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Singapore Carbon Taxes
An Analysis of the Policy Context[1]

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[1] This is an update of the 13 November 2017 KAS-RECAP policy analysis by the same author titled 'Singapore's Prospective Carbon Taxes, An Analysis of the Policy Context'. Updates pertain to the commencement in 1 January 2019 of the Carbon Pricing Act 2018 https://sso.agc.gov.sg/Acts-Supp/23-2018/Published/20180601?DocDate=20180601

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Key Points

- Singapore's power mix is dominated by gas (95.5%). The establishment of an LNG regasification plant in 2013 has expanded its access to global sources and, thus, increased energy security. Total dependence on piped gas is to end by 2030.

- Given geographical and geological constraints, the deployment of renewables and civil nuclear is limited. Currently, Photovoltaic (PV) *SolarNova* by the Economic Development Board (EDB) and the Housing Development Board (HDB); *Floating Solar PV* by the Public Utilities Board (PUB) and EDB, and Waste-to-Energy (WtE) by National Environment Agency's (NEA) Integrated Waste Management Facility 2024, are the major sources of RE for electricity generation amounting to about 4% (2016).

- Energy Efficiency (EE) in industry, buildings, transport, household, water and waste (by EDB and NEA) is, thus, Singapore's key strategy for reducing GHG emissions. Yet, a government regulatory approach to EE may incur high costs and unintended social consequences.

- The deployment of carbon taxes was announced in 2017 as '*the most economically efficient and fair way to reduce greenhouse gas emissions so that emitters will take the necessary actions*' (2017 Budget). The tax was implemented in 2019 with the enactment of the 2018 Carbon Pricing Act (CPA).

- Pricing carbon through a carbon tax has thus been placed at the foundation of the EE strategy. It is anticipated that taxes will encourage changes in consumption, provide market incentives for the adoption of EE technologies, and stimulate the growth of green industries.

- Carbon taxes will be applied upstream, that is, to direct emitters (power stations, etc). Emitters can opt to improve energy efficiency and reduce emissions or pay taxes. Consumers can opt to use less electricity and save energy (but taxes will not apply downstream). Tax revenue will fund transitional costs as well as measures taken by industries to reduce emissions.

- Thus, it is expected that energy efficiency, low-carbon technology, and reduced emissions will in future 'grow' out of carbon taxes (see Figure 4).

1. The Policy Context

Understanding the policy context within which policy instruments are deployed in the delivery of public policy is essential in assessing the pros and cons a particular instrument may encounter and its success in achieving its intended goal.

Singapore has decided to implement carbon taxes as a market-based instrument to reduce GHG emissions. The policy context of this decision relates to: trends in Singapore's economic and energy policy; trends in energy demand (buildings, industry, transport) and supply (primary oil & gas and power sector); the nationally determined contributions (NDCs) Singapore has pledged for 2020 (in Copenhagen 2009) and for 2030 (in Paris 2015); Singapore's GHG emissions; and Singapore's carbon footprint.

These are discussed.

1.1. Trends in economic and energy policy

Economic Overview

Given its robust services-oriented economy, Singapore's gross domestic product (GDP) is expected to increase from 405 US$ billion PPP[2] in 2020 to 505 US$ billion in 2040 (World Bank 2015; APERC 2016: 280). Due to its projected population growth from 5.7 million in 2020 to 6.2 million in 2040, the total final energy demand (TFED) (2013-2040) will increase by 15% (from 20Mtoe[3] to 23Mtoe) (Singapore Statistics 2017; APERC 2016).

The city-state is 100% dependent on imports of oil and gas for domestic consumption, including power generation and supplies to its three oil refineries that export refined products. High levels of renewables (including hydro, solar, wind, geothermal, biomass and marine) are unsuitable to a compact, highly urbanised, low wind, tropical locality. Nuclear energy has been excluded given its safety risks.

The domestic TFED utilised in buildings, industry and transport (20Mtoe in 2013) is significantly smaller than the total primary energy supply (TPES) (23Mtoe). This substantial gap is due to the fact that a large proportion of the oil supplied (imported) is refined and re-exported (52Mtoe in 2013) as well as utilised by the international shipping and aviation industries that demand large quantities of bunker and jet fuels (IEA 2016; APERC 2016).

Energy-related emissions were 47MtCO_2e in 2013 and are projected to rise to 53MtCO_2e in 2040 and stabilise thereafter (ibid.).

[2] PPP: purchasing power parity
[3] Mtoe: million tonnes oil equivalent

While the refinery sector is a large source of revenue, it creates a situation of embedded emissions in products that are processed by not consumed domestically. This is a challenge in calculating the city's GHG emissions and in setting 'effective' reduction targets.

Energy Policy: The Energy Policy Group and the National Energy Report 2007

In 2007, Singapore took a 'whole of government' approach to energy policy with the establishment of the Energy Policy Group (EPG). Ministries and agencies with portfolios touching on energy were institutionally brought together to formulate, coordinate and implement an energy policy framework and study a wide-range of energy related issues in the power, transport sectors, energy efficiency, climate change, energy industry, R&D, and regional and international cooperation.

