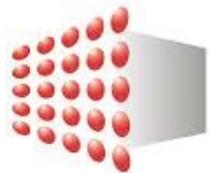


*An interdisciplinary approach to
examine Singapore's drive towards
energy efficiency: Policies for a low
carbon future*



ENERGY
STUDIES
INSTITUTE



Melissa Low

*Third Asian Energy Conference: "Diversity in Urban Energy Transitions in Asia:
Trajectories, Governance and Policy Innovations",
Asian Energy Studies Centre (AESC), Hong Kong Baptist University
3 – 4 July 2019*

Abstract

Under the Paris Agreement, countries need to ratchet up their climate targets every 5 years. Singapore's first NDC to reduce its emissions intensity by 36% from 2005 levels and stabilize its emissions with the aim of peaking around 2030 will need to be updated by 2025 and become more ambitious. Presently, a number of legislative and fiscal measures exist to drive energy efficiency in Singapore. These include the Energy Conservation Act, carbon tax of S\$5/ton from 2019-2023 and a number of energy efficiency grants now consolidated under the Energy Efficiency Fund. However, key challenges including the low penetration of renewable energy, slow take-up of energy efficiency grants and huge untapped potential of green financing remain. This presentation will examine Singapore's emissions trajectory, climate and energy governance and policy interactions relating to its drive to create a low carbon future. It will also propose an interdisciplinary approach to examining these policies.

Overview

- Singapore's Climate Change Pledges & Energy Efficiency Targets
- Current Energy Efficiency Policy Landscape
 - Legislative
 - Fiscal
 - Are these new policy innovations?
 - Do they complement or contradict?
- Research Agenda
 - An interdisciplinary approach

Climate Change Pledges

Singapore's 2020 pledge

- Reduction of GHG emissions by 16% below Business-as-Usual (BAU) levels in 2020, contingent on a global legally binding agreement
- Unconditional pledge of 7 – 11% below 2020 BAU levels

Singapore's 2030 pledge (1st Nationally Determined Contribution, 2015)

- Singapore intends to reduce its Emissions Intensity by 36% from 2005 levels
- Stabilize its emissions with the aim of peaking around 2030



On 23 September 2014, during the UN Secretary-General Ban Ki-Moon's Climate Summit, Singapore formally **ratified the Doha Amendment to the Kyoto Protocol**.



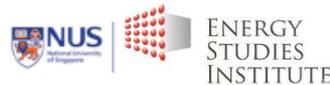
On 22 April 2016, Minister for Foreign Affairs Vivian Balakrishnan **signed the Paris Agreement** at the United Nations

Singapore's Intended NDC Preparation

Inter-Ministerial Committee on Climate Change

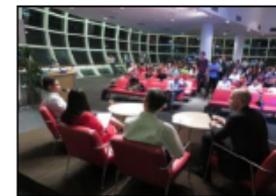


Energy System Modelling



Energy Efficiency Studies

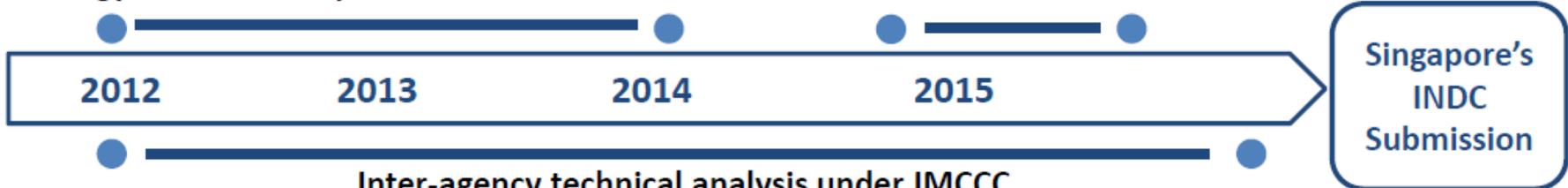
- Economy-wide
- Industrial Sector



Public Consultation

- Online Consultation
- Stakeholder/Sectoral Consultations

Energy Tech Roadmaps



Inter-agency technical analysis under IMCCC

(Source: National Climate Change Secretariat, Singapore)

Inter-Ministerial Committee on Climate Change (IMCCC)

Chaired by Deputy Prime Minister and Coordinating Minister for National Security

Members:

Minister for the Environment and Water Resources, Minister for Finance, Minister for Foreign Affairs, Minister for National Development, Minister for Trade and Industry (Trade), Minister for Trade and Industry (Industry) and Minister for Transport

IMCCC Executive Committee

Chaired by Permanent Secretary (PMO) (Strategy)

Members:

PS (Environment and Water Resources), PS (Finance) (Performance), PS (Foreign Affairs), PS (National Development), PS (National Research and Development), PS (Trade and Industry), PS (Transport) and Chairman (Economic Development Board)

Resilience Working Group (RWG)

Chaired by PS (National Development) and PS (Environment and Water Resources)

