices are more eco-friendly.	The Meetings, Incentives, Conventions & Exhibitions Industry (MICE) 3R Toolkit* is an initiative of the MICE 3R taskforce comprising NEA, STB and members of the Singapore Association of Conference and Exhibition Organisers and Suppliers (SACEOS) to provide guidance on 3R initiatives for the MICE industry. For some examples of eco-friendly practices, MEWR has a Best Practice Guide for organising environmentally-friendly events^. The Guide covers topics such as venue selection, waste management, electricity and water usage and public hygiene. It also includes some information emcees can highlight to encourage participants to lead a Clean and Green lifestyle.

		*https://www.nea.gov.sg/docs/default-source/default-document-library/mice-3r-toolkit.pdf ^https://www.mewr.gov.sg/top/faqs/guide-to-environmentally-friendly-practices-for-events
Dialogue and Engagement		
12.	Conduct regular meetings to consult the public (including civil society, stakeholder and other local groups) on the progress towards achieving the emissions targets, including Singapore's long-term low emissions trajectory and future carbon tax framework. Organise regular town hall meetings to galvanise collective action. To be run by trained facilitators, with key officials responding to concerns (e.g. citizens' jury for war on diabetes). Officers to work with groups on the ground to develop solutions and scale them up with supportive policy (e.g. in legal, financial and infrastructural domains).	MEWR has regular meetings and dialogues with key stakeholders. It also organises an annual Partners for the Environment Forum to facilitate discussions with and between partners on collaborations. In 2019, MEWR convened a #RecycleRight Citizens' Workgroup to improve household recycling in Singapore, where Singaporeans from diverse backgrounds worked together to co-create solutions. MEWR has identified four pilot projects from the recommendations submitted, and will work with members to develop and co-deliver them. We recognise that various members of the public, including members of civil society groups, desire more frequent engagement with government agencies on climate action. Singapore's LEDS is one that belongs to all of Singapore – our people, our businesses, and our communities. This is why a public consultation exercise was conducted to gather views on the strategies to enable Singapore's low carbon transition. We will continue to study ways to increase engagement with the various groups and involve them in developing solutions.
13.	Engage experts to develop sound policy (think tanks, economists, psychologists, researchers from reputable institutes).	The Government regularly engages reputable researchers from various research institutes in Singapore to study various low carbon technologies, mitigation measures possible for Singapore, as well as long-run abatement potential and costs. For example, the Solar PV Roadmap for Singapore, and Carbon Capture Utilisation and Storage Singapore Perspectives. Through these engagements, we seek subject matter expert views, which serve as reference for our policy-making. Furthermore, our climate policies are grounded on robust climate science. We have made early investments to set up the Centre for Climate Research Singapore (CCRS) in 2013 to focus on tropical climate and weather. CCRS is building itself up as the regional centre for tropical climate science to help the region better prepare for climate change. For a start, CCRS launched a $10 million five-year National Sea Level Research Programme (NSLP) in 2019 with the aim of bringing together international and local researchers to enhance our understanding of how the various factors of sea-level rise affects Singapore and the Southeast Asian region. In 2020, CCRS will set up a new Programme Office to drive the formulation and implementation of our national climate science research masterplan and systematically build up climate science capabilities across our research institutes and universities.

14.	Support existing climate related workshops and movements to increase their outreach and resources, promoting an environment of mutual encouragement.	In the Year of Climate Action (YOCA), MEWR set up the Climate Action SG Grant for organisations supporting the YOCA. NEA also created resources such as exhibits, games and roadshows for community, schools and corporate partners to tap on to help raise awareness and expand reach to their audiences. Across the MEWR family, YOCA saw about 800 climate action-related events initiated and organised; these efforts were a result of ground-up support, with green initiatives championed by individuals, schools, businesses, non-profit organisations and more. The Climate Action SG Grant supported youth projects such as the Carbon Tax and Our Climate Actions seminar by NUS Masters of Environmental Management Alumni and the Chili Padi Academy accelerator programme by I'dECO Yale-NUS Sustainability Movement for SEA youths to learn about environmental issues, as well as make sustainable and meaningful change. NEA also encouraged organisations to run climate related movements/workshops. For example, in 2016, NEA awarded the Eco Friend Award to Ms Nor Lastrina Binte Hamid, Co-Founder of the Singapore Youth for Climate Action, who created SYCA as a platform for youths to join hands and take action in response to climate change. Their activities included a Learning and Leadership programme to groom future leaders who put climate change issues at the forefront of the sustainability agenda. NEA also has ongoing grants such as the 3P Partnership Fund which aims to encourage organisations and companies from the People, Private and Public (3P) sectors to work together to develop innovative and sustainable environmental initiatives that promote environmental ownership amongst the local community.
15.	Involve and raise the profile of organisations or individuals who are trying to make a difference for climate change.	We agree that it is important to recognise individuals for outstanding efforts in environmental sustainability. NEA organises the EcoFriend Awards to recognise the efforts and achievements of people in Singapore who have dedicated personal time and effort to protect, promote, and improve our environment. Between 2007 and 2019, there have been 137 recipients of the Awards. Out of the 343 nominations awards, over 50% are new nominees. Since 2008, the Singapore Packaging Agreement (SPA) Awards have been presented annually to recognise SPA signatories who have made notable efforts and achievements in reducing, reusing or recycling packaging waste. In 2019, the SPA achieved a cumulative reduction of about 54,000 tonnes of packaging waste over 12 years.

