



Nordic Innovation House

Overview of Circular Economy & Energy Efficiency in Singapore

April 2023



Agenda

- **Introduction**
- Singapore's business climate
- Singapore sustainability approaches
- Sub-sector 1: Energy Efficiency (by Business Sweden)
- Sub-sector 2: Waste Value Optimisation (by Embassy of Denmark in Singapore)
- Sub-sector 3: Food & Packaging Waste Management (by Innovation Norway)
- Grant, schemes, initiatives, and regulations
- Conclusion



Executive Summary

Nordic Innovation House (NIH) in Singapore has identified the Circular Economy and Clean Technology sectors as interesting for Nordic companies to further explore for sales growth. Through this report, NIH and the Nordic TPOs aim to further explore the sectors in Singapore and identify business opportunities in Singapore for Nordic companies, while raising the awareness of the Singapore business climate for Nordic companies.

Nordic companies are renowned for their advancement in the Circular Economy and Clean Technology space, and this is generally due to the following



Strong reputation for sustainability

Nordic countries are ranked in the top 4 positions on the UN Sustainable Development Report



Highly innovative culture

Nordic countries take the top 3 spots on the European Innovation Scoreboard



Long-term shared vision

The Nordic governments have an aligned vision to establish a green, competitive, and sustainable Nordic Region by 2030



Three subsectors which have high synergy with the expertise provided by the Nordic companies have been identified and will be further explored within this report



Energy Efficiency



Food & Packaging Waste Management



Waste Value Optimisation

Profiles of contributors to the paper



Business Sweden

As the Trade and Invest Council of Sweden, Business Sweden helps Swedish companies to find new growth opportunities abroad to shorten time-to-market while also providing hands-on implementation support. Business Sweden also helps foreign investors find opportunities to expand operations and develop products in Sweden

<https://www.business-sweden.com/>

46 offices globally

500+ consultants



Ministry of Foreign Affairs of Denmark

The Royal Danish Embassy in Singapore handles a variety of tasks besides consular services. For the department under the Trade Council of Denmark, it is focused primarily on export promotion and assistance to Danish companies and organisations working in Singapore.

<https://singapore.um.dk/en>

70+ offices globally

2,700+ staff globally



Innovation Norway

Innovation Norway is the Norwegian Government's most important instrument for innovation and development of Norwegian enterprises and industry. Innovation Norway provides companies with competence, advisory services, promotional services and network services.

<https://www.innovasjon Norge.no/>

37 offices globally

~700 staff globally

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Singapore, with its pro-business mindset, is a natural hub for companies to conduct business in the region

Overview

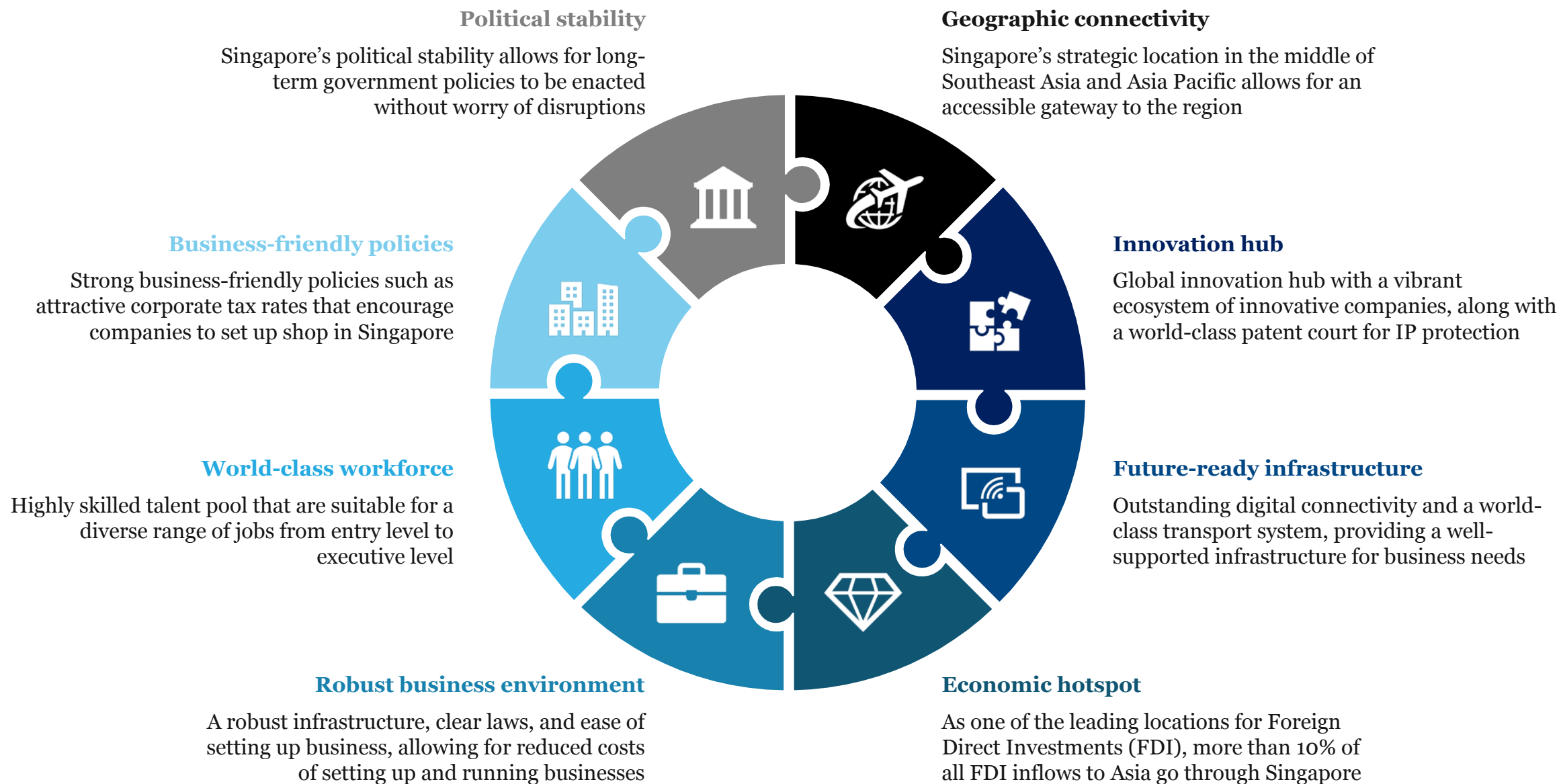
- Singapore is a relatively young nation, having gained its independence only in 1965, with a population of only 5.5 million
- Since founding, Singapore has experienced exponential growth, with its GDP per capita growing from around US\$500 in 1965 to around US\$73,000 in 2021
- Singapore has one of the most business-friendly environment in the world, with strong governmental support helping to create a robust infrastructure that is highly attractive to companies from around the world
- Singapore's economy is also viewed as one of the strongest and most stable in the world that is anchored by the nation's political stability, low corruption rates, and clear business compliance requirements
- Singapore has a highly skilled workforce that is educated with the convenience of being able to conduct all businesses in English
- Singapore actively looks to attract investments, with a big part of the country's economy based on Foreign Direct Investments, trading and exports in the region.