International Negotiations Working Group (INWG)

Chaired by PS (Foreign Affairs)

Long Term Emissions and Mitigation Working Group (LWG)

Chaired by PS (PMO) (Strategy) and PS (Trade and Industry)

Measurement, Reporting and Verification (MRV) Task Force (inter-agency)

Facts about Singapore

- Urban city-state of just 719km²
- Tropical climate on equator
- Low-lying, gentle topography
- Highest point 164m
- Population: 5.61 million in June 2016
- Population density: ~7,712 persons/km²
- External merchandise trade S\$967 billion in 2017
- Nominal GDP: S\$447 billion in 2017
- Per capita GDP: S\$73,083 in 2016
- Contribution to global emissions: 46,831.68 gigagram CO₂-equivalent, 0.11% of global emissions (2010)
- Per capita emissions: 26th out of 142 countries based on IEA 2015 data
- Projecting from 2005, Singapore's business-as-usual (BAU) emissions are expected to reach 77.2 million tonnes (MT) in 2020

Economic Structure, 2017 (Nominal Value Added Share, %)

Manufacturing	19.2
Construction	4.3
Utilities	1.3
Other Goods Industries	0.0
Wholesale & Retail Trade	17.6
Transportation & Storage	7.2
Accommodation & Food Services	2.1
Information & Communications	4.2
Finance & Insurance	13.3
Business Services	14.8
Other Services Industries	12
Ownership Of Dwellings	3.9

(Source: National Environment Agency, Singapore in Figures 2015, Climate Action Plan 2016, Third Biennial Update Report 2018)

Emissions by IPCC Sector (2012)

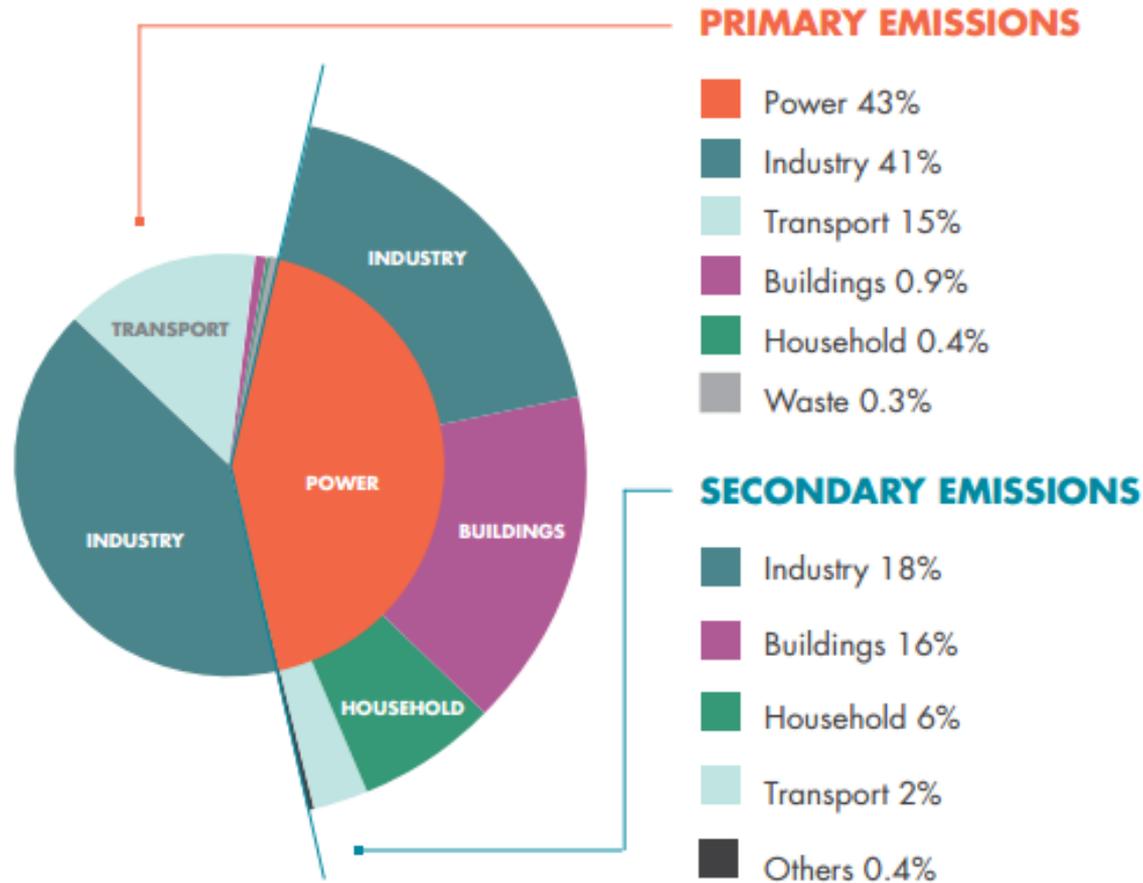


Figure 1-3: Singapore's GHG Emissions Profile (2012)