		In 2019, NEA also ran a profiling campaign on waste reduction champions, which was amplified on mass media channels to reach the broader public. NEA also regularly profiles partners through social media channels. MEWR also organises the biennial President's Award for the Environment, which is the highest environmental accolade for individuals, educational institutions and organisations that have made outstanding contributions towards environmental and water resource sustainability in Singapore.
16.	A grassroots action plan to reduce consumption and recycle to close the generational knowledge gap.	NEA works with the 5 Community Development Councils (CDCs) on their districts' eco-plan, which encompasses plans and activities to promote awareness and action. Some key initiatives from the 5 districts include: - The South West CDC's "Recycle Our E-waste @ South West" recycling programme focused on three areas: Educate, Empower, and Effect. This campaign followed two others, "Foodprints @ South West" which encourages residents to reduce food waste, and "Cool South West! Towards Zero Waste", which encourages residents to reduce use of disposables. - Project EARTH, a 3Rs programme co-organised by NEA, Central Singapore CDC and supported by Public Waste Collectors (PWCs) and key grassroots organisations aims to promote 3Rs through educational outreach and mobilisation of residents for 3Rs initiatives in Central Singapore District. - North East SAVER (Save And Value Earth through Reducing, Reusing, Recycling) is an umbrella programme for all resource conservation initiatives (3Rs, food waste reduction, e-waste, Repair) in the North East District. 3R initiatives include upcycling workshops at community events, public libraries and schools. Cash for Trash recycling and e-waste collection drives were conducted in collaboration with town councils and public waste collectors on a regular basis. Educational pamphlets, 3R life hacks booklets and NE SAVER collaterals were also distributed at exhibition booths during community events. - Recycle @ North West is a collaboration between Tzu Chi Foundation and NEA to organise and manage a recycling programme in each of the 19 constituencies within North West District. The objectives of the project are to encourage more residents to go Green through recycling; to create a platform where residents can recycle their items on a sustained basis; and to create social cohesion in a Green setting. Mass recycling trainings are conducted to equip volunteers with knowledge on proper recycling. - "I'm An Eco Auditor" programme in South East District aims to empower at least one member in every household to be the 'Eco Auditor' who encourages their family members to adopt an eco-friendly lifestyle. Since 2019, more than 1,500 Eco Auditors has reached out to about 8,000

		households to spread awareness on minimising waste, EE and conservation and adopting a zero waste lifestyle. Apart from the CDC eco-plans, NEA also works with grassroots on environmental protection campaigns, namely, the Food Waste Reduction Campaign, #RecycleRight Campaign, and the "Say YES to Waste Less" campaign, which worked closely with the five CDCs amongst other partners to align and promote the same key messages.
17.	Does NCCS plan to conduct an in-person public consultation session to explain the six key strategies contained in the public consultation document?	Over the months following the release of the public consultation document on REACH, we have been conducting several in-person consultation sessions on the six key strategies with a variety of stakeholders, including companies, academics, youths, and other organisations.
Curricula and Campaigns in Schools		
18.	Deepen youths' understanding of climate justice and implications of climate change on other societal issues (food security, weather, climate refugees) through compulsory modules or other; implement programmes/activities to enhance knowledge on climate change and motivate students to take action; replace dated Character and Citizenship Education lesson topics.	The Government recognises that schools are a key platform for educating the young on environmental issues. In turn, this can translate to students' long-term behavioural change to adopt environmentally-friendly habits and instil an appreciation for nature in students. Topics on the environment are incorporated in the national curriculum through multiple subjects. Primary school students start learning about environmental issues, such as conservation, global warming and the importance of responsible use of resources in their Science and Social Studies classes. In secondary school, students dive deeper into these issues through their Geography, Science and Social Studies classes. Among other topics, they learn about biological ecosystems, natural resource depletion and the roles of different stakeholders in environmental conservation. In junior college, students participate in discussions on climate change through their Geography, General Paper and Biology classes. Beyond school lessons, students can participate in their school's environmental clubs and related activities to increase their knowledge on climate change and translate it to action to address climate change. Students also participate in activities, including learning journeys and programmes, where they can take their learning beyond the classroom.
19.	Curriculum to teach students about native flora and fauna and incorporate nature-related and outdoor activities to boost an appreciation for nature and Singapore's natural heritage.	NParks launched the Community in Nature (CIN) initiative in September 2011 as a national movement to connect and engage different groups in the community (e.g. schools, volunteers, non-governmental organisations) to conserve Singapore's natural heritage. CIN brings together all of NParks' nature-related events, activities and programmes to encourage the community to bond over and with nature. Through the CIN school programme, we encourage and empower schools of all levels to conserve biodiversity. For example, under the Greening Schools for Biodiversity programme, students are involved in targeted planting of biodiversity-attracting plants to enhance

		their school habitat. This is supplemented by student-led biodiversity surveys and outreach efforts to increase awareness and appreciation of biodiversity in their campuses. The Kids for Nature is an outdoor education (OE) programme developed to meet the objectives of the Programme for Active Learning (PAL) with an emphasis to build social and emotional competencies for lower primary students. PAL (OE) is one of the four domains of activities where children learn relevant skills and knowledge to enable them to be safe and comfortable outdoors, and cultivate a sense of ownership for the environment through direct experiences with nature. NParks had also developed a pre-school resource package on our City in a Garden and local biodiversity which is disseminated to all pre-school centres throughout Singapore. NParks also works with MOE to conduct training sessions and learning journeys for teachers so that they can educate their students on Singapore's native flora and fauna.
20.	Launch programmes for a zero waste culture in schools, including the incorporation of nature-related and outdoor activities to boost appreciation for nature.	NEA has been promoting a "Let's not be Wasteful" mind-set among students and encouraging youth mobilisation through MOE's curriculum, MOE's values-in-action programme, as well as through NEA and partner programmes. NEA programmes include the development of student-tailored resources such as videos, posters and booklets that feature an appealing mascot (Captain Green), The Youth for the Environment Day, a platform to engage youth to champion environmental ownership by leading, organising and participating in programmes to show their passion and commitment towards global and local environmental issues, and the "Love Your Food @ Schools" project between 2017 and 2019 which aimed to involve students, staff and canteen stallholders in segregating their food waste for treatment and using on-site food waste digesters. NEA also leverages aspects of the formal school structure to engage students on environmental issues. For example, visits to the Incineration Plants for Secondary/tertiary students complement the formal curricula and add an element of experiential learning. NEA encourages organisations that run programmes for environmental protection to scale up their initiatives or work with other stakeholders including schools. NEA's partners include Food from the Heart and WWF, who engage schools through activities that promote waste minimisation. NEA also invites these partners to attend relevant events to facilitate networking with schools. For example, the Environmental Education Advisor (EEA) networking session for school teachers, Youth for the Environment Day, and Clean and Green Singapore. Through these events, partners are able to share
21.	Mobilise students to take initiative in programmes for environmental protection (e.g. WWF Eco-Schools programme).	