Under the leadership of the Ministry of Trade and Industry (MTI), EPG includes the ministries of Environment and Water Resources (MEWR), Foreign Affairs (MFA), Transport (MOT), and Finance (MOF) and agencies such as the Energy Market Authority (EMA), the Economic Development Board (EDB), National Environment Agency (NEA), Land Transportation Authority (LTA), and Building and Construction Authority (BCA).

In the same year, EPG published the Singapore National Energy Report: Energy for Growth (NER 2007) with the objective of balancing energy security, economic competitiveness, and environmental sustainability. To operationalise these objectives, five strategies were devised:

- Promoting competitive markets;
- Diversifying the fuel mix;
- Enhancing energy efficiency;
- Developing the energy industry by investing in energy R&D, and;
- Upscaling international cooperation.

These strategies are resulting, among others, in an end of total dependence on piped-gas imports from Malaysia and Indonesia and, instead, reliance on global imports of liquefied natural gas (LNG) that is regasified locally.

They have also resulted in: a) the deployment of photovoltaic (PV) under the *SolarNova and Floating PV programmes* for government buildings, public spaces and reservoirs that are used as test beds for the potential deployment in the private sector; b) the intensification of energy efficiency to support Singapore's commitment to reducing carbon intensity by 36% from 2005 levels by 2030; and c) investing in R&D by 'building a clean energy ecosystem with a critical mass of companies, skilled manpower, and R&D capabilities' (MTI 2015).

It is under the promotion of competitive markets strategy that market-based instruments (carbon taxes) have been considered with the decision to introduce them made in the 2017 Budget (C6-C10) (see Section 2).

1.2. Trends in energy demand and supply

Following a business as usual scenario (BAU)[4] with the purpose of outlining likely energy futures, Singapore's energy trends are as follows (APERC 2016, Vol. II: 282):

- In the buildings and industry sectors, a continued efficiency improvement due to programmes in place;
- In the domestic transport sector, a continued expansion of light rail (MRT) and discouraged growth of private vehicles;
- In the energy supply mix, a continued increase of oil and gas imports and increase in global LNG to end the 100% reliance on piped gas;
- In the power mix (electricity), a discontinuation of coal, deployment of limited PV, increasing trends in waste-to-energy (WtE), and no nuclear;
- In the overall access to renewable energy (RE), WtE (from incineration) will remain the main RE fuel together with a PV penetration of 600 megawatts peak demand (MW_p);
- In ensuring energy security, the requirement of having 60 days-worth of fuel reserves to be held by generation companies (gencos) remains;
- Finally, with regards climate mitigation, policymakers' thinking is that there is limited room for reducing CO_2 emissions due to the city's heavy dependence on imported fossil fuel energy because of the absence of local resources.

The limitation of the BAU is that it assumes a continuation of current energy demand and supply trends, does not factor-in improved efficiency, high renewables, or a diverse fuel mix (electricity generation) other than a high reliance on gas.

Demand

According to APERC 2016, following the same BAU, the overall trend is that TFED is set to increase by 15% (from 20Mtoe in 2013 to 23Mtoe in 2040) with the non-energy sector (oil refineries) being the major contributor. The industry and buildings share of TFED will also increase while in the transport sector it will decrease due to a strong policy of discouraging private vehicular ownership.

In the building sector, energy demand will grow from 24Mtoe (2013) to 30Mtoe (2040) due to factors such as population growth, rising living standards and consequential use of more appliances and electronic devices, and GDP growth. Commercial buildings take the bulk of the demand (74%) while the share of

[4] BAU is defined here as one where current policies and trends will continue (APECR 2016, Vol. II: 1). The Singapore's Government definition of BAU may be different.

residential demand will decrease by about the same percentage. The fuel mix in buildings will see a decrease in the share of electricity due to fuel efficiency and an increase of gas that accounts to 95.5% of the power mix. Several legislative instruments will continue to contribute to greater energy efficiency in buildings: Building Control Regulation 2008; Building Control Act 2012; Building Control Regulation 2013 (setting Green Mark Standards for new builds and retrofits with regards energy efficiency, water efficiency; environmental protection; indoor environmental quality; and others).

In the industrial manufacturing sector (chemical, petrochemical, shipbuilding, biomedical, electronics), there will also be an increase in energy demand from about 5.9Mtoe in 2013 to about 7.6Mtoe in 2040. This growth is attributed to an improvement in the sector's energy intensity from 17toe per USD million in 2013 to 15toe[5] per USD million in 2040 (APERC 2016: 284). Energy efficiency in this sector is currently supported by government policies such as: Energy Efficiency National Partnership (EENP); Energy Efficiency Improvement Assistance Scheme (EASe), and Grant for Energy Efficient Technologies (GREET) for SMEs. Since 2013, the government has required all industrial companies consuming 54TJ[6]/yr of energy or more to comply with the Mandatory Energy Management Requirements (MEMR). The chemicals and petrochemicals industry are the single largest industrial manufacturing consumers that will experience an increase in energy demand from 2.2Mtoe in 2013 to 3Mtoe in 2040. This is reflective of Singapore's very stable industry structure. Energy demand in all industrial manufacturing (pharma, biotech, electronics, environment and water) will also see growth from 3.6Mtoe to 4.5Mtoe during the same period (ibid.).