(Source: Climate Action Plan 2016, Third Biennial Update Report, 2018)

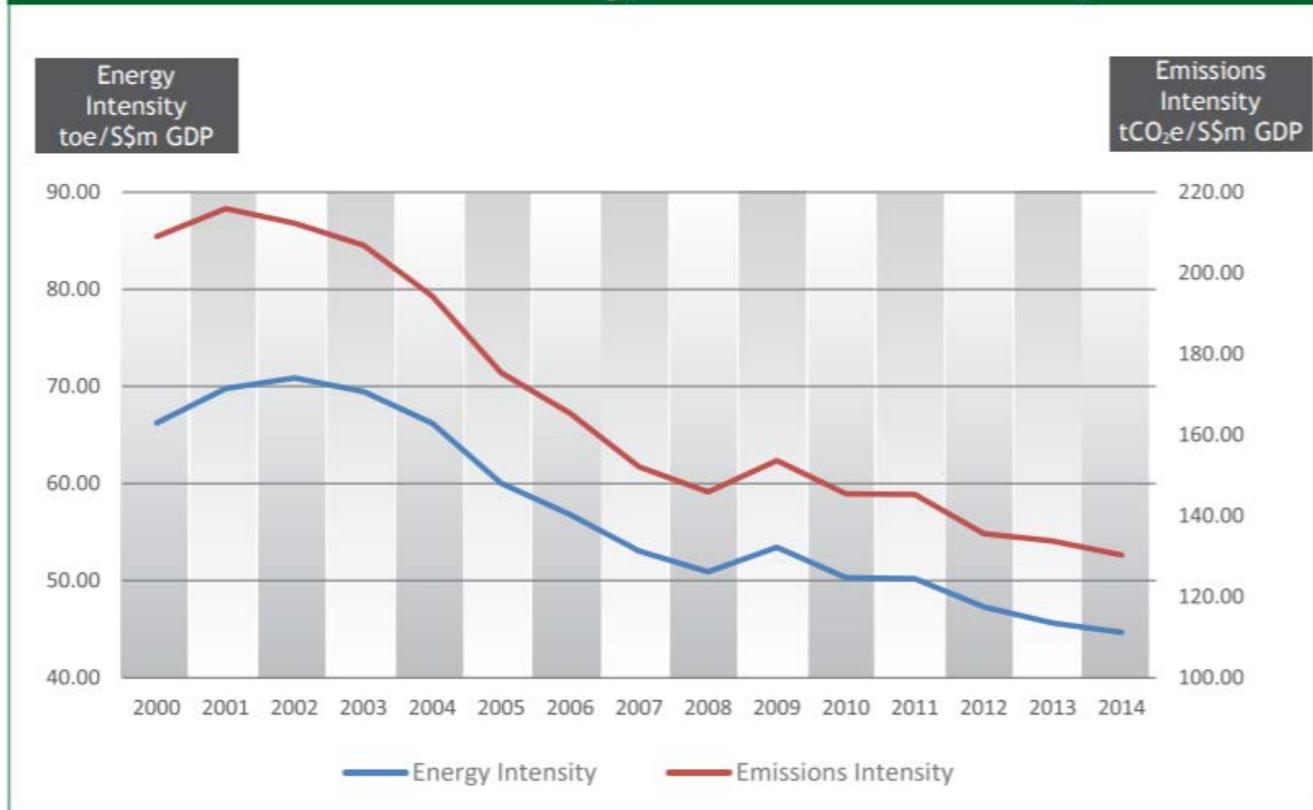
Emissions by IPCC Sector (2014)

Sector	Emissions (Gg CO ₂ e)	% of Total Emissions
Industry (Energy Use)	20,301.60	41.92%
Energy and Transformation Industries ¹⁶	19,596.79	40.46%
Transport	6,902.32	14.25%
Industry (Fugitive Emissions)	998.40	2.06%
Commercial-Institutional	426.70	0.88%
Residential	207.12	0.43%

End-Use Sector	Electricity Consumed (GWh)	% of Total Electricity Consumption
Industry-related	19,753.20	42.57%
Commerce & Service-Related	17,046.60	36.74%
Household	6,924.40	14.92%
Transport-related	2,441.00	5.26%
Others	237.70	0.51%

(Source: Singapore's Third Biennial Update Report 2018)

Time Series of Energy and Emissions Intensity



2000 – 2014:

Emissions
intensity
↓ 37%

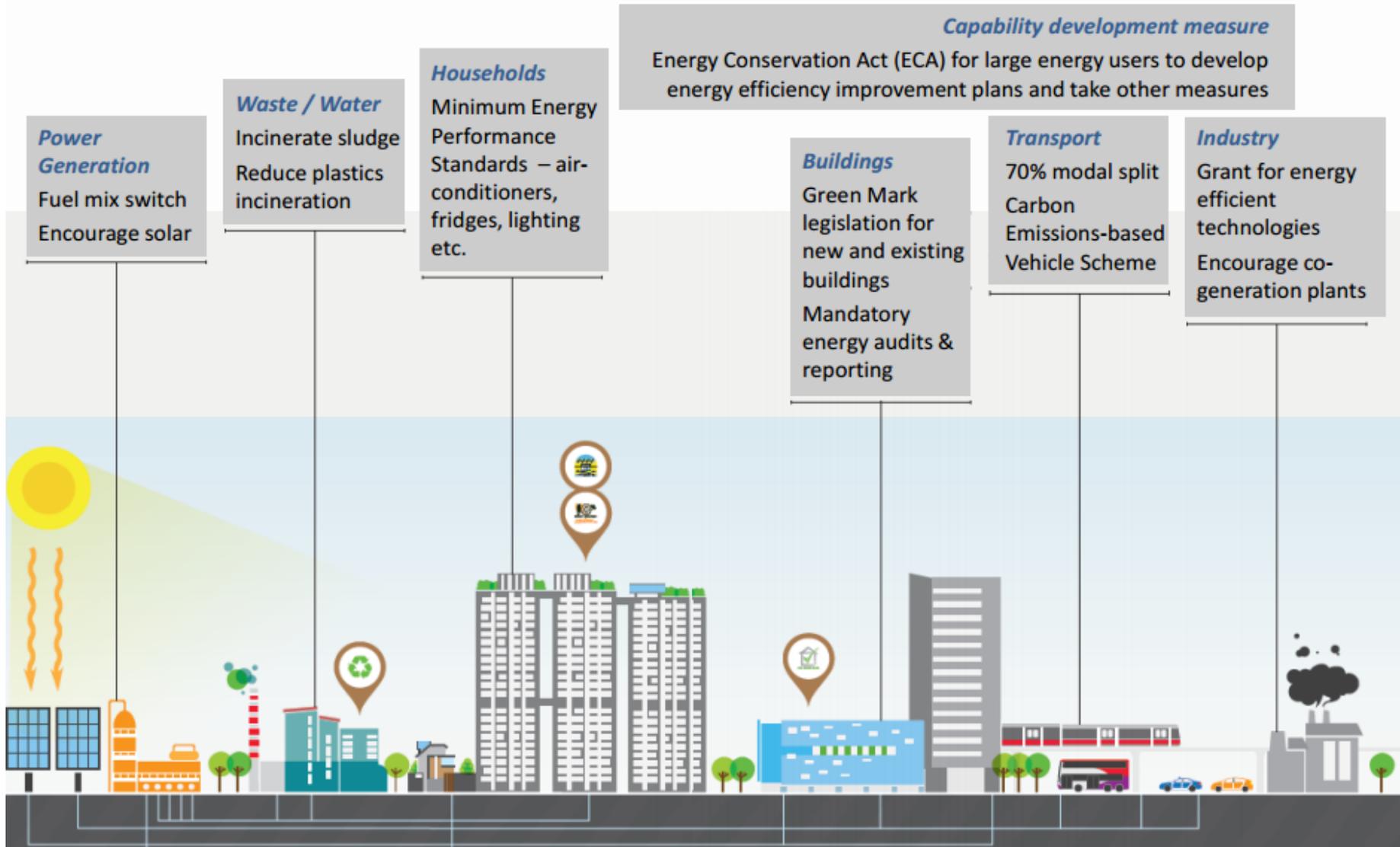
Energy
intensity
↓ 33%

- From 2000 to 2014, Singapore's economy grew at a compounded annual growth rate (CAGR) of **5.5%**, while real GDP levels (in 2010 dollars) increased by 112% from S\$183 billion in 2000 to S\$390 billion in 2014.
- Singapore's GHG emissions grew at a slower rate with a CAGR of **2.0%**, or an increase of **26%** (9,839 Gg CO₂eq) from 2000 to 2012/ **32.8%** (12,579 Gg CO₂eq from 2000 to 2014).

Current Energy Efficiency Policy Landscape

- Targeted at improving industrial energy efficiency, within the context of an open trade-oriented economy
- Singapore aims to achieve 1-2% improvement per year, similar to leading developed countries such as Belgium and Netherlands
- Combination of legislative and fiscal tools (selected ones listed):
 - Energy Conservation Act 2012 (Enhanced in 2017)
 - Carbon Pricing Act 2018
 - Green Mark Scheme
 - Energy Efficiency Fund
- Capability Development

Mitigation Measures Across All Sectors of Economy



(Source: National Climate Change Secretariat)

Whole-of-Government effort to address Energy Efficiency



Source: Joash Seng, Senior Lead (EDB) /
Leow Beng Kwang, Senior Manager (NEA)

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Key Documents in Singapore's Climate Strategy

1. Biennial Update Reports (2014, 2016)

- International Consultation & Analysis (ICA) Facilitative Sharing of Views (FSV) under the UNFCCC
- Singapore to submit 3rd BUR in Dec 2018