		their programmes with teachers and students and encourage schools to take part in various partner-initiated environmental protection programmes.
22.	Organise formal consultations with schools to find out more about school processes that go against the environment.	NEA has built a network of Environmental Education Advisors (EEAs) over the years and engages them annually through a formal platform called the EEA Networking Session. These teachers plan, coordinate, and implement environment programmes for their school students and staff, as well as serve as the contact point between NEA and the schools. NEA works with the EEAs to support them in implementing initiatives, which improve their school's processes, or drives awareness amongst their students. EEAs also share their successful initiatives and get recognised through NEA-organised events such as the EEA networking session or Eco friend Awards. In addition, the Environment Fund for Schools may also be used to help fund environmental programmes in schools. Teachers who are committed to spearheading environmental projects in their schools are highly encouraged to participate and take part in planned networking sessions and workshops.
23.	Have at least one teacher at school participate in NEA's Environmental Education Advisors.	
24.	Make visits to Singapore Incineration Plants compulsory for primary school students alongside NE show.	Visits to incineration plants aim to cultivate a sense of shared environmental ownership and eco-conscious community in Singapore. We encourage educational institutions to organise trips to NEA's incineration plants. However, successful bookings are subject to availability of slots and it may be difficult to accommodate to all requests to visit the site. Schools that are keen to organise a visit to the incineration plant are recommended to do so early when registration opens.
25.	Engage students in a national reforestation drive.	In January 2019, NParks announced the Forest Restoration Action Plan, which will be undertaken over the next 10 years to regenerate the secondary forests in the Bukit Timah and Central Catchment Nature Reserves, and their surrounding buffer parks. These efforts will be facilitated by NParks and spearheaded by the community. Participants include primary and secondary schools, tertiary institutes, as well as families who have assisted in the removal of invasive weeds, and the planting of trees and shrubs.
26.	Address canteen vendors' reliance on single use plastics.	The move towards reusables and away from single-use plastics and disposables greatly depends on consumers' choice to use them less. In line with 2019 being designated as the Year Towards Zero Waste, the "Say YES to Waste Less" nation-wide campaign was launched to drive awareness of the impact of excessive consumption of disposables and the need to reduce their use. 59 partners, covering more than 1,600 premises from major food and beverage establishments, malls/retail chains, e-tailers, supermarkets, hotels, schools, organisations, and non-governmental organisations participated in this campaign.

		The main message of the campaign is 'Make the Right Choice. Choose Reusables.' Consumers are encouraged to choose reusables like reusable bags, bottles and/or containers instead of single-use plastics/disposables. Doing so will send a message to vendors about customers' preference for reusables and allow them to cut their use of disposables by addressing their concerns of losing customers should they cut their use of disposables. Many educational institutions have organised their own initiatives to encourage staff and students to reduce waste. For example, in Bukit View Secondary School, plastic straws are not provided and reusable cutleries and containers are made available for staff to pack food in canteens. Canteen vendors also impose a small charge on disposable packaging to discourage their use. At NUS, initiatives include a 10-cent plastic bag tax and Bring Your Own schemes (e.g. Project Box, Project Tumbler) that reward customers who use reusable for takeaways.
Emissions Data and Reporting		
27.	Release data relevant to climate action and responsiveness, especially emissions data, provide regular reports on environmental performance. Include a breakdown of Singapore's carbon emissions profile and carbon accounting methodology, and materials flow analysis for a circular economy.	Singapore reports its climate actions, emissions data and other climate-related information regularly. Our third Biennial Update Report (BUR)/fourth National Communication (NC), which captures information on Singapore's climate efforts and detailed emissions profile, was submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in December 2018 and can be found on our website (www.nccs.gov.sg/media/publications/plans-reports). NEA, MSS, and EMA also provide updates on other climate-related statistics, including recycling rates, rainfall and temperature, and energy use.
28.	Publish a list of companies and their emissions data which are not accounted for in the national GHG inventory.	Our national GHG inventory accounts for all our emissions and provides a detailed breakdown up to sub-categories of emissions in accordance with the Intergovernmental Panel on Climate Change (IPCC) Guidelines. Data required for the national GHG inventory is collected and compiled through legislation and surveys administered by various government agencies. We are unable to provide company level data due to data confidentiality.
29.	Systematic identification and classification of manufacturing processes ranked by emissions intensity to the individual business and sub-process level.	
30.	Emissions intensity calculations are confusing because of the GDP figures being rebased to 2010 levels since 2014. It would be helpful to know if rebasing GDP is part of the trajectory calculations, and if this effectively renders Singapore's NDC to be a "moving target".	Singapore's pledge is to reduce our emissions intensity by 36% from 2005 levels by 2030 and to stabilise emissions with the aim of peaking around 2030. We have included in our Nationally Determined Contribution (NDC) that in achieving our 2030 EI target, we expect our emissions to stabilise at around 65 $MtCO_2e$. Our aim to peak emissions also highlights that we will work towards reducing our emissions thereafter.
31.	To hit the target for emissions intensity reduction, Singapore's projected emissions	Singapore has communicated the assumptions and methodological approaches, including those for estimating and accounting for anthropogenic GHG emissions, as part of its Intended Nationally

	intensity level would need to be 114.205 tCO_2e/S$m GDP in 2030, but the following data is needed: total emissions for 2030 and Nominal GDP for 2030. Can this information be made available to the public?	Determined Contribution (INDC) submission in 2015. The INDC document can be found on the UNFCCC's official website*. *https://www4.unfccc.int/sites/NDCStaging/pages/Party.aspx?party=SGP
32.	There is currently a window open for Governments to submit an updated NDC in 2020 pursuant to Article 4, paragraph 9 of the Paris Agreement. There has not been any announcements by NCCS or the Government on whether Singapore intends to submit a more ambitious NDC target in 2020 and it would be useful to know if we do or do not, and the reasons behind the decision.	As stated by Minister for the Environment and Water Resources Masagos Zulkifli during his delivery of Singapore's National Statement at the 25th Session of the Conference of the Parties (COP) to the UNFCCC on 10 December 2019, Singapore will be updating its NDC in 2020. More details on our updated NDC will be released in due course.