In the domestic transport sector energy demand is projected to decline from roughly 3Mtoe in 2013 to 2.6Mtoe in 2040. This is the result of several government initiatives like decreasing the role of private vehicles and light-duty vehicles, and increasing the millage of light rail (MRT). But energy sources stay steady with oil seeing a slight decrease in the domestic transport demand (from 2.5Mtoe to 2.1Mtoe), electricity increasing slightly from 0.2Mtoe to 0.42Mtoe as the MRT expands, and gas experiencing a small share taken mainly by a fuel switch (to liquefied petroleum gas- LPG) in light-duty vehicles (ibid.).

Supply

Total energy imports are expected to increase from 73Mtoe in 2013 to 101Mtoe in 2040. Oil share (64Mtoe) is expected to remain steady till 2040. Gas shares are expected to rise from 8.9Mtoe to 12Mtoe (APERC 2016).

[5] toe: tonnes of oil equivalent
[6] TJ: terajoules

Oil imports delivered via tankers navigating in protected sea lanes will be derived from an increasingly large pool of countries to ensure energy security. These will continue to be intended for the export market as refined products will remain a significant source of revenue.

Gas imports, on the other hand, are intended for domestic consumption, mainly, in the power generation sector where gas accounts for 95.5% of the power mix (EMA 2015a). These are projected to increase from 8.9Mtoe in 2013 to 12Mtoe in 2040 (APERC 2016).

1.3. Singapore's Nationally Determined Contributions (NDCs)

Providing the driving force to the EPG and the NER 2007 mentioned above are the NDCs. In 2016, the city pledged to reduce energy emissions intensity by 36% from 2005 levels by 2030[7] and to stabilise its carbon emissions to 65MtCO_2e[8] at current rates by 2030. Although Singapore is one of the least carbon-intensive economies ranking 123 out of 140 countries (if embodied GHG of imported goods, shipping and aviation are excluded), its per capita emissions ranks 26 out of 142. This means an increase of 143% from 1994 emissions level (Climate Action Tracker: Singapore).

Climate Action Tracker rates Singapore's 2020 (Copenhagen 2009) and 2030 (Paris 2015) pledged targets as 'highly insufficient'. Saying: 'The "Highly insufficient" rating indicates that Singapore's climate commitment in 2017 is not consistent with holding warming below 2°C, let alone limiting it to 1.5°C as required under the Paris Agreement, and is instead consistent with warming between 3°C and 4°C. If all countries were to follow Singapore's approach, warming could reach over 3°C and up to 4°C. This means Singapore's climate commitment is not in line with any interpretation of a "fair" approach to the former 2°C goal, let alone the Paris Agreement's 1.5°C limit. If [we] were to rate Singapore's projected emissions levels in 2017 under current policies, Singapore would also be rated "Highly insufficient"' (Climate Action Tracker: Singapore).

Table 1: Singapore's Climate Commitments (Source: Climate Tracker 2016)

Copenhagen pledge	
2020 target	7-11% below BAU by 2020 (unconditional) [138-168% above 1994 by 2020] 16% below BAU by 2020 (conditional) [100% above 1994 by 2020]
Conditions	Conditional to legally binding international agreement
Paris Agreement target	
Ratified	Yes
2030 target	-36% of emissions intensity below 2005 by 2030 [143% above 1994 by 2030]
Coverage	Economy-wide, all gases covered
Emission peak target	2030
Long term goal(s)	
Long-term goal(s)	-45% of emissions intensity below 2005 by 2035 **(Aspirational goal)**

[7] The St. Petersburg Declaration (2012) introduced an aggregate energy emissions intensity aspirational goal for all APEC economies of -45% from 2005 levels by 2035.
[8] MtCO_2e million tonnes of carbon dioxide equivalent

It is important to note too that, despite Singapore's five-prone strategy approach to emissions, reduction targets are mostly to be met by energy efficiency (EE) measures in various sectors under the *Energy Conservation Act* implemented since 2013 (Chapter 92C, latest amendment 2014; See also KAS RECAP policy paper n. 2 Francesch-Huidobro 2017). The Act mandates energy management requirements for large emitters: Part III domestic & industrial; Part IV transport sector (Singapore Statues Online 2014).

1.4. Singapore's GHG Emissions

Although it is difficult to access Singapore's GHG emissions data (sources included and methodologies greatly vary between International Energy Agency (IEA), US National Energy Information Administration, Carbon Dioxide Information Analysis Centre, official communications of Singapore to the UNFCCC, etc), the per capita emissions in Singapore are about 8.5 tonnes CO_2 (ranking 26th highest out of 142 countries) which accounts for 0.11% of global emissions (UNFCCC 2015; Climate Action Plan p. 6, Singapore's GHG Emissions Profile (primary & secondary emissions).