2. Climate Action Plan (2016)

- Mitigation and adaptation; Waste Management, E-Mobility Technology Roadmaps (total 7)

3. Public Sector Sustainability Plan 2017-2020 (2017)

- Singapore's largest employer, comprising 16 ministries, 64 statutory boards and about 145,000 public officers
- Goals articulated in the **Sustainable Singapore Blueprint**
- Targets to reduce electricity and water consumption by 15% and 5% respectively by 2020

4. Energy Conservation Act (2012, amended 2017)

5. Carbon Pricing Bill/Act (Tabled and passed in 2018)



Energy Conservation Act 2012, 2017

- **What it is:** An effort to consolidate laws on energy efficiency under one Act.
- **Who it affects:** Industrial companies that use >54 Terajoules (TJ) of energy per year; 188 companies operating 240 energy-intensive facilities are regulated under the ECA
- **What it does:** Requires affected companies to appoint an energy manager, monitor and report energy use and GHG emissions, and submit annual energy efficiency improvement plans
- **2017 enhancements:** Tightened energy monitoring and reporting requirements by introducing minimum energy efficiency standards for energy-consuming systems. Affected companies now also have to submit enhanced emissions reports detailing energy consumption, energy production and GHG emissions and implement an energy management system and conduct energy efficiency opportunity assessments (EEOA) for new ventures and expansions of existing business from 2021.

Energy Conservation Act 2012, 2017

Mandatory Energy Management Practices under Energy Conservation Act (ECA)

- Energy management practices introduced for industrial sector in Apr 2013
- Requires energy-intensive companies in industrial sector* consuming 54 TJ of energy or more each year to:
 - Appoint at least one energy manager;
 - Monitor and report energy use and GHG emissions annually; and
 - Submit an energy efficiency improvement plan and review it annually
- 188 companies operating 240 energy-intensive facilities are regulated under ECA

Enhanced Mandatory Energy Management Practices under ECA

Existing energy-intensive facilities shall put in place a structured Energy Management System and conduct Energy Efficiency Opportunities Assessments

- New energy-intensive facilities and major expansions shall:
 - Plan for and install instruments and meters at system level
 - Report energy use and energy performance indicators based on measured data
 - Review facility design, develop economically feasible energy/carbon efficiency measures for incorporation into the new facility and report findings

Minimum Energy Performance Standard (MEPS) for Common Industrial Equipment and Systems

- Set at premium efficiency level (IE3) for single speed 3-phase induction motors (from Oct 2018)
- To be extended to other common industrial equipment and systems over time

* Covers manufacturing, utilities and sewage & waste management companies

5

Source: Joash Seng, Senior Lead (EDB) /
Leow Beng Kwang, Senior Manager (NEA)

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Singapore's Carbon Tax

- **What it is:** Fixed Price Credit Based (FPCB) system, single uniform carbon price of S\$5 from 2019-2023. Tax will be reviewed with intention to increase it to between S\$10 – 15/tCO₂e by 2030. The tax covers six greenhouse gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆). To be implemented from 2019.
- **Who it affects:** For direct emissions, companies emitting >25,000 tCO₂e annually will be taxed on 100% of their emissions. Applied upstream. 30 – 40 large emitters which account for about 79% of Singapore's GHG emissions.
- **What it does:** create a price signal to incentivize emitters to change their behavior and reduce emissions, provides sufficient time for companies to understand the new carbon tax requirements, develop monitoring and reporting plans, put in place systems, processes and capabilities to comply
- **It will likely:** increase operating costs (equivalent to 6-12% increase in current oil prices), increase household expenditure on electricity prices of between 2-4% (electricity prices have fluctuated up to 10% quarterly between 2010 and 2016)

Carbon Pricing Bill passed 20 March 2018

- Public consultation period over 6 weeks from 31 October to 8 December 2017
- The Bill sets out the overall carbon tax framework and obligations for large GHG emitters, including the measurement, reporting and verification (MRV) requirements.
 - **Verifiable Emissions Reports & Monitoring Plans**
- The Bill also gives the National Environment Agency (NEA) the **powers** to make and amend related regulations for matters such as the MRV requirements for affected facilities.
 - **To carry out tests, inspections, enter facility “at reasonable hours”/”during normal business hours without notice or less than 6 hours previous notice”, search premises, examine activity/things, take photographs, bring assistance/workmen/instruments/take readings, inspect documents, seize/take possession of items etc.**
 - **Power to obtain energy consumption data from energy suppliers.**
- **Offences**
 - **Incorrect info that would affect tax liability, through fraud or negligence – fine amount from equal to tax undercharged to quadruple tax plus imprisonment between 3-5 years.**

Energy Efficiency Fund (E2F)

- **What it is:** launched on 3 April 2017, supports efforts by businesses to improve energy efficiency of industrial facilities, particularly if new facilities and expansions include resource efficient designs, and if existing facilities conduct an energy assessment and adopt more energy efficient equipment technologies.
- **Who it affects:** Industrial facilities, Small and Medium-sized Enterprises
- **What it does:** The grant application process has been streamlined so that companies can apply for funding support with minimal paperwork. The NEA also pre-identified a list of energy efficiency retrofit projects for which the application and processing procedures are simplified.
- **New:** Enhanced Industry Energy Efficiency (IEE) package launched at the Singapore International Energy Week on 30 October 2018 by Mr Chan Chun Seng, Minister of Trade and Industry

Types of Grants



National
Environment
Agency

Safeguard · Nurture · Cherish

EDB
singapore



ENERGY
MARKET
AUTHORITY

Smart Energy. Sustainable Future

Energy Efficiency Fund (E2F)

Who can apply for this?