J: Others

	Economic Growth/GDP	
1.	Replace GDP with another indicator to encompass more holistic markers of well-being, such as psychological and environmental health (like Scotland, Bhutan and New Zealand).	The 2030 Agenda for Sustainable Development is a global development framework adopted by World Leaders at the UN Sustainable Development Summit in September 2015. It comprises 17 Sustainable Development Goals (SDGs) which apply to all countries in order to mobilise efforts to end poverty, fight inequalities, and tackle climate change. As a small country with limited land and no natural resources, Singapore appreciates the challenges of sustainable development. This is why we participate actively in the negotiations on the 2030 Agenda and the 17 SDGs, and continue to support efforts to implement and achieve the SDGs globally. We undertook our first Voluntary National Review (VNR) of the SDGs at the UN High-Level Political Forum in July 2018. Through the VNR process, we found many areas in our sustainability journey where our efforts have paid off, identified and reflected on challenges and constraints that we face, as well as identified opportunities that may arise to overcome these challenges. More information can be found at the Sustainable Development Goals website*, and at the SDG microsite^ by MFA. *https://sustainabledevelopment.un.org/memberstates/singapore ^https://www.mfa.gov.sg/SINGAPORES-FOREIGN-POLICY/International-Issues/Sustainable-Development
2.	Make publicly available the mechanics used to determine and weigh the trade-offs between pursuing economic growth and reducing carbon emissions.	Pursuing economic growth and reducing carbon emissions are not necessarily mutually exclusive, and could potentially be reinforcing. In an increasingly carbon-constrained world, the efficient use of carbon resources can in fact improve our economic competitiveness and enable sustainable economic growth. The Government has also been supportive of businesses' efforts to lower their carbon footprint, such as working with the manufacturing sector to accelerate the adoption of energy efficient technologies, which have allowed businesses to enjoy cost savings. The Government will continue to work with the industry to make our economy more carbon efficient and capture new growth opportunities at the same time.

Responses to Feedback and Suggestions on Singapore's Long-Term Low Emissions Development Strategy

Climate Targets		
3.	Legislate carbon emissions to peak well before 2030, to ensure that Singapore will achieve net-zero carbon emissions by 2050 (from a baseline of 2010).	Our aim to reduce emissions intensity by 36% from 2005 levels, and to stabilise emissions with the aim of peaking around 2030 is an ambitious stretch goal. This is because we have already taken early action to grow our economy in a sustainable manner, such as switching to natural gas in the early 2000s to generate electricity. Meeting our target will not be easy and will require significant whole-of-nation effort. There are new challenges, such as significant demands for data centres and increased digitalisation, which creates additional emissions that we will need to manage. Going forward, even more ambitious action is needed to achieve the peaking element within our pledge, as our absolute emissions need to decline. We are studying how further advances in technology can help Singapore transit earlier to a low carbon future, and exploring the feasibility of working towards net zero emissions. For example, the government has commissioned studies to evaluate the opportunities and challenges of carbon capture, utilisation and storage (CCUS), and hydrogen, and recommend next steps for Singapore. We will also work with industry and our research community to explore pilot projects and implement research and development initiatives to improve their feasibility, and to develop the necessary frameworks to support adoption when these solutions become economically viable.
4.	Declare a near-term deadline for a roadmap for a sharp decrease to meet the "net-zero" requirements of the Paris Agreement.	
5.	What are Singapore Government's thought considerations behind 'peaking around 2030'? Is it possible to expedite measures to ensure Singapore's emissions peak before that?	
6.	Adopt a standard of absolute carbon emissions instead of emissions intensity.	An emissions intensity (EI) indicator was chosen to highlight Singapore's approach to achieve growth in a sustainable manner. That being said, we have included in our NDC that in achieving our 2030 EI target, we expect our emissions to stabilise at around 65 $MtCO_2e$.
7.	GIC and Temasek to pressure companies under their portfolio to set ambitious targets (carbon neutral by 2050).	The Government does not prescribe how GIC and Temasek invests. They both emphasise sustainability in their investment activities. Temasek encourages companies to adopt responsible and sustainable practices in their businesses, operations and supply chains. GIC integrates sustainability considerations holistically into its investment processes, in order that it protects and enhances the long-term value of its investments.
8.	Develop a national emissions dashboard comprising absolute GHG emission reduction targets from now to 2030 and beyond, consistent with the IPCC's recommendation of emission reduction of 45% below 2010 levels	Singapore reports our national GHG emissions inventory and tracks the progress of our mitigation measures in our BUR and NC documents to the UNFCCC. In accordance with the IPCC Guidelines on National GHG Inventory, international transport emissions are excluded from our national totals but reported separately in our reports. As required by the Paris Agreement, Singapore will track the

	by 2030 and net-zero emissions by 2050. Singapore's actual GHG emissions can be tracked against these targets, so that individuals and businesses know whether our climate action efforts have been effective. Include maritime and aviation emissions.	progress of our NDC implementation and achievement in our Biennial Transparency Reports under the Enhanced Transparency Framework for Action and Support from 2024.
	Tree Planting	
9.	National campaign of tree planting like Plant-a-Tree days: involve the public in planting trees. Institute tree planting as a Community Involvement Project in schools.	Singapore's greening campaign kick-started in 1963, and the provision of greenery was integrated into our development plans to ensure that the greening of the city is in tandem with urbanisation. Over the years, greenery has been integrated into our urban matrix, with pervasive greenery on retaining walls, pedestrian overhead bridges, viaducts, and along our roads. Singapore is now a biophilic City in a Garden with around 7 million trees in our nature reserves, parks, gardens, and along our streetscapes. Over 50,000 trees are planted annually to maintain, protect and enhance Singapore's green cover. With the Forest Restoration Action Plan, NParks aims to plant 250,000 trees and shrubs over the next 10 years to regenerate the secondary forests in the Bukit Timah and Central Catchment Nature Reserves and their surrounding nature parks. These restoration efforts have been supported by a range of community partners, including schools, nature groups, companies and organisations. For example, corporate organisations such as OCBC and Keppel Corporation have been supporting the action plan through their participation in NParks' Plant-A-Tree programme. As part of the annual NParks Biodiversity Week, we work with schools to organise Green Wave – a worldwide biodiversity campaign that educates children and youths about the importance of protecting our natural environment. Each year, students from around the world plant locally important trees in their school compounds at 10 am on 22 May, the International Day of Biological Diversity. This creates a figurative "green wave" that makes its way across the globe.
10.	Preserve forests (e.g. Tengah), adopt afforestation methods to grow trees in small land spaces, encourage the greening of vertical spaces, vertical farms and manicured green areas. Grow climber plants on bus stop shelter, footpath shelters, even buildings. Consider use of fast growing species. Make vertical gardens	Given Singapore's land constraints, there is a need to find a balance between meeting development needs and retaining natural areas in our land use planning. Singapore currently has a robust planning evaluation process in place through which development proposals are comprehensively assessed before approval is given for the development to proceed. Considerations such as public needs, other viable development alternatives, economic and social considerations, and the impact on environment, traffic, maritime navigation etc., are assessed by relevant regulatory agencies.