Overview

-  Attractive corporate tax rate (maximum of 17%)
-  67.5% employment rate in 2022
-  26 Free Trade Agreements (e.g. EU-SG FTA)
-  US\$105 billion FDI inflow in 2021
-  Ranked 1st in the Global Competitiveness Index



Singapore's robust ecosystem allows for high ease of conducting business, which provides an attractive environment for Nordic companies to set up shop



Singapore is located at the heart of APAC and offers strong access to the region's rapidly expanding markets



- Singapore is a preferred business hub and trading centre in Southeast Asia
- It is a top location for regional headquarters for Southeast Asia and for APAC
- As a crucial transport hub, Singapore within 8 hours travel time from other major cities in the APAC region

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To transition to a circular economy, the government launched the Zero Waste Masterplan and the Singapore Green Plan 2030



Initiatives

Zero Waste Masterplan

Singapore Green Plan 2030

Key Outcomes

The Zero Waste Masterplan was launched to achieve a sustainable, resource-efficient, and climate-resilient Singapore

The plan sets forth ambitious and concrete goals to increase adherence to multilateral agreements, while expediting the target of net zero emissions

- 1 **Landfill extension**
Extend Semakau Landfill's lifespan beyond 2035
- 2 **Waste reduction**
Reduce amount of waste sent to landfill per capita per day by 30% by 2030
- 3 **Recycling boost**
Achieve a 70% overall recycling rate by 2030 (81% non-domestic, 30% domestic recycling rate)

- 1 **National emissions target**
Achieve net zero emissions by or around 2050 and a transition to a low-carbon future
- 2 **Green citizenry**
Mobilise stakeholders and the community to action through funding and platform provision
- 3 **Green government**
Incorporation of sustainability in the government via new target setting, sustainability-considered tenders, and engagement efforts

Focus Areas

Food waste
 Electronic waste
 Packaging waste
 Recycling right
 Circular economy

City in nature
 Sustainable living
 Energy reset
 Green economy
 Resilient future

Source: Zero Waste Masterplan, Singapore Green Plan 2030

The Zero Waste Masterplan identifies key approaches for Singapore to build a sustainable and resource efficient country

Zero Waste Masterplan

Strengthening 3 resiliences



Climate Resilience

Address existential threats of climate change especially rising sea levels



Resource Resilience

Ensure safe and secure supply of critical resources like food and water



Economic Resilience

Ensure the future Singapore economy remains competitive

3 targets

1

Extend Semakau Landfill's lifespan beyond 2035

2

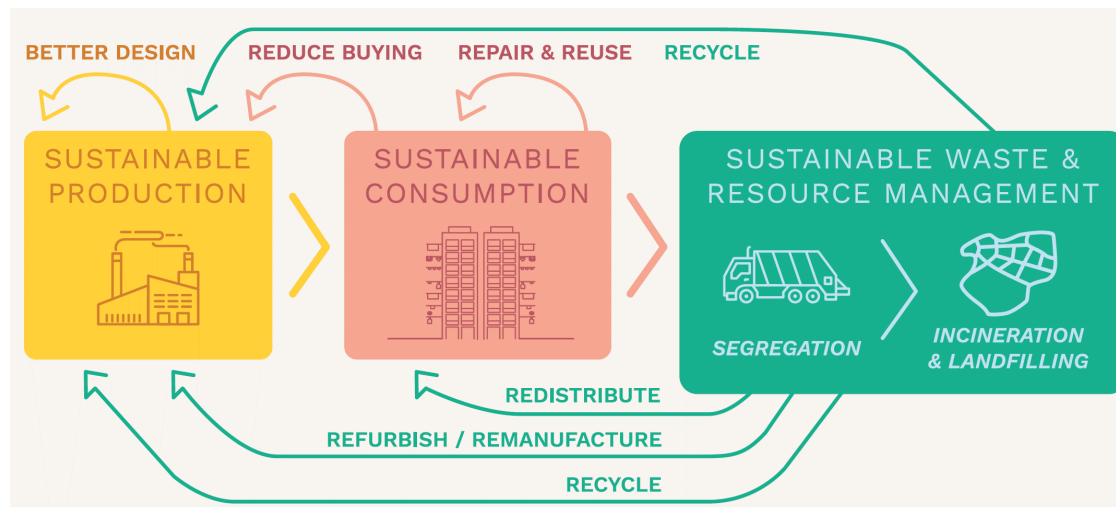
Reduce amount of waste sent to landfill per capita per day by 30% by 2030