Companies, including SMEs in the manufacturing sector* with:

-  A Singapore-registered owner or operator
-  Group annual sales turnover of less than S\$500 million

Resource Efficiency Grant for Energy (REG(E))

Who can apply for this?



Companies in the manufacturing sector* with:

-  A Singapore-registered owner or operator
-  Group annual sales turnover of more than S\$500 million

New!

Genco Energy Efficiency Grant Call (Genco EE Grant Call)

Who can apply for this?



Power Generation Companies:

-  Operating combined-cycle gas turbine(s) (CCGT)

*The CCGT undergoing the energy efficiency project must be sited in Singapore

Types of Grants



Energy Efficiency Fund (E2F)

New!

What is the maximum funding?



Projects can receive funding support of up to 50% of qualifying cost – an increase from the previous 30% maximum funding.

The enhanced E2F will take effect from 1 Jan 2019.

For more information on E2F, visit www.e2singapore.gov.sg

Resource Efficiency Grant for Energy (REG(E))

New!

What is the maximum funding?



Projects can receive funding support of up to 50% of qualifying cost – an increase from the previous 30% maximum funding.

The REG(E) will take effect from 1 Jan 2019.

For more information on REG(E), visit <https://www.edb.gov.sg/en/news-and-resources/news/enhanced-industry-energy-efficiency-package.html>

New!

Genco Energy Efficiency Grant Call (Genco EE Grant Call)



Projects can receive funding support of up to 50% of qualifying cost.

The Grant Call will take place from 30 Oct 2018 to 1 Apr 2019.

For more information on Genco EE Grant Call, visit www.ema.gov.sg/energy_efficiency_for_power_generation.aspx

Other Incentive Schemes to Promote Energy Efficiency

Incentives – EDB’s Energy Efficiency Schemes and Incentives

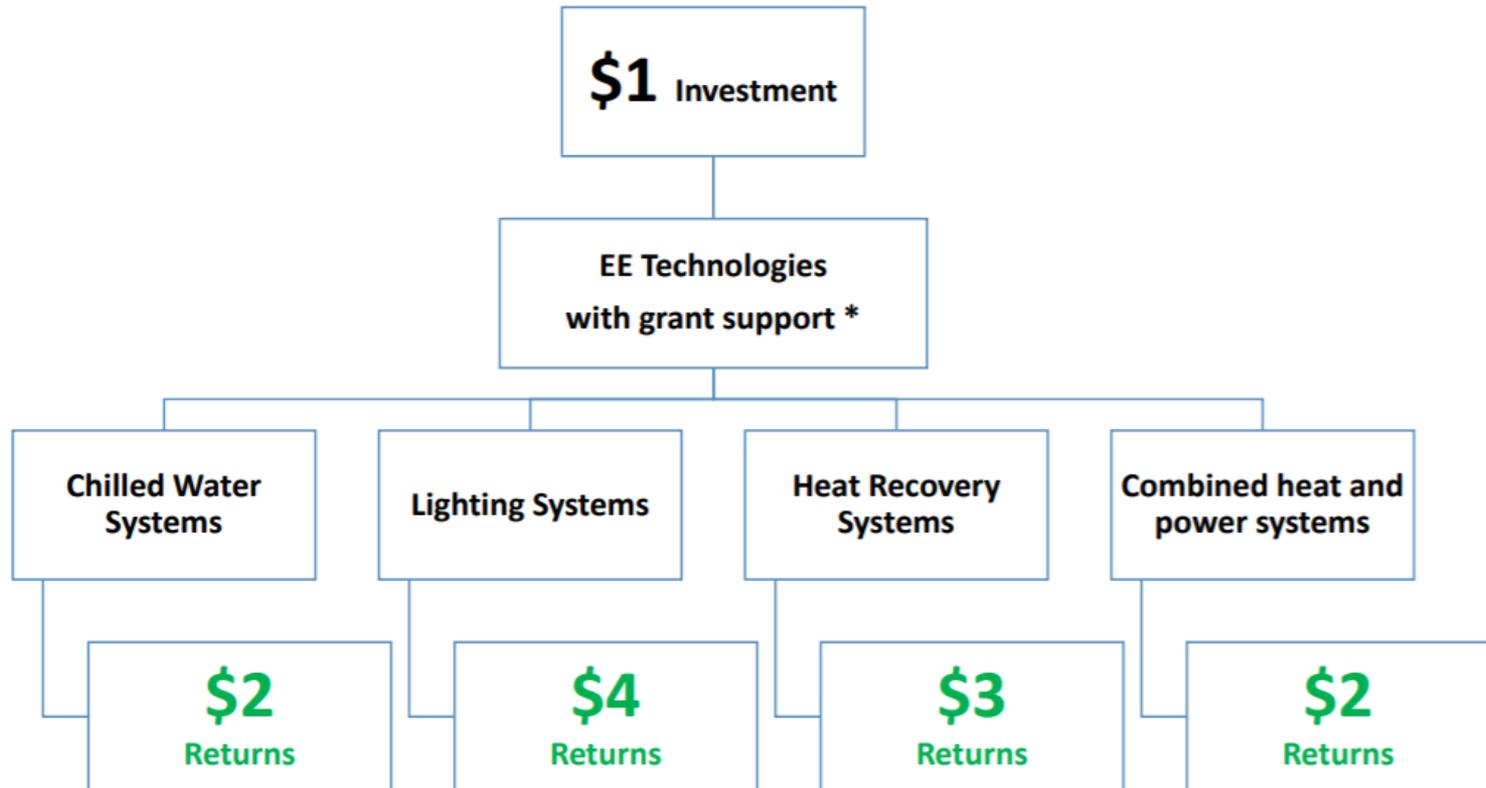
- REG(E) will support Singapore-registered owners / operators of industrial facilities in the sector to implement projects that present measurable and verifiable carbon abatement, or equivalent energy savings.