The share of direct emissions per sector and the indirect emissions for each sector's electricity usage is: (NCCS 2016: 6 (data of 2012)

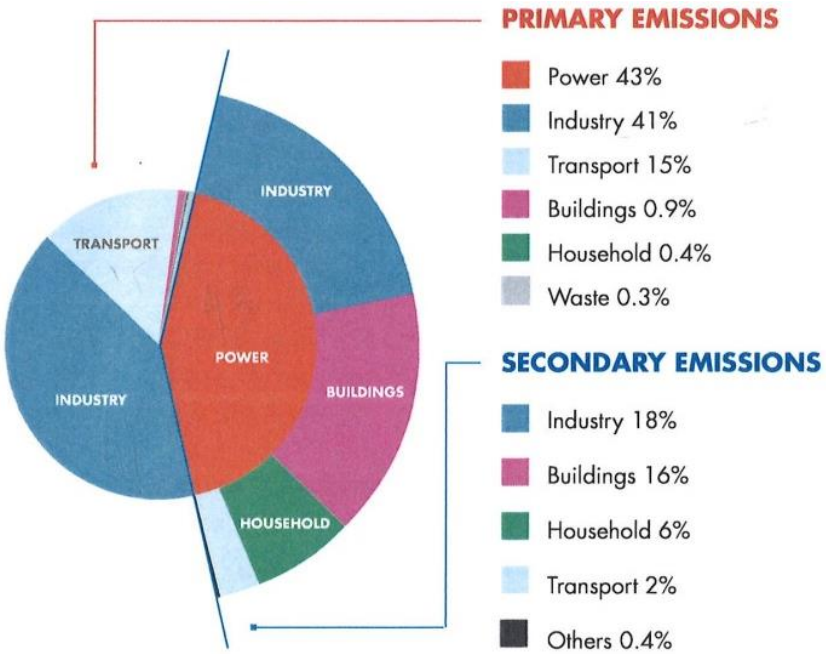
Primary emissions:

- Power 43%
- Industry 41%
- Transport 15%
- Buildings 0.9%
- Household 0.4%
- Waste 0.3%

Secondary emissions (from electricity use):

- Industry 18%
- Buildings 16%
- Household 6%
- Transport 2%
- Others 0.4%

Figure 1: Singapore Emissions Profile 2012 (Source: NCCS 2016: 6)



When combined, they represent the total GHG emission by sector (i.e. industry 59%). Total emissions were 49MtCO_2e (2012).

With limited possibility of increasing RE and the unsuitable development of civil nuclear within its 719 Km^2 land area Singapore is totally dependent on fossil fuels.

According to APERC's Energy Outlook 2016 (p. 292), 'total energy related CO_2 emissions under the BAU will grow by 14% from 43MtCO_2e (2013) to 53MtCO_2e (2040).[9]

1.5. Singapore's carbon footprint (embodied carbon in imported goods)

As an economically open city-state, Singapore's accounting of emissions and calculation of its carbon footprint[10] is challenging. Shall *direct* emissions from activities on the territory be counted only? (i.e. domestic sales of locally-manufactured products) or should emissions emanating from upstream activities (*indirect*) be included (i.e. import of fuels for power generation) or even the export of these indirect emissions? (i.e. import of refined oils)

[9] Singapore government anticipates emissions will peak in 2035 to 65Mt$CO_{2\text{-}e}$
[10] Carbon footprint is the total GHG emitted by individuals, events, and products expressed in carbon dioxide equivalent.

Figure 2: CO_2 Emissions with and without Marine Bunkers (million tonnes) (Source: Doshi 2015: 124)

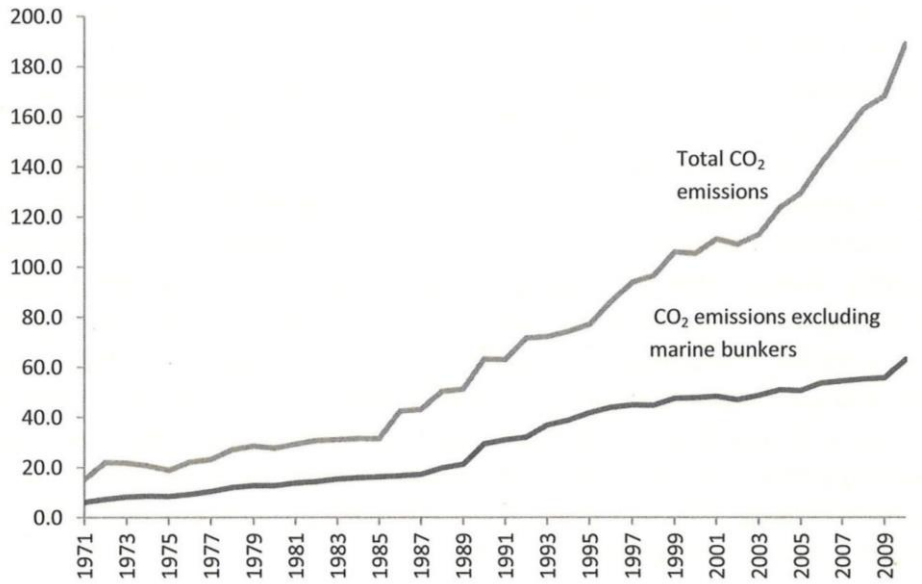
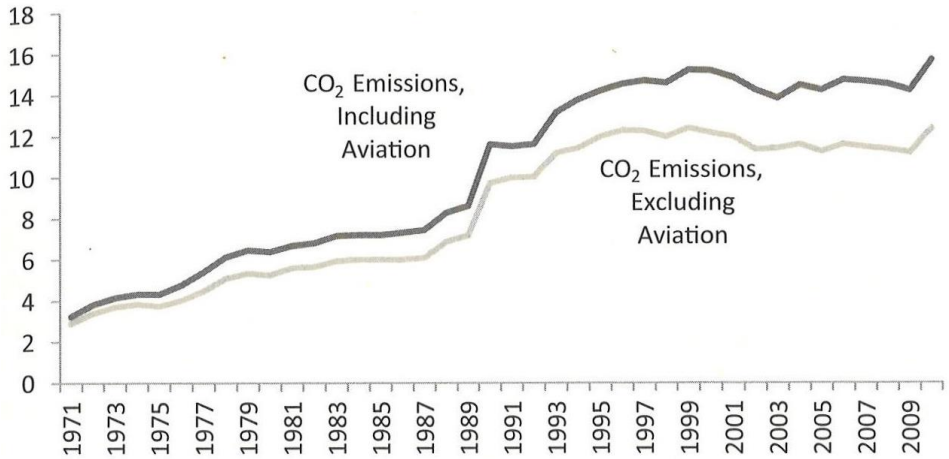