3

By 2030, achieve a 70% overall recycling rate:

- 81% non-domestic recycling rate
- 30% domestic recycling rate

To achieve this, a circular economy approach will be adopted



The Singapore Green Plan 2030 is a whole-of nation movement to drive sustainable development within the country

The Singapore Green Plan 2030 comprises of 5 pillars that will target all aspects of life



City in Nature

To create a green, liveable and sustainable home for Singaporeans. Focused on transforming Singapore into a City in Nature by conserving and extending the nature habitat in Singapore, and increasing animal health and welfare standards



Sustainable Living

To transition to a Zero Waste Nation powered by a circular economy. Focused on introducing a circular economy, eco-stewardship programmes and increasing green commutes



Energy Reset

To use cleaner energy sectors across all sectors in Singapore. Focused on expanding solar energy and other green energy, green transportation, and green buildings to lower emissions levels



Green Economy

To utilize green growth to create jobs and harness sustainability as a competitive advantage. Focused on helping targeted sectors decarbonize and to help businesses seize opportunities in the green economy



Resilient Future

To ensure preparations are made to deal with climate change and build up national resilience. Focused on shoring up coastal and flood defences, strengthening food security, and keeping Singapore's temperature cool

In support of UNSDGs:



Nordic Innovation House Singapore (NIH) explores landscape of Energy Efficiency and Circular Economy in Singapore in this market study



Energy Efficiency

Energy efficiency is the process of using less energy to perform the same task – that is, eliminating energy waste. It is also a vital component in achieving net-zero emissions of carbon dioxide through decarbonization.

Singapore's meteoric growth, coupled with its limited natural resources, has exacerbated the need for efficient energy solutions as the country continues to grow. The Singapore Green Plan 2030 was launched to spearhead a transition into cleaner energy sources while ensuring energy efficiency is adopted across all industries. The government has also implemented upcoming carbon tax increases, which increases the need for solutions that minimize carbon emissions



Waste Value Optimisation

Waste value optimisation includes locally generated waste streams such as wood waste, construction waste, and e-waste.

Singapore's integrated solid waste management system focuses the 3Rs (Reduce, Reuse, Recycle) in the journey towards a Zero Waste Nation, which is aimed at prolonging the lifespan of the nation's landfill (Semakau) beyond 2035. However, to date, most 3R activities in Singapore have revolved around reduction & recycling with reuse/upcycling taking a back-seat, resulting in an untapped potential for material reuse projects under NEA's 3R Fund.