Resource Efficiency Grant – Energy (REG-E)	Investment Allowance – Energy Efficiency (IA-EE)	Energy Efficiency Financing Pilot (EE Financing)
<ul style="list-style-type: none"> Supports EE improvement and removal of non-CO₂ GHG projects Grant support is outcome based and tied to the amount of carbon abatement achieved by the supported project 	<ul style="list-style-type: none"> Supports EE improvement projects Provides typically 30% of tax allowance, above usual Capital Allowances for fixed CAPEX incurred within 3-year qualifying period. 	<ul style="list-style-type: none"> Pilot scheme with <u>Sustainable Development Capital (Asia) Limited</u> to provide 3rd party financing for up to 100% of upfront cost for EE improvement projects. EDB supports through partial credit guarantees agreements with PFIs.
<ul style="list-style-type: none"> <u>Min Criteria:</u> CO₂(e) abatement of 0.5 kilo-tonnes per annum Support capped at 50% of qualifying cost 	<ul style="list-style-type: none"> <u>Min Criteria:</u> 3% improvement in EE at the facility level <u>OR</u> 10% improvement in EE at the equipment or system level 	<ul style="list-style-type: none"> Companies are not required to pay for upfront costs, but repay through energy savings.

Source: Joash Seng, Senior Lead (EDB) /
Leow Beng Kwang, Senior Manager (NEA)