	compulsory at communities/commercial buildings.	Development projects near areas with biodiversity, including Nature Reserves, Nature Areas, and marine and coastal areas are subject to greater scrutiny. If there is reason to believe there could be significant adverse environmental impact, environmental studies will be required to assess the impact and proposed mitigation measures. Findings from environmental studies are carefully considered, including the extent of potential impact and the adequacy of proposed mitigation measures, before any development is permitted to proceed. Developers are expected to undertake environmental monitoring and management measures to limit the impact of their works. Singapore has an extensive green network comprising of roadside greenery, parks and gardens, nature reserves and other green spaces. The Government has taken an active role in encouraging the integration of greenery into our urban landscape. For example, to ensure that greenery is provided during road development, a road code was put in place, requiring verges to be set aside for tree planting. Likewise, plots for parks and gardens are set aside during city planning and subsequently, township development. NParks works with private developers and building owners to incorporate greenery into their developments. For example, the Landscaping for Urban Spaces and High Rises (LUSH) programme and the Skyrise Greenery Programme (SGP) were introduced to incentivise the incorporation of more greenspaces within developments in the form of communal gardens at ground- and mid-level buildings and landscaping applied on walls or roofs of buildings. NParks continues to work towards the target of 200 hectares of skyrise greenery by 2030 under the Singapore Sustainable Blueprint, together with other key public agencies like HDB and URA, as well as private developers. NParks has also been greening Singapore's infrastructure to make greenery more pervasive and to soften the built environment. NParks has been planting low maintenance climbers and shrubs onto roofs of bus shelters, along covered linkways, at MRT stations, and on noise barriers, and also has plans to plant trellises along covered linkways islandwide. In greening Singapore's urban landscape, there are multiple considerations to take into account to ensure the safety as well as the sustainability of the greenery. These include species of the plants, structure and design of the building/infrastructure and availability of resources to maintain the plants/garden. While NParks encourages the spread of greenery in our city, these factors should be considered.
11.	Penalise land intensive golf courses and private swimming pools, reappropriate for tree planting.	
12.	Do not chop away trees and bushes at Pasir Ris Park, Clover and Binchang and other areas.	

13.	Investigate the sum of potential landmass suitable for replanting.	NParks collaborates with other agencies to identify areas that are currently devoid of trees and are not slated for development in the near-term, to carry out tree planting. This helps to mitigate the Urban Heat Island (UHI) effect, and provides other ecosystem services. NParks also works closely with stakeholders from the private and public sectors to ensure the provision and enhancement of greenery within and around their developments.
14.	Give little pots of plants as event souvenirs.	MEWR, with NEA and PUB, have published a Best Practice Guide to guide public agencies in organising environmentally-friendly events*. Tips are also provided on NEA and PUB's websites to help event organisers reduce waste and conserve energy and resources. The Government encourages any event organiser to use the Guide and these tips as reference for their own events. *https://www.mewr.gov.sg/top/faqs/guide-to-environmentally-friendly-practices-for-events
15.	Encourage everyone to grow plants at their corridor.	Placement of plants along corridors of HDB estates are allowed as long as they comply with fire safety guidelines*. Interested individuals who do not have sufficient space along their corridors may join one of the 1,500 community gardens throughout Singapore. *https://www.scdf.gov.sg/home/community-volunteers/community-preparedness/fire-safety-guidelines-for-hdb-estates
16.	Plant species that sequester carbon rapidly (like bamboo), bear flowers or edible fruits.	In greening Singapore's urban landscape, there are multiple considerations to take into account to ensure the sustainability of greenery and safety. These include structure and design of the building, site conditions and maintenance of plants/trees. These factors are taken into account when deciding the type of greenery planted at various locations and may render certain plant species unsuitable.
	Climate Resilience	
17.	Release Singapore climate data for the use of research or streamline the process to obtain such data. This will make data more available for research, leveraging our local research capability.	Singapore's climate data (rainfall, temperature, wind speed) can be found online at www.weather.gov.sg. Research publications on Singapore's climate and weather patterns can also be found on the official CCRS's website*. *http://ccrs.weather.gov.sg/publications-listing-page/
18.	Address flooding and sea level rise. Invest in seawalls to allow ocean life and corals to thrive on them. Invest in planting mangroves as a natural bulwark to protect our shorelines and infrastructure. Deepen knowledge of nature-based solutions for terrestrial and marine ecosystems.	Since 2011, Singapore has spent $1.8 billion on drainage improvement works to boost our flood resilience. In the next two years, another $400 million will go towards upgrading and maintaining our drains. The government is studying the long-term risks and impact of rising sea levels, and has taken some early steps to protect our coastal areas. Over 70% of our coastline is protected from erosion with engineered structures, such as stone embankments. Going forward, we expect to invest $100 billion, or even more, in coastal defences.

		Our plan will also incorporate nature-based solutions, such as active restoration of our mangrove areas. NParks has been actively enhancing and restoring the mangroves at the Sungei Buloh Wetland Reserve, one of our key nature reserves with an extensive mangrove forest spanning 202 hectares. In 2018, the Mandai Mangroves and Mudflats were designated as a Nature Park to complement the ecological functions of Sungei Buloh. NParks has also partnered with JTC to launch Singapore's largest purpose-built reef structures in the waters of the Sisters' Islands Marine Park in 2018. These reef structures serve as an *in-situ* coral nursery, and contribute some 1,000m^2 of additional reef substrate to the Marine Park, thereby supporting ongoing habitat enhancement and reef restoration efforts. The coral nursery will play an important role in the conservation of coral species, so that locally rare corals that may be threatened by coral bleaching can be moved to a controlled environment to enhance their chances of survival. In addition, the reef structures will provide opportunities for research to be conducted, and serve as test beds for new technologies to study coral reef resilience.
19.	Strengthen partnerships among local and regional scientific community to fill knowledge gaps in implementing nature-based solutions. Platforms such as the ASEAN Working Group on Climate Change can be tapped to scale nature-based solutions by developing common standards and verification processes due to cross-border nature of environmental issues.	Singapore is actively engaged in environmental cooperation through bilateral and regional platforms such as the Sino-Singapore Tianjin Eco-City, the Asia-Pacific Economic Cooperation (APEC), and ASEAN, and will continue to do so in the future. Nature-based solutions are already a part of Singapore's climate strategy. For example, to guard Singapore against sea-level rise, government agencies will work closely with stakeholders and partners to develop optimal coastal protection strategies, incorporating nature-based solutions where feasible. Moving forward, we will continue to study ways to develop and scale nature-based climate solutions.
20.	Harness technology to address the increase in temperatures.	Rising temperatures from climate change will compound the UHI effect in Singapore given our highly urbanised environment, and this is particularly pertinent given Singapore's inherent vulnerability to rising temperatures. UHI is a complex topic that the Government will continue to study in greater depth. To better understand the overall effect of rising temperatures on our local microclimate, we will continue to invest in R&D. We will also strive to enhance our strategies, including tapping on the latest technologies, to help Singapore cope with the rising temperatures.
21.	Enhance cooling through the study of microclimate: encourage structural arrangements that exploit environmental conditions as much as possible to achieve optimal cooling.	
22.	Singapore should be using a scenario-based, and risk-based, framework for analysis of the future impacts of climate change – from both a transition and a physical point of view. Apply	Singapore adopts both a scenario-based and risk-based framework in analysing the future impact of climate change. The Second National Climate Change Study carried out simulations on global climate models based on two different GHG concentration scenarios (or Representative Concentration Pathways (RCP) 4.5 and RCP 8.5) on Singapore. We have also developed a