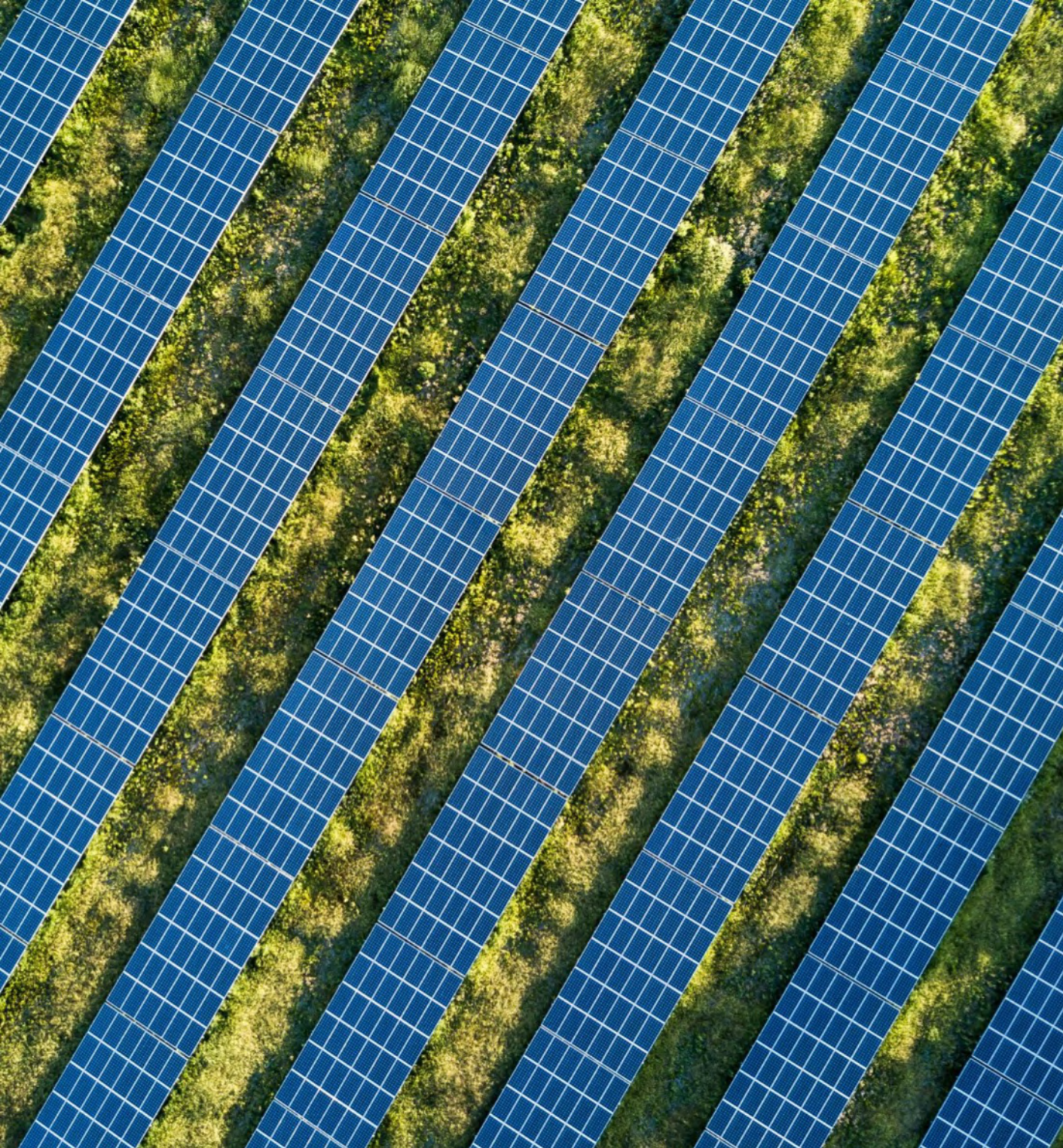
Food & Packaging Waste Management

As SG imports majority of good, Extended Producer Responsibility (EPR) schemes in Singapore are complicated and need tailored/advanced solutions.

Singapore is a resource-poor nation and are big consumers of packaged goods. By 2025, Singapore will extend the EPR laws for both packaging and electronic waste. The Deposit Return Scheme is the first under the Packaging EPR regulation and may be an effective initiative that comes with challenges such as lack of infrastructure and facilities; governance of the fund and materials; potential fraud and resource circularity.

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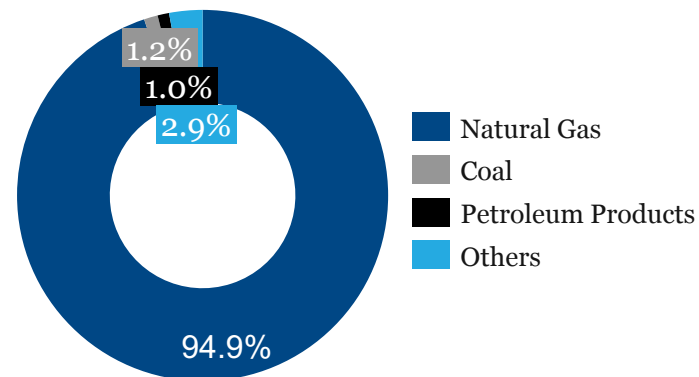
Efficient usage of energy is highly critical in resource-strapped Singapore, hence the government's strong push for energy efficiency across Singapore

Energy efficiency is defined as using less energy to perform the same task or produce the same result, leading to minimised energy costs, greater energy resilience and environmental benefits

Energy efficiency in Singapore

- Singapore's energy policy in a nutshell is to reduce emissions, which is mainly caused by energy consumption; hence, Singapore seeks to transform the way energy is used, while adopting clean sources of energy to mitigate emissions
- As the nation develops and population grows, energy consumption has also risen; in a resource-strapped country, energy is a precious resource, which highlights Singapore's urgent need to ensure greater sustainability in the energy sector

Electricity generation fuel mix in Singapore



Source: Energy Market Authority

4 energy supply switches

4 energy supply switches have been identified to guide Singapore's whole-of-nation approach towards an energy sector that is sustainable, affordable, and reliable



Solar Energy

One of the most promising renewable energy sources



Natural Gas

The main fuel for generating electricity in Singapore



Regional Power Grids

Helps to overcome the land constraints in Singapore



Low-carbon alternatives

Aimed at helping reduce Singapore's carbon footprint

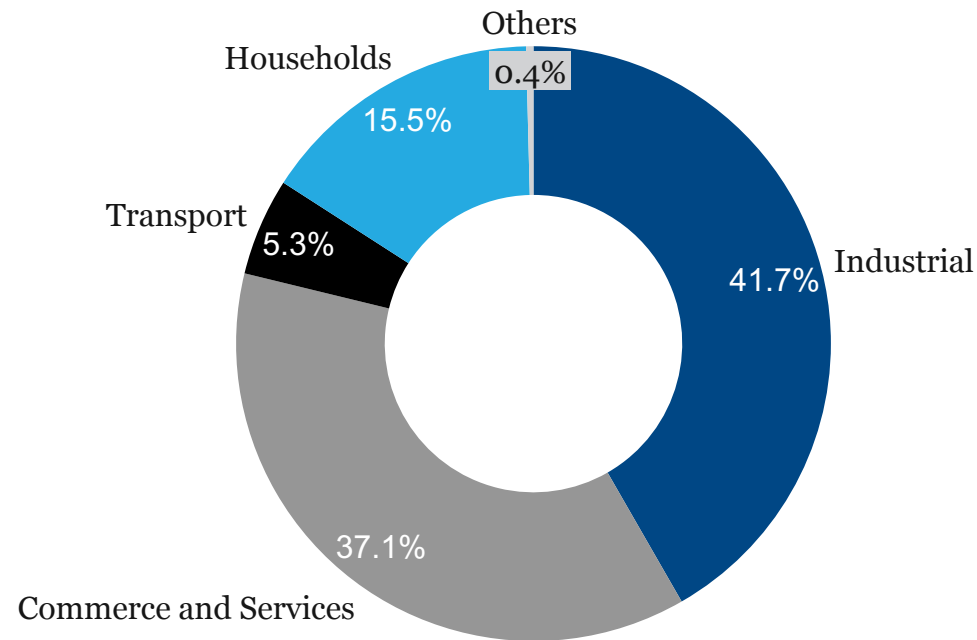
Singapore's energy efficiency strategy

Singapore has identified the following approaches in their energy efficiency strategy