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Typical Returns

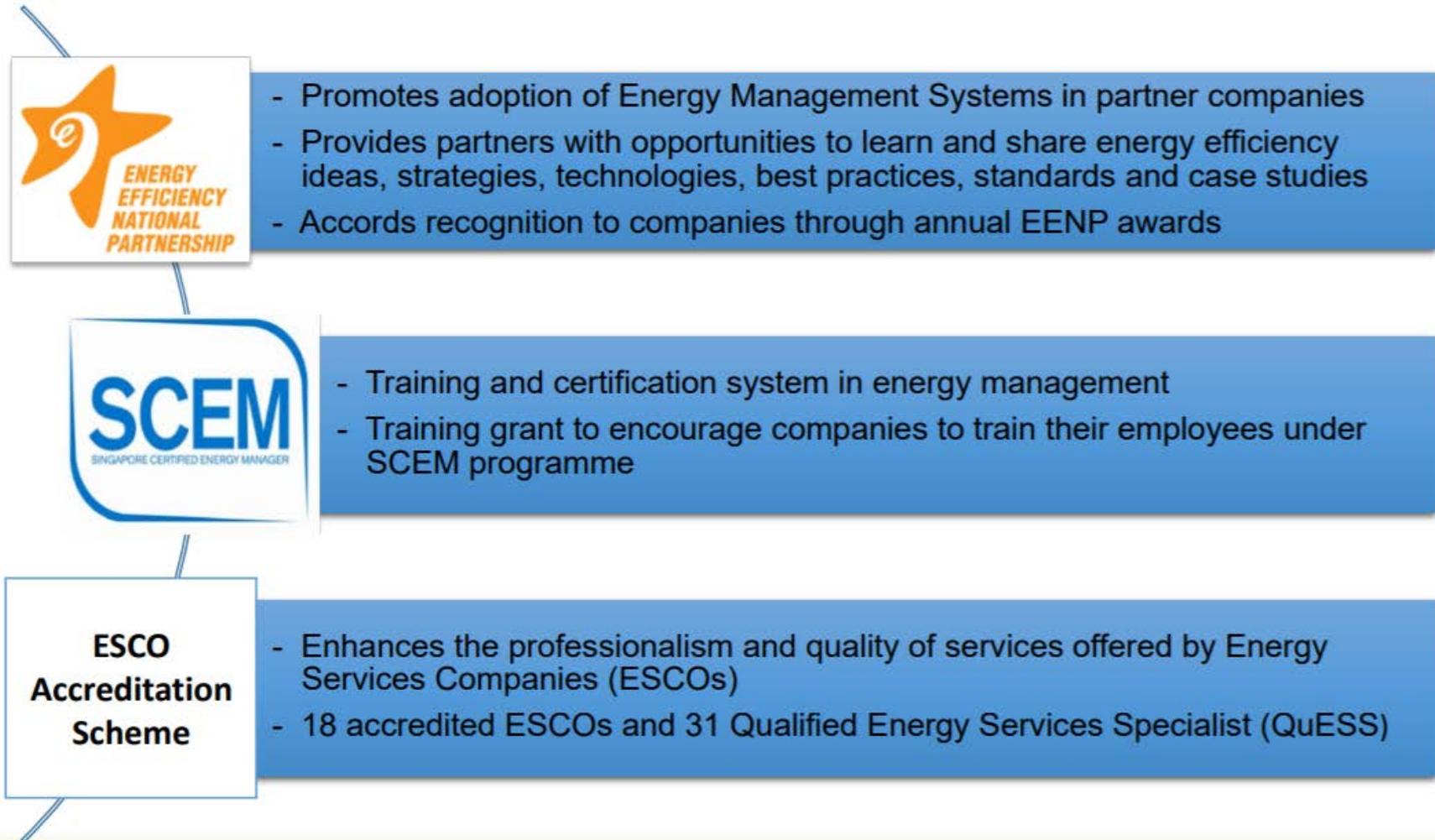


* Based on past grant data and an equipment lifespan of 15 years

Source: Joash Seng, Senior Lead (EDB) /
Leow Beng Kwang, Senior Manager (NEA)

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Capability Development for Energy Efficiency



Source: Joash Seng, Senior Lead (EDB) /
Leow Beng Kwang, Senior Manager (NEA)

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Key Challenges in Energy Efficiency Drive (1)

Business Culture / Uncertainty

1. Industrial companies not headquartered not in SG, improvements mostly in ancillary services e.g. chillers, lighting or land lease running out (business uncertainty)
2. Lack of enforced standards in energy efficiency measurement and verification resulting in some “cheating”
(Culture: avoidance of calling out fellow engineers)
3. Grants could be seen as “free money”: Companies 1) prefer to wait it out than to trigger legislation e.g. Green Mark Scheme incentive triggers 3-year reporting cycle, 2) for redevelopment
(Culture: Don't fix what's not broken)

Key Challenges in Energy Efficiency Drive (2)

Current Policy Landscape reducing incentive to innovate

4. Low carbon tax at S\$5/ton (US\$3.8), and general lack of awareness of how cost pass-through will affect business
 - To be increased to S\$10-15 (US\$7.6-11.4) by 2030
 - Not new policy innovation, but Singapore is first country in Southeast Asia to implement a carbon tax

5. Energy prices not subsidized but low wholesale retail electricity prices results in longer payback periods, and companies usually not willing to have payback of >2-3 years

Key Challenges in Energy Efficiency Drive (3)

Capabilities and Awareness

6. Lack of technical expertise and right experience e.g. ESCOs EEOA accreditation by 2021 but only 3 currently accredited
7. Over-bundling of projects/big Government tenders (Public Sector Sustainability Plan 2017-2020/Guaranteed Energy Savings Performance (GESp) Contracting Model) results in lack of track record and credit-worthiness of home-grown ESCOs
 - Linked to lack of awareness within Government e.g. Limiting Tendering Capacity to S9 and S10 results in established ESCOs such as Honeywell, ENGIE, Johnson Controls getting projects
8. Financial Institutions prefer to fund “safe” projects in chiller retrofits and solar PV installations, lack of awareness leads to long project gestation and less attractive interest rates



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See: <http://eeoa.sg/energy-efficiency-opportunities-eeo-assessor-certification-scheme/>

Research Agenda

- Examine the use of financial and market-based instruments to encourage the industrial manufacturing sector to be more energy efficient
- Examine the current energy service companies (ESCO) landscape, and identify possible government levers that can enable successful implementation of relevant instruments to achieve energy efficiency improvements
 - **And whether they complement or contradict with one another**
- Provide recommendations and policy design to promote energy efficiency in Singapore's carbon-constrained landscape, within the context of an open trade-oriented economy

Thank you!

Questions?

You may also email me further questions at esimlyx@nus.edu.sg