	the TCFD style framework to inform both risks and opportunities could be incredibly beneficial when planning for the future.	Resilience Framework which helps to identify and assess climate change risks in tandem with advancements in climate science, and formulate adaptation plans to tackle these risks in a flexible and dynamic manner.
		Sustainable Urban Planning
23.	Research and adopt plot area ratios and urban geometry that promote a continuous urban-canopy design feature to achieve: - fill-in for walkable cities; - increased sunlit areas for PV use; - shading and rain cover between buildings for further energy and rainwater-capture efficiency improvements.	The Government continues to prioritise sustainable development, resource conservation and optimisation, and integrated urban planning to ensure quality living for our residents. Singapore's urban designers, city planners and engineers continuously re-think traditional ways of urban planning to shape the consummate urban and sustainable city of the future. For example, Marina Bay Sands uses an advanced computerised control system to automatically dim or brighten their lights, depending on the time of day and weather conditions. Rainwater is collected on the roof of the accompanying ArtScience Museum, which is reused in the building's washroom system.
24.	Use land and floor area incentives through URA and BCA to give priority to carbon-light/social and community activities, and disincentivise energy-intensive lifestyle-based activities through controls on the use of space.	
25.	Enable a rainwater collection licensing scheme such as the Urban Water Harvesting System in HDB's Tengah Forest Town project. Other proposed projects in schools also offer good case studies for future green infrastructure development.	The Urban Water Harvesting System is an innovative water-saving initiative pioneered by HDB. Such rainwater collection systems would require significant changes to the existing town infrastructure. For the system mentioned, HDB has centralised and integrated the detention tank, rainwater-harvesting tank and the treatment system so that surface run-off from the entire precinct can be collected, stored and recycled. The Government will continue to study innovative ways to better utilise our water resources.
26.	Create more ponds and water catchment between buildings.	
27.	Encourage horticultural landscaping companies that service schools and residences to work with select biodiverse edible gardens to coordinate enabling efforts, including halting mosquito fogging in a small buffer area around the site to allow biodiversity on-site to develop.	NParks launched the Edible Horticulture Masterplan (EHM) in November 2017 to engender greater interest in gardening and allow both gardeners and residents to enjoy various benefits of gardening together. Concerted outreach efforts, through the introduction of training programmes, talks, workshops and brochures about edible gardening, have made it more accessible with many gardens expanding the variety and quality of edibles grown. NParks also provides advice on how to start community garden projects within the neighbourhoods of public housing estates and schools. More information can be found at: https://www.nparks.gov.sg/gardening/community-gardens/start-a-community-garden

Aviation and Shipping		
28.	Singapore should take responsibility of at least half of the emissions in international aviation bunkers, and include maritime and aviation carbon emissions in national GHG inventory accounting reporting. Adopt targets for aviation in line with the International Air Transport Association's proposals: - 1.5% per year improvement in EE - Cap total industry emissions starting from 2020 - 50% reduction in total emissions by 2050	The aviation and maritime transport sectors in Singapore are largely international. Singapore's domestic maritime transport comprises harbour and pleasure crafts, while domestic aviation is negligible. In accordance with the IPCC Guidelines on National GHG Inventory, international transport emissions are excluded from our national totals but reported separately in our reports. Given the global, transboundary nature of international aviation and maritime transport, Singapore fully supports the leadership and efforts of the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO) in addressing international aviation and maritime transport emissions or international transport emissions on a global basis. The two organisations are making good progress in addressing international transport emissions. As a member of the ICAO and the IMO, and a member on their Councils, Singapore is contributing actively to their efforts. In addition to implementing the standards and requirements of the ICAO and the IMO on international transport emissions, Singapore has voluntarily taken on additional initiatives and measures in the aviation and maritime transport sectors to address emissions. For aviation, efforts Singapore supports include the ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), technological and operational improvements (such as Singapore carriers using more fuel-efficient aircraft and the Singapore air navigation service provider enhancing air traffic management with partners), and exploring the use of sustainable aviation fuels. On maritime transport, Singapore is actively facilitating the greater adoption of LNG as a cleaner fuel for global shipping, including forming an international focus group, comprising port authorities and maritime administrations, to build a network of LNG bunker-ready ports. Singapore is also actively participating in the follow-up of the IMO's Initial Strategy on the Reduction of Ship Emissions, including mitigation measures.
29.	Work with international and regional organisations such as the IMO, Global Maritime Forum and ASEAN on shaping the long-term direction for a cap-and-trade regime for the logistics and transport sectors such as the Getting to Zero Coalition initiative (Global Maritime Forum, accessed September 2019) which aims to introduce zero emissions vehicles into operation by 2030.	