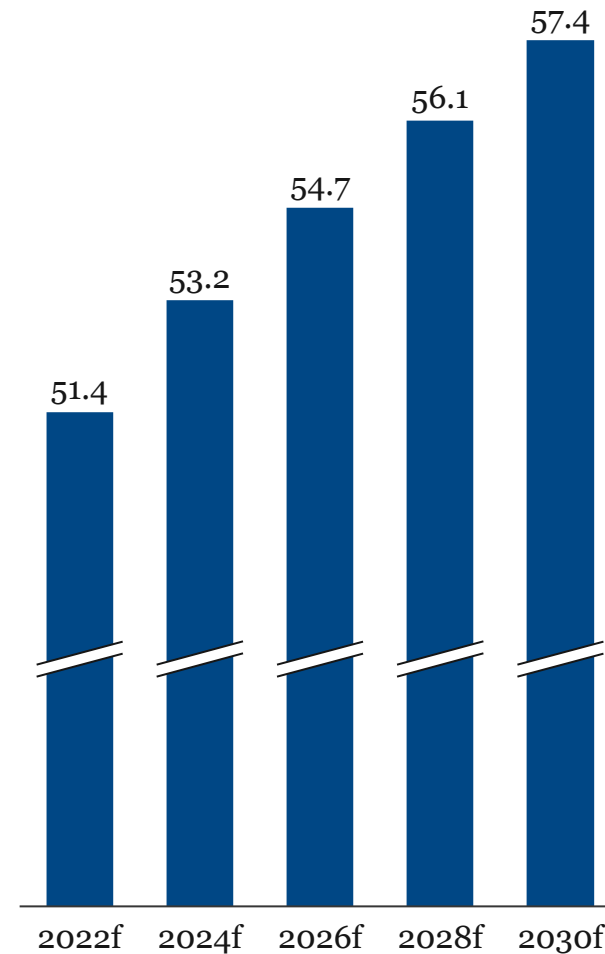
- 1 Promoting the adoption of energy efficient measures and technologies
- 2 Building our capability to sustain and drive energy efficiency efforts and developing a local knowledge base in energy management
- 3 Raising awareness amongst the public, households and industry / businesses
- 4 Supporting research and development efforts to enhance Singapore's capability in energy efficient technologies

Almost 80% of the electricity consumption in Singapore come from the industrial and commerce and services sector

Breakdown of Electricity Consumption (2022)