Figure 3: CO_2 Emissions with and without Jet Fuels (tonnes per capita) (Source: Doshi 2015: 147).



In Schulz' (2010) accounting, the volume of indirect emissions was high (80MtCO_2e to 130MtCO_2e between 1995 and 2005), with Singapore reporting to the UNFCCC 26.5MtCO_2e in 1994 (ibid. p. 4851). Indirect GHG emissions embodied in products

traded in Singapore, exceeded direct emissions by a factor of 4-5 (between 25Mt and 325 MtGHGe[11] (ibid. p. 4851). Exports of indirect emissions were generally lower but in a similar order of magnitude between 3-4 times the direct emissions (ibid. p. 4853).

These findings (summary Table 2 Schulz 2010: 4852) 'are important in assessing the usefulness of using an urban scale emissions account and its value in identifying the most effective climate mitigation potential if only direct emissions are accounted for'.

Singapore's paradox is that its compact structure and well-planned and regulated transport system, results in its per capita energy use and emissions being low (as mentioned). But the actual direct emissions data varies greatly per source and is quite high due to its international trade volume (shipping and aviation) and to the international bunkers involved (shipping bunker and aviation fuel) although bunker oils are a separate category according IMO and its accounting should not be allocated to individual countries (email communication NEA to CCA).

2. The Carbon Tax

- Where do carbon taxes fit in the context of these economic and energy policy trends, in trends in energy demand and supply, in Singapore's NDCs, in GHG emissions and in its carbon footprint?
- Why the choice of market-based instruments at this point? How do these differ from traditional command and control regulation?

2.1. The 2017 Budget on Carbon Tax and the 2019 Implementation

In February, Budget 2017 announced:

> *'Singapore has joined more than 130 countries, including China, Japan and South Korea, in having ratified the Paris Agreement, re-affirming our commitment to address climate change and reduce emissions. It is in our own interest to support the international coordination required to deal with an issue that affects all countries, and in particular, small-island states like ours (C.6).*
>
> *There are different ways to reduce emissions. One is to ensure consumers understand the effects of their actions. So we have* ***energy efficiency labels****,*

[11] Million tonnes greenhouse gas equivalent

> *like ticks on air-conditioners or refrigerators. Another is to regulate for higher standards. Singapore has good* ***environmental protection standards*** *and the Ministry of the Environment and Water Resources continues to ensure that our regulations are up-to-date.* ***But the most economically efficient and fair way to reduce greenhouse gas emissions is to set a carbon tax, so that emitters will take the necessary actions (C.7).***
>
> *Singapore has studied this option for several years. We intend* ***to implement a carbon tax on the emission of greenhouse gases.*** *We will consult widely with stakeholders, and aim to implement the carbon tax* ***from 2019****. The tax will generally be applied upstream, for example, on power stations and other large direct emitters, rather than electricity users (C.8).*
>
> *We are looking at a* ***tax rate of between S$10 and S$20 per tonne of greenhouse gas emissions.***[12] *This is in the range of what other jurisdictions have implemented. It will create a price signal to incentivize industries to reduce their emissions, complementing the regulatory measures which we are also introducing. It will help us to achieve our commitments to reduce emissions under the Paris Agreement, do so efficiently and at as low a cost to the economy as possible. This may also spur the creation of new opportunities in green growth industries such as clean energy. Revenue from the carbon tax will help to fund measures by industries to reduce emissions. The impact of the carbon tax on most businesses and households should be modest (C.9).*
>
> *The Government has started* ***industry consultations*** *and will continue to reach out. Public consultations will begin in March. The final carbon tax and exact implementation schedule will be decided after our consultations and further studies. We will take into consideration the lessons from other countries and prevailing economic conditions in Singapore in implementation. We will also provide appropriate measures to ease the transition'* (MOF Budget 2017: Moving Forward Together, C.10).

A carbon tax at a rate of between **S$10-20 per tonne of GHG**[13] will be equivalent to a rise in electricity price between 0.43-0.86 cents KWh or S$2.1-4.3 **from an average of S$72/month (per 4 bedroom household) to S$76/month.** The carbon tax is **mainly targeting between 20-30 power stations** that will be required to begin paying taxes by **2019.** It is linked to the Paris Agreement ratified in 2016 as the 'most economically efficient and fair way' to mitigate emissions (National Climate Change Secretariat (NCCS). The Singapore government anticipates the co-benefit of carbon taxes to be in the form of promoting clean energy growth as revenue collected will help fund measures by industries to reduce emissions (NCCS).