30.	Regulation/incentives for the shipping industry to reduce emissions and dumping of waste. The IMO has set a limit for sulphur in fuel oil used on board ships of 0.50% m/m (mass by mass) from 1 January 2020. NCCS and MPA can work out a system where it is first voluntary and then mandatory. Keeps companies accountable with a public long-term record of emissions.	The IMO's International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships. It includes regulations pertaining to marine pollution by oil, noxious liquids, harmful substances, sewage, garbage and emissions. As a Contracting State to MARPOL, Singapore has implemented MARPOL regulations through our Prevention of Pollution of the Sea Act. The Act gives the MPA the power to take measures and enforcement actions to prevent pollution, including denying entry of ships or detaining ships. For example, the MPA conducts verification checks as well as fuel oil analysis on ships calling at Singapore as part of Port State or Flag State inspections, to ensure their compliance with the IMO 2020 Global Sulphur Limit. The MPA also has the Maritime Singapore Green Initiative (MSGI) since 2011, which is aimed at reducing the environmental impact of shipping and shipping-related activities on the coastal and marine environment. The MSGI comprises various programmes, such as the Green Ship Programme and Green Port Programme, which incentivises decarbonisation and use of cleaner alternative fuels with lower carbon content (e.g.LNG) for Singapore-registered ships as well as foreign ships calling at the Port of Singapore.
31.	Develop a set of national/regional standards for emissions from logistics activities such as warehousing and shipping feeder services.	
32.	Adopt a national governance framework for emissions from maritime terminals (encompassing the container, bulk, oil and cruise terminals).	
33.	Shift consumers and businesses travel behaviour to limit air travel only for essential and emergency purposes through a variety of incentives and policy actions such as surcharges on all flights such as proposed in the EU (Sustainable business, accessed September 2019) or for multiple trips in a year.	Singapore does not intend to impose quotas or conditions to limit air travel. Instead, we are contributing to international efforts to make air travel more environmentally-friendly. Efforts Singapore supports include the ICAO's CORSIA, technological and operational improvements (such as Singapore carriers using more fuel-efficient aircraft and the Singapore air navigation service provider enhancing air traffic management with partners), and exploring the use of sustainable aviation fuels.
34.	Develop a stewardship framework (with both voluntary and co-regulatory components) for the shipping and warehousing sectors, under which the industry takes ownership for its own emissions and recommends specific incentives or guidelines for emissions abatements. This could begin with Singapore-based firms, and other regional countries can be invited to take part.	Within the shipping community, there is convergence on the urgent need for funds to support R&D for solutions for the shipping industry's long-term transition to low/zero carbon energy sources. To this end, a number of key shipping industry organisations have proposed the establishment of an International Maritime Research Fund, to be managed and administered by the IMO. The proposed Fund would be sustained by contributions from shipping companies based on their ships' fuel consumption, which are envisaged to be about US$5 billion over the first 10 years. The proposal is expected to be formally discussed by the IMO at the end of March 2020. Recognising the industry's urgent need for R&D to derive decarbonisation solutions, MPA, in consultation with the industry, will actively participate in the discussions.

35.	Companies should engage in voluntary participation in the ICAO carbon emissions reporting and reduction scheme CORSIA.	Singapore carriers (Jetstar Asia, Scoot, SilkAir and Singapore Airlines) have been making early preparations to ensure that they can implement CORSIA according to the timelines established by the ICAO. This includes monitoring their emissions based on CORSIA since 2019.
Government Organisational Structure/Other Policy Initiatives		
36.	Expand the Centre for Climate Research Singapore to provide multi-disciplinary policy expertise for Singapore's decarbonisation.	The CCRS is part of the MSS, under NEA. CCRS was set up in 2013 to advance the scientific understanding of weather and climate in Singapore and the wider Southeast Asian region. The Centre has since grown to be one of the region's most advanced tropical climate research centres. Recognising that climate science is a very complex subject, the Government is continually strengthening Singapore's climate science capabilities. We are undertaking a S$10 million National Sea Level Research Programme (over the next 5 years) to develop more robust projections of sea level rise around Singapore. The Government's investments in climate science will also help to deepen the region's knowledge and adaptation capabilities. CCRS will also set up a new Programme Office this year to drive the formulation and implementation of our national climate science research masterplan and systematically build up climate science capabilities across our research institutes and universities. On decarbonisation, the Government works with various research institutes, such as the Energy Studies Institute at NUS, Energy Research Institute at NTU, and many more, to provide the multi-disciplinary policy expertise for decarbonisation.
37.	Reform MEWR and NCCS to give a stronger mandate to enact climate change policies.	Reducing Singapore's emissions requires coordinated and concerted effort across all sectors: industry, power, buildings, transport, households, waste, water and others. As such, climate change policies require multi-agency effort, involving a wide number of ministries and statutory boards. The Inter-Ministerial Committee on Climate Change (IMCCC) was set up in 2007 to enhance whole-of-government (WOG) coordination on climate change policies. Under the IMCCC, the Long-Term Emissions and Mitigation Working Group (LWG) studies how Singapore can stabilise its long-term emissions, examines options for emissions reduction, and identifies capabilities, infrastructure and policies needed for long-term mitigation. Through WOG effort, the various ministries and statutory boards have developed sector-relevant targets such as increasing public transport modal share and increasing percentage of green buildings by gross floor area, and they all contribute to emissions reduction.
38.	Empower ministries to translate the NDC commitments into emissions reduction targets for individual sectors and business entities.	
39.	Commit a part of the annual budget to climate change and decarbonisation policies.	The Government expects to collect revenue from the carbon tax ($5/t$CO_2$e from 2019 to 2023) of about $1 billion over the first five years, and is prepared to spend more than this in the same period to support worthwhile projects which deliver the necessary abatement in emissions.

		PM Lee announced in his 2019 National Day Rally speech that the Government is undertaking a comprehensive effort that could cost S$100 billion over 100 years to build up Singapore's coastal defences island-wide to protect us from rising sea-levels. The Government is studying various funding options. Funding on smaller-scale infrastructure such as localised flood proofing measures can be funded from the budgets of Ministries. For larger, long-lived infrastructure, the Government will look at the option of borrowing in order to better spread the spending among the generations which will benefit from it. Based on our existing framework, reclamation costs can be met from the reserves, with the land created being protected as part of past reserves. The Government will also explore the option of tapping on past reserves, as the severe impact of climate change is an existential issue for Singapore.
Food Security		
40.	Elucidate the threat of food shortage and natural disasters.	The agriculture and food, or agri-food, landscape is changing rapidly. By 2050, global population is expected to grow another 30% to 9.7 billion. Global food demand is also projected to rise by 60% as incomes rise in developing countries, leading to greater demand for meat and proteins. The negative impact on food security is further compounded by widespread declines in crop yields due to climate change impacts. The IPCC estimates the decline of crop yield could be up to 25% by 2050. To ensure that Singapore's food security continues to be resilient, SFA takes a multi-prong approach comprising: i) diversification of import sources, ii) grow local and iii) grow overseas. In our 'import source diversification' strategy, Singapore buys from many diverse sources, to reduce the risk of reliance on any one supply source, and enable us to tap on/ramp up supply from other sources when traditional sources are disrupted. Singapore's diversification strategy is a broad-based framework to mitigate disruptions to Singapore's food supply from a particular region, including disruptions caused by disease outbreaks, extreme weather and climate events. Local production or 'grow local' helps to mitigate our reliance on imports and serves as a buffer during supply disruptions to import sources. In 2019, SFA announced the goal to achieve "30 by 30", which is to transform Singapore's agri-food industry to produce 30% of its nutritional needs by 2030. Key to this is for our farms to harness technology and innovation to grow food in a productive, climate-resilient and sustainable way. Singapore's 'grow overseas' strategy involves opening up new markets and helping our farms overcome land constraints in Singapore. Produce from local farms which are established overseas could also be exported back to Singapore, contributing to our food security.