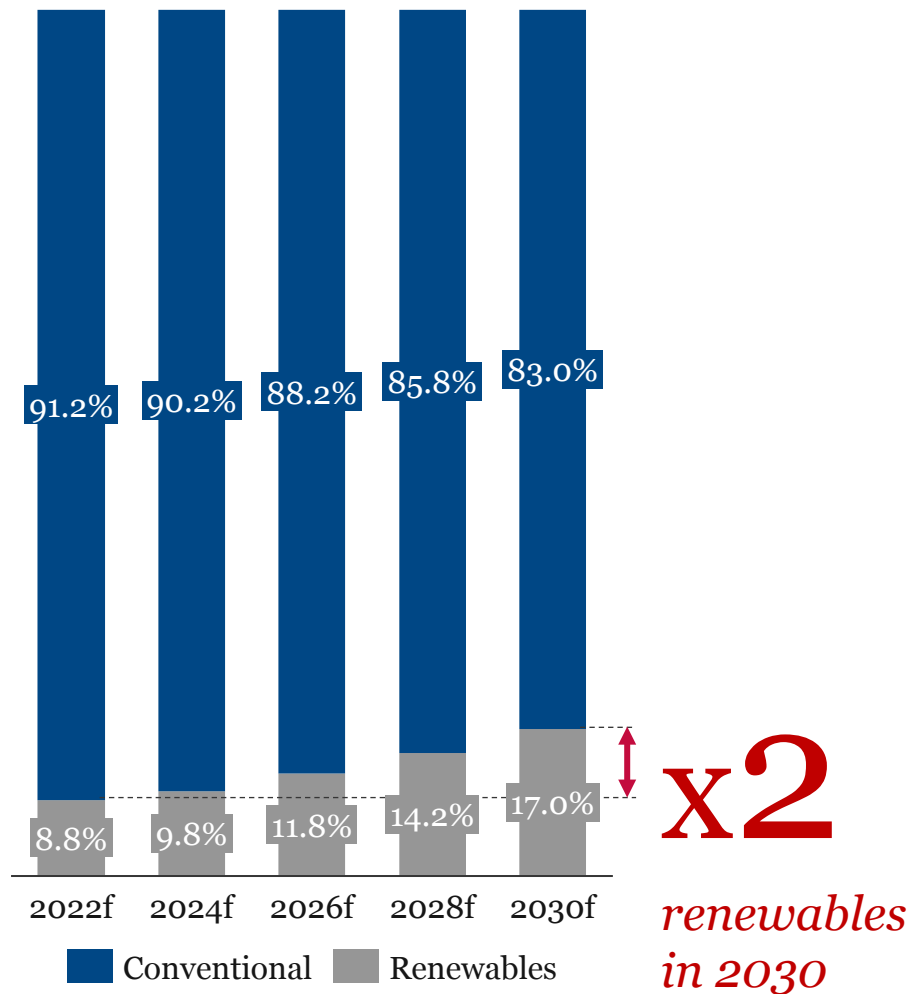
Electricity Consumption, TWh



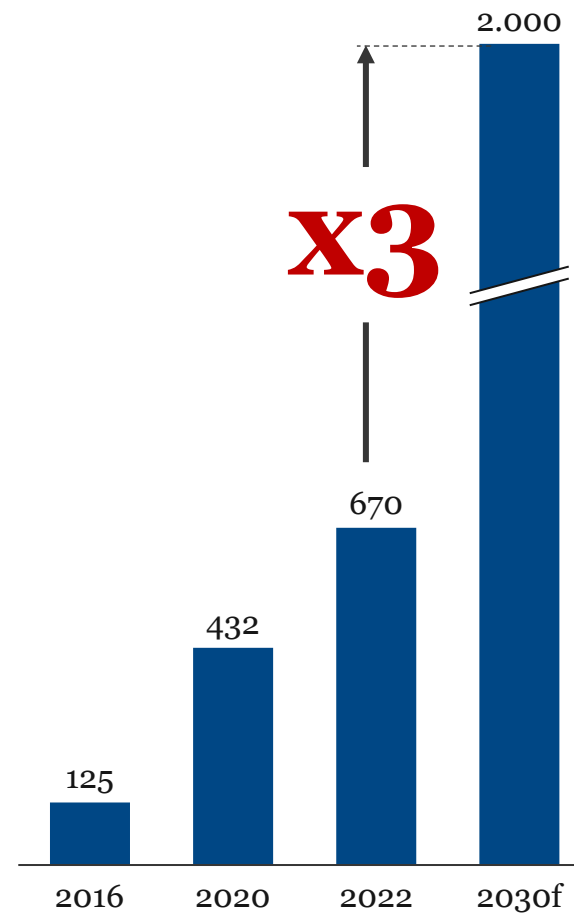
- Electricity consumption is expected to grow at a modest rate of 1.3% up till 2030 as a result of the relatively small market size in Singapore
- In terms of electricity consumption, the Industrial sector accounts for the largest (41.7%) as a result of significant electronics manufacturing and machinery processes, while Commerce and Services sector comes in second (37.1%) due to Singapore's strong service-based industry
- Despite the modest electricity consumption prediction, there is significant growth potential due to significant demand from Singapore's energy-intensive manufacturing sector and services sector remain stable, as well as new demand coming from the government's sustainable push (e.g. building of 60,000 electric vehicle charging points by 2030)

Renewables is expected to be the increasing focus of Singapore's electricity generation source as Singapore prepares for a greener future

Breakdown of Electricity Generation Capacity



Installed Capacity of Solar PV Systems, MWp



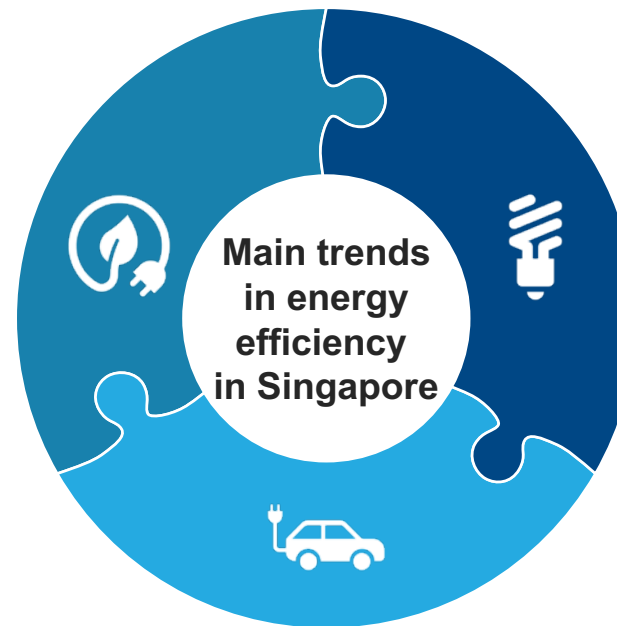
- As a result of the government's push for green sources of energy, there is a substantial shift expected for renewable sources of energy, with the share of renewables in terms of electricity generation capacity doubling from now until 2030
- Due to geographical constraints, the government has identified solar energy as the most viable form of renewable energy, and have set a target on tripling Singapore's solar capacity from 670 MWp currently to 2GWp by 2030
- Energy generated by renewables is expected to increase slightly from the current 2.0TWh to 3.4TWh in 2030

Green power sources, energy-efficient technologies and clean transportation are the main trends observed in Singapore's energy efficiency landscape

Green power sources

Singapore has been switching from oil to natural gas for its power generation source since the early 2000s.

With the aim of reducing emissions, coupled along with the need of an enhanced energy security, alternative sources of energy supply are considered. Due to geographical constraints in Singapore (i.e. low average wind speed and lack of a fast-flowing water body), solar energy has emerged to the forefront as a viable green source of energy in addition, with the government focusing much of its green energy sources efforts in the field of solar energy.



Energy-efficient technologies

Singapore has been actively encouraging energy-efficient technologies throughout society, and this is evidently seen in households, buildings, and the industrial sectors, which account for more than 50% of the energy consumption in Singapore.

The government has led the way with both supply-side and demand-side approaches including policies on energy standards as well as incentivizing adoption of energy-efficient technologies.

Clean transportation

As part of Singapore's pledge to reduce carbon emissions, an area of focus has been the transition from current petrol and diesel-based transportation, to cleaner-energy transportation that produces lesser emissions.

To this end, the Singapore government is trying to increase electric vehicles (EV) adoption through policies, public education, as well as the building of EV support infrastructure. The aim is to promote, and in some cases, mandate, the transition of clean transportation in both the private and public sectors.