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[12] As the Carbon Pricing Act 2018 (CPA) was enforced on 1 January 2019, the tax per tCO2e was set as at the lower price of S$5 for the period 2019-2023. A review of the scheme is intended in 2023 by when the tax will likely increase by 2030 to S$10 to S$15tCO2e (NEA https://www.nea.gov.sg/our-services/climate-change-energy-efficiency/climate-change/carbon-tax).

[13] See footnote 11 above.

Singapore's *Climate Action Plan* (2016) sets out four strategies to achieve its pledge:

- Improving energy efficiency;
- Reducing carbon emissions from power generation;
- Developing and deploying cutting-edge low-carbon technologies; and
- Encouraging collective action among government agencies, individuals, businesses, and the community.

NCCS affirmed that with regards emissions reduction: 'A carbon tax will enhance Singapore's existing and planned mitigation efforts under our Climate Action Plan, and stimulate clean technology and market innovation. A tax on greenhouse gas (GHG) emissions will incentivize emitters to factor in the costs of their GHG emissions in their business decisions. This would encourage companies to improve their energy efficiency and innovate to reduce their GHG emissions' (NCCS 2016: 25).

Who will be covered?

The carbon tax will be applied upstream, for example, on power stations and other large direct emitters. For stationary emissions, the government is looking at a proposed threshold of 25,000 tCO_2e of greenhouse gas (GHG) emissions annually.[14] This is equivalent to emissions produced by the annual electricity consumption of 12,500 Housing Development Board (HDB) 4-room households. Based on current data, there are around 30-40 of such large direct emitters (NCCS FAQ online).

What GHG will be covered?

The six greenhouse gases that will be covered under the carbon tax are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) (ibid.).

What is the expected impact on business: economic efficiency and fairness?

The increase in operating cost from S$10-20/$tCO_2e$[15] carbon tax is equivalent to US$3.5-7.0/barrels (bbl) increase in crude oil prices. This represents a 6.4% to 12.7% increase from current oil prices (2016), compared to historical quarterly oil price fluctuations which have ranged from -29% to +35% from 2011 to 2016. Companies will receive greater government support for industrial energy efficiency.

[14] But any industrial facility that emits direct GHG equal to or above 2,000 tCO2e annually will be required to be registered as a reportable facility and to submit an Emissions Report annually.
[15] See footnote 11 above.

Possible forms of support include more information about energy efficiency improvement opportunities, enhancing existing energy efficiency incentives, and providing capability-building for companies to put in place better energy management systems. The government is also studying different modes of assistance to help businesses with the transition. Views from companies and the public were sought via industry consultations and public consultations which began in March and were completed in May 2017 (ibid.) (see also NCCS, Public Consultations, Annex).

How will it be operationalised?

Given the fact that the National Environment Agency (NEA) is communicating with industry regarding carbon taxes, these will be operationally linked to the promotion of energy conservation and efficiency which are NEA's core tasks via the Energy Efficiency Programme Office (E^2PO), a multi-agency committee lead by NEA in collaboration with Energy Market Authority (EMA).

Two new tools will be supporting the deployment of carbon taxes:

- ***Energy Efficiency Opportunities Assessment*** (EEOA) by which any company using more that 54TJ of energy will have to be assessed by 2021. Companies using more that 500TJ will be assessed every 6 years, while those using between 54 and 500TJ will be assessed every 3 years. Companies are to appoint energy assessors. EEOA Assessors' role would be to identify energy efficiency opportunities, recommend energy efficiency opportunities, and prepare assessment reports at ISO50002 standards. Assessors will have to be certified yearly according to a given criteria[16].

- ***Measures Report Verification System*** (MRVS)[17]. MRVS applies to all industrial sector firms with emissions of more than 25,000tCO_2e per year. There are two elements of MRVS:

  a) ***Monitoring Plan*** (MP) that discloses how a firm calculates (computation) its GHG emissions and the methodology it uses, and;

  b) ***Emission Report*** (ER) that summarises the company's emissions including comments from third-party verification which should be audit firms and/or certification companies with a lead auditor certified to