41.	Adopt the Food and Agriculture Organisation's (FAO) city-region food system model to restructure the food industry.	The FAO's City Region Food Systems (CRFS) approach aims to foster the development of resilient and sustainable food systems within urban centres, peri-urban and rural areas surrounding cities by strengthening rural-urban linkages. The values that an ideal CRFS fosters are food security and nutrition, livelihoods and economic development, sustainable natural resources management and minimised environmental impact, and social inclusion and equity. (Source: www.fao.org/in-action/food-for-cities-programme/approach-old/crfs/en/) In 2019, SFA announced the '30 by 30' goal, where we aim to transform our agri-food sector to produce 30% of Singapore's nutritional needs by 2030. Key to this is for our farms to harness technology and innovation to grow food in a productive, climate-resilient and sustainable way. Singapore has some first movers in our midst. Sustenir produces vegetables and fruits such as kale and strawberries in an indoor, high-tech vertical setting, using IoT and sensors. Such climate-resilient solutions makes farming more like manufacturing – where production takes place within a controlled environment with a defined input. The result is an assured and consistent output, and a predictable way to address the effects of climate change and extreme weather. Urban farming in alternate spaces such as in vacant multi-storey carparks, state buildings and rooftops is also gaining interest. This involves the innovative use of spaces in the urban environment to farm, reduces the carbon footprint as it brings food closer to homes and raises awareness on the importance of food security by involving the community directly in food production. SFA is working with agencies to make more of such spaces available.
42.	Increase important food supplies from this region to reduce the carbon footprint incurred from food imports. Increase investments or support for climate adaptation and agricultural productivity measures in countries that Singapore relies on for food, to ensure minimal disruption to the production and transportation of key supplies.	As a small nation with limited agricultural output, Singapore depends heavily on imported food supplies, particularly from regional countries. To ensure that Singaporeans enjoy a wide variety of food, SFA continuously works to identify new and potential food sources in the region and beyond. This includes outbound trade missions for food sourcing and fostering new business relationships. SFA's primary strategy to ensure a continuous supply of safe food is to diversify our food sources. This is to reduce reliance on any single country and allow us to switch quickly to alternative sources when the need arises. To do this, SFA takes a multi-faceted approach through close collaboration with industry players and other government agencies.
43.	A single, streamlined set of procedures/standards for grassroots farmers, urban farming communities to sell their produce. Current barriers to selling: SFA requires certain food quality standards; the	SFA has been looking to unlock more spaces to grow food locally, including underutilised/ alternative spaces (e.g. vacant state buildings, rooftops). Singapore can make creative use of such spaces to grow food locally and test-bed technological innovations that can lead to "growing more with less".

	sale of vegetables on rooftops is a grey area because rooftops are not agriculture zones; NParks encourages individuals to grow food, but not on a large scale.	Farming spaces located in the city/heartlands are also able to bring agriculture closer to the public. Urban farming in alternative spaces not only provides food for the nearby communities but also attunes Singaporeans to our efforts to ensure food security. Those who are interested in setting up commercial urban farms can seek approval from SFA. An example of farming in alternative spaces is the urban farm pilot by Citiponics in Ang Mo Kio. Citiponics is the first commercial farm on the rooftop of a multi-storey car park.
44.	Work through the success of the popular NParks allotment gardening programme to increase the physical accessibility of land and space allotments for entrepreneurs and small-holders who may desire to use SLA community use sites for community farming leases.	SFA has been working with agencies such as HDB and SLA to avail more spaces for farming and bring food closer to homes. Urban farming in alternative spaces such as vacant multi-storey carparks, vacant state buildings and rooftops is gaining interest. This involves innovative use of spaces in the urban environment to farm, reduces carbon footprint and raises awareness on the importance of food security by involving the community directly in food production. An example of farming in alternative spaces is the urban farm pilot by Citiponics in Ang Mo Kio. Citiponics is the first commercial farm on the rooftop of a multi-storey car park. The farm opened in April 2019 and produces fresh vegetables that are sold at the NTUC FairPrice outlet at Ang Mo Kio Hub under its LeafWell brand. To support the local community, the farm hires residents from the neighbouring estates. They also engage schools and other members of the public via farm tours and learning journeys. To foster a love for gardening, NParks introduced the Allotment Gardening Scheme as part of our Community in Bloom (CIB) programme. With Allotment Gardens situated near HDB residential estates, these plots are widely accessible to the community. Today, more than 1,000 allotment gardening plots have been introduced in more than 10 parks island-wide.
45.	Research and develop food varieties that can adapt to the changing climate.	The development of productive, climate-resilient, innovative and sustainable technological solutions for urban agriculture and tropical aquaculture is a key focus of the $144 million Singapore Food Story R&D Programme, led by SFA and A*STAR.
46.	Develop alternative proteins (lab grown meats) with optimal nutritional profiles to reduce dependency on food imports.	R&D in the area of alternative proteins will be covered under the $144 million Singapore Food Story R&D Programme, led by SFA and A*STAR. To ensure the safety of novel foods, SFA has developed a novel food regulatory framework. This will allow food businesses the space to innovate and produce new food products, whilst ensuring that any food safety risks of these new products are identified early and managed.
47.	Incentivise agricultural businesses and newly leased farm tenants to meet two objectives for the food and farming sector: enable a people-	Since 2017, SFA has been tendering out and awarding agriculture land to companies with the best concepts, based on the 'fixed price' method and 'concept & price' method instead of the 'price only' method which typically favours tenderers that have deep pockets.

	centred approach to a just and inclusive circular food system in Singapore, and to contribute new value to the food system through regenerative and resource-smart means. Alternative KPIs can support this: nutrition per land unit area, the use of indigenous crops, and initiatives to work with independent groups or other farms to circulate reusable materials.	SFA also has the Agriculture Productivity Fund that incentivises farms to remain productive by harnessing innovative, sustainable technologies and advanced farming systems. Apart from productivity, our farms need to be resource-efficient, and apply circular principles to reduce resource use. SFA has observed a small but growing number of local farmers that have incorporated sustainable practices in their operations in recent years including renewable energy, sourcing from sustainable sources, recycling farm waste, etc.