Singapore is aiming to achieve net zero emissions by 2050, with the mid-term goal of cutting emissions to 60 MtCO₂e in 2030

Singapore's Net Zero plans towards 2050



Achieve net zero emissions by 2050

Part of the nation's Long-Term Low-Emissions Development Strategy (LEDS), and builds on the 2020 LEDS of halving peak emissions to 33 MtCO₂e by 2050

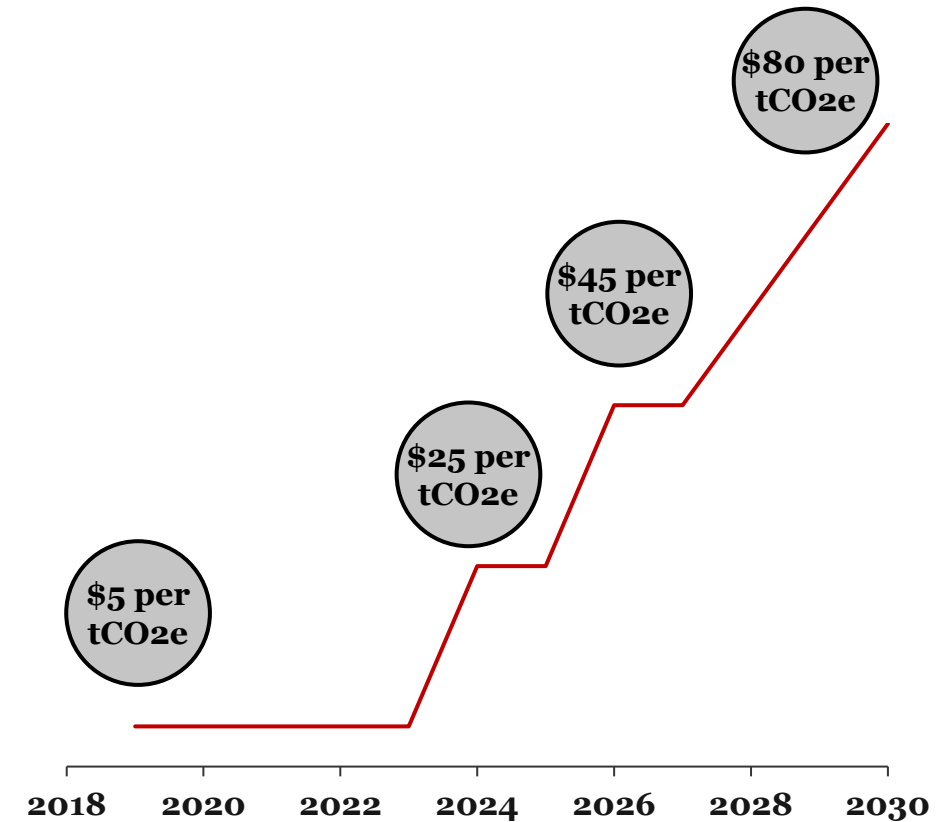


Reduce 2030 emissions to 60 MtCO₂e after peaking emissions earlier

Part of the revised 2030 National Determined Contribution (NDC), which is an economy-wide absolute greenhouse gas emissions limitation target



Singapore's revised carbon tax is viewed as a key enabler of this transition



Since 1 Jan 2019, taxable facilities have to pay a carbon tax for reckonable GHG emissions. Starting at \$5 per tonne of GHG emissions (tCO₂e) in 2019, the carbon tax is slated to rise over the years to \$50-80/tCO₂e by 2030.

4 key thrusts have been identified to assist in Singapore's Net Zero Plan



Catalyse Business Transformation

- Improving energy efficiency through grants for energy efficiency and emissions reduction
- Shifting towards a more sustainable Energy and Chemicals sector



Invest in Low-carbon Technologies

- Some low-carbon technologies that are looked at include Carbon Capture Utilisation and Storage, Low-carbon Hydrogen, Solar and energy storage systems etc.



Pursue Effective International Co-operation

- Seeking collaboration through agreements (e.g. international climate action, regional power grids) or market-based mechanisms (e.g. international carbon markets for carbon credits)



Adopt Low-carbon Practices

- Green commutes in the form of green public transport, cleaner vehicles like EVs, and low carbon schemes (e.g. Walk-Cycle-Ride)

To achieve Net Zero, The Singapore Green Plan 2030 was created with targets and initiatives to accelerate the adoption of energy efficiency



Green Energy

2030 targets

- Increase solar energy deployment by five-fold to at least 2 GWp, and generate enough electricity to power more than 350,000 households a year
- 200 MW of energy storage systems deployment beyond 2025, which can power more than 16,000 households daily
- Best-in-class generation technology that meets heat-rate/emissions standards and reduces carbon emissions
- Diversified electricity supply with clean electricity imports



Greener Infrastructure and Buildings

2030 targets

- Green 80% of Singapore's buildings (by Gross Floor Area) by 2030
- 80% of new buildings (by Gross Floor Area) to be Super Low Energy buildings from 2030
- Best-in-class green buildings to see an 80% improvement in energy efficiency (over 2005 levels) by 2030 Long-term target: Reduce desalination energy further to 1kWh/m³