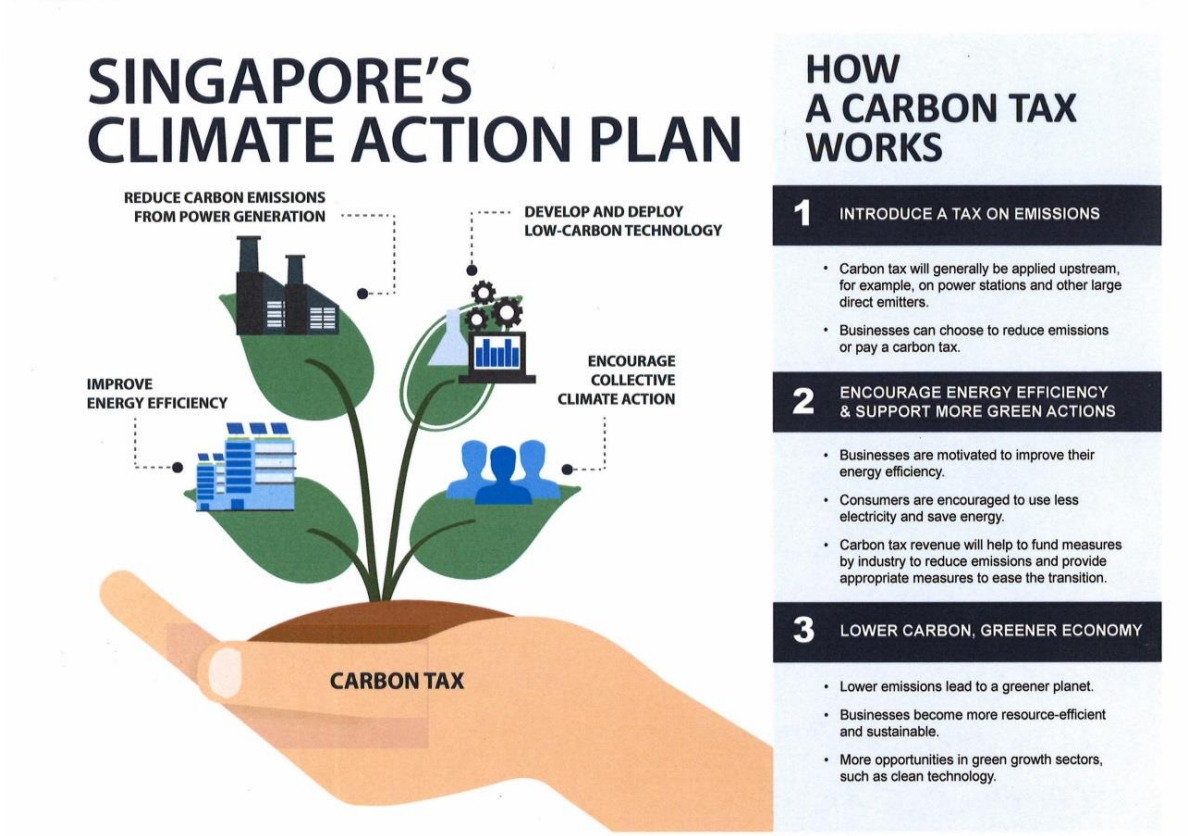
[16] See assessors verification and accreditation guidelines here https://www.nea.gov.sg/our-services/climate-change-energy-efficiency/climate-change/carbon-tax/verification-and-accreditation-requirements

[17] Measuring and Reporting requirements guidelines: https://www.nea.gov.sg/our-services/climate-change-energy-efficiency/climate-change/carbon-tax/measurement-and-reporting-requirements-for-greenhouse-gas-emissions

ISO14065 standards. ER will require each firm to appoint a GHG manager that must be in-house.

The National Energy Policy 2007 and the Climate Action Plan make explicit connections between the introduction of taxes, the encouragement of energy efficiency, and the low carbon economy (cleaner production and consumption) (Figure 4).

Figure 4. Carbon Taxes and Singapore's Climate Action Plan (Source: NCCS 2016).



2.2. What are the advantages/disadvantages of market-based instrument versus command and control tools?

Carbon taxes use government regulation determining its deployment and market signals linking the value of goods and services to their 'true' cost, including externalities[18]. They have the following *advantages* (Doshi 2015: 173-178):

- Correct market failure leading to economic efficiency as GHG emissions are an unpriced externality;
- Allow flexibility for firms to determine how to best achieve reduction targets depending how much it will cost them;
- Raise revenue by definition;
- Establish a carbon price creating market incentives to reduce emissions by developing and investing in cleaner technologies;

[18] The cost or benefit that affects a party that did not choose to incur such cost or benefit.

- Exemptions/surcharges can have the effect of further mitigating undesirable social or economic behaviour in consumption and production patterns.

But taxes also have potential *disadvantages*:

- Taxes fix the price of carbon but allow emissions' levels to vary. Reduction of GHG emissions cannot be pre-determined as may be the case with cap-and-trade which fixes emissions reduction and allows costs to be determined by market;
- If fiscal regimes vary greatly with the government of the day, taxes become a very unpredictable tool in curbing emissions. In the case of Singapore, given the political continuity provided by its one-party-dominant system, taxes are 'safe';
- The compliance flexibility for firms is not very high: a firm needs to yearly budget how much to mitigate and how much to pay in taxes;
- Tax law and tax administration can be slow in responding to rapid economic conditions and may become obsolete, as such;
- Although taxes are relatively simple to administer there can be strong lobbies calling for exemptions (but not the case in Singapore, as of now).

On the other hand, the *advantage* of using government regulation (i.e. permits, prohibitions, standards, enforcements, etc) is that desired actions can be prescribed to achieve a specific objective in case of serious environmental impact (i.e. handling of radioactive waste). Regulation also has the advantage of being simple to administer (i.e. by setting technical installation standards of abatement that do not require regular measurement and monitoring).

The *disadvantage* of using regulation that applies across the board is that it increases costs for firms with high mitigation costs that have to make the same reduction as those with low mitigation costs. As information about such costs is very difficult to obtain by governments, the result is the unfair application of rules without differentiating their effects on those to whom they apply. This can have unintended consequences like dissuading foreign investors and adding cost of living to citizens.

3. Conclusion & Recommendations

Singapore's strategic location between the Indian and Pacific Oceans has made it a leading financial, transport, and oil trading centre. It now also aspires to be an LNG hub. Trends suggest that its economy will continue to grow in the foreseeable future. The city will continue to be dependent of imported fuels and room for more RE penetration will remain limited. Nuclear is, for now, out of the question. Energy demand will continue to be much lower than supply given that much of what is supplied is exported as refined products. This poses questions about the city's

calculation of its GHG emissions and setting of reduction targets. GHG emissions will continue to grow but eventually stabilised.

Energy policy has been institutionalised across government in the form of the Energy Policy Group and the national strategy announced in 2007 (Energy for Growth: National Energy Report – NER). The NER included the deployment of market-based instruments and, thus, carbon taxes have been deployed from 2019. Carbon taxes are being explicitly linked to the key reduction strategy of energy efficiency which, up to now, has been driven by strong government regulation with its potential high costs and unintended social consequences.

With no room to 'improve' the fuel mix in electricity generation, EE will remain the main stay of any carbon reduction future but will be less reliant on government regulation by pricing carbon through the deployment of carbon taxes. These are intended to internalise environmental externalities. In a one-party political system, the support from the industry in up-taking carbon taxes is almost guaranteed given the predictability of the fiscal regime, tax laws and tax administration. Yet, high emitters may find reductions too burdensome and economically difficult to bear.

This policy analysis is intended as a contribution to ongoing debates on energy security and climate change mitigation in Asia-Pacific. Besides facilitating collaboration between industry, governments and citizens, the analysis can help raise awareness through dialogue and policy analysis to:

- Ensure that levels of carbon taxes are comparable to international experience and that they drive companies to set up reduction targets;
- Make companies aware that their reduction targets are contributing to Singapore's NDCs;
- Continue to monitor the International Maritime Organization (IMO)[19] and the International Civil Aviation Organization (ICAO)[20] emissions reduction developments;
- Engage the Singapore government on the question of embedded emissions;
- Persuade publicly listed companies to share their Emissions Report (ER) via the Singapore Exchange (SGEX) to encourage constructive benchmarking and public scrutiny;

[19] In 2011, IMO adopted mandatory technical and operational energy efficiency measures which are expected to reduce the amount of CO_2 emissions from international shipping. These mandatory measures (EEDI/SEEMP) entered into force on 1 January 2013. In 2012, international shipping was estimated to have contributed about 2.2% to the global emissions of carbon dioxide (**CO_2**). Further improvement of its energy efficiency and effective emission control is needed as sea transport will continue growing apace with world trade (http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Default.aspx

[20] ICAO adopted new emissions standards for aircraft https://www.icao.int/Newsroom/Pages/ICAO-Council-adopts-new-CO2-emissions-standard-for-aircraft.aspx

- Consider how carbon taxes can be supplemented by other instruments such as allowing high emitters for whom reductions will be too costly to offset their emissions by purchasing internationally accredited carbon credits;
- Take account of results of the industry and public consultations 20 Mar to 20 Apr 207 regarding the proposed carbon taxes.

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- National Climate Change Secretariat, Strategy Group Prime Minister's Office. Frequently Asked Questions http://www.ifaq.gov.sg/NCCS/apps/fcd_faqmain.aspx#TOPIC_11696

Agencies

- International Energy Agency (IEA) – Paris http://www.iea.org/
- Asia Pacific Energy Research Centre (APERC) – Tokyo http://aperc.ieej.or.jp/
- Building and Construction Authority (BCA) – statutory body- building standards and regulations
- Economic Development Board (EDB) – statutory body- global operations and corporate development
- Energy Market Authority (EMA) – statutory body- regulator
- Inter-ministerial Committee on Climate Change (IMCCC) (Resilience, International Negotiations, Long Term Emissions and Mitigation Working Groups - develops Singapore climate pledges
- Land Transport Authority (LTA) – statutory body- planning design, building and maintenance of land transport
- Ministry of Environment and Water Resources (MEWR) – environmental protection and water security

- Ministry of Finance (MOF) – fiscal policy
- Ministry of Foreign Affairs (MFA) – international relations/negotiations
- Ministry of Trade and Industry, Energy Division (MTI) – industry and trade development
- Ministry of Transport (MOT) – mobility
- National Climate Change Secretariat- Prime Minister's Office (NCCS-PMO)
- National Environment Agency (NEA) – statutory body - promotion of energy efficiency (E_2PO)
- Public Utilities Board (PUB)- gas & water policy

Energy Efficiency Government Schemes (Climate Action Plan 2016: 14)

Capacity Building

- Singapore Certified Energy Manager (SCEM)
- Energy Conservation Act (ECA) Chapter 92C
- Carbon Pricing Act 2018 (CPA)
- Energy Efficiency National Partnership Programme (EENP)

Financing

- EE Financing Pilot Programme

Incentives

- Resource-Efficient Design S$600,000 per project (cap)
- Energy Audits co-funded by NEA S$200,000 per project (cap)
- Retrofit Projects for energy efficient equipment and technologies, 20% co-funded by EDB and NEA
- Grants and tax deductions under Accelerated Depreciation Allowance Scheme (ADAS)
- Investment Allowance – Energy Efficiency Scheme (IA)

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