Sustainable Towns and Districts

2030 targets

- Reduce energy consumption in existing HDB towns by 15%



Cleaner-energy Vehicles

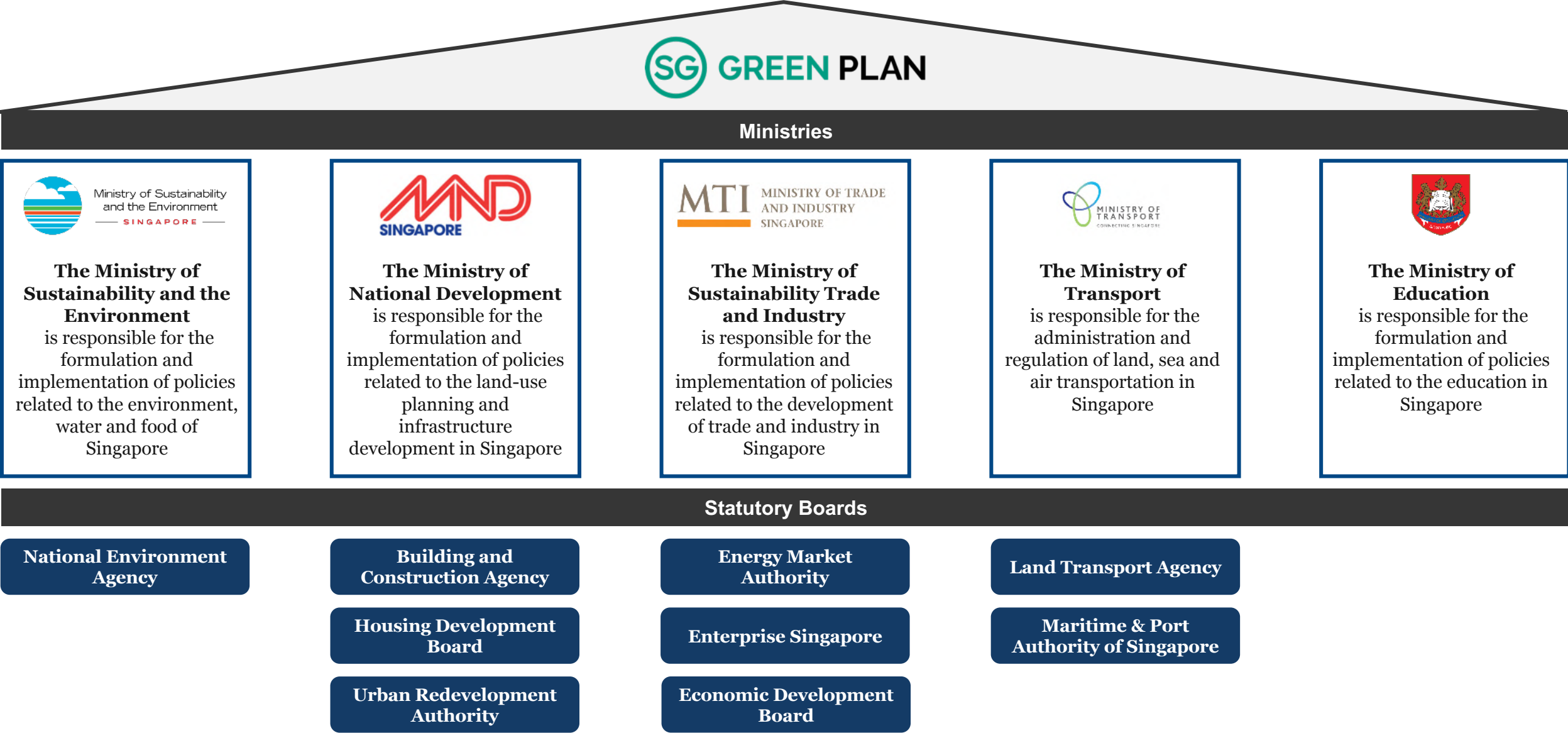
2030 targets

- All new car and taxi registrations to be of cleaner-energy models from 2030
- Target 60,000 charging points nationwide by 2030, including 40,000 in public carparks and 20,000 in - private premises

The push for energy efficiency in Singapore is primarily driven by the government, with the Singapore Green Plan 2030 being the overarching strategy to achieving the energy efficiency goals.

While the plan encompasses areas outside of energy efficiency, it is still a key tenet of the plan. Some of the 2030 targets for energy efficiency are listed below.

The SG Green Plan is overseen by 5 ministries who are supported by the relevant statutory boards sitting within them



Source: Singapore Green Plan 2030

One of the main energy efficiency initiative under the Singapore Green Plan 2030 is the Singapore Green Building Masterplan

The Singapore Green Building Masterplan (SGBMP) was launched in March 2021 and is part of the Singapore Green Plan 2030. It was co-created by the Building and Construction Authority, Singapore Green Building Council, and 82 industry stakeholders from different points of the value chain into developing the next vision and outcomes of green buildings in Singapore. The SGBMP aims to deliver 3 key targets of 80-80-80 in 2030



Stepping up the pace to green 80% of our buildings by 2030

- Expedite greening of buildings in Singapore
- Increasing sustainability standards of Singapore buildings

**\$63 million
cash incentive
for Existing
Buildings 2.0**



80% of new developments by GFA to be Super Low Energy (SLE) buildings from 2030

- The government has mandated SLE performance in public sector buildings where feasible, and offered incentives for private sector buildings, to ensure that most of the new developments in 2030 would be SLE



Achieving 80% improvement in energy efficiency for best-in-class green buildings by 2030

- The government has provided funding of \$45million to push the boundaries in energy efficiency through research, innovation, and implementation

**\$45 million for
co-creation and
acceleration**

Another initiative is the GREENGOV.SG initiative, where the government is taking a leading role in incorporating energy efficient practices



A key component of the Singapore Green Plan 2030 is the GREENGOV.SG plan which strives to attain ambitious sustainability targets in carbon abatement and resource efficiency and be a positive influence and enabler of green efforts. It has 3 pillars as follows.

01

Excel with new and more ambitious targets

- The public sector aims to peak its carbon emissions around 2025, ahead of the national target
- By 2030, the public sector aims to reduce energy and water use by 10% from the average of 2018 - 2020 levels, and to reduce the amount of waste disposed by 30% from 2022 level
- The public sector will set targets for buildings, information technology, transport, and solar deployment that are more ambitious than the national targets

02

Enable a sustainable economy and green citizenry, by embedding sustainability in our core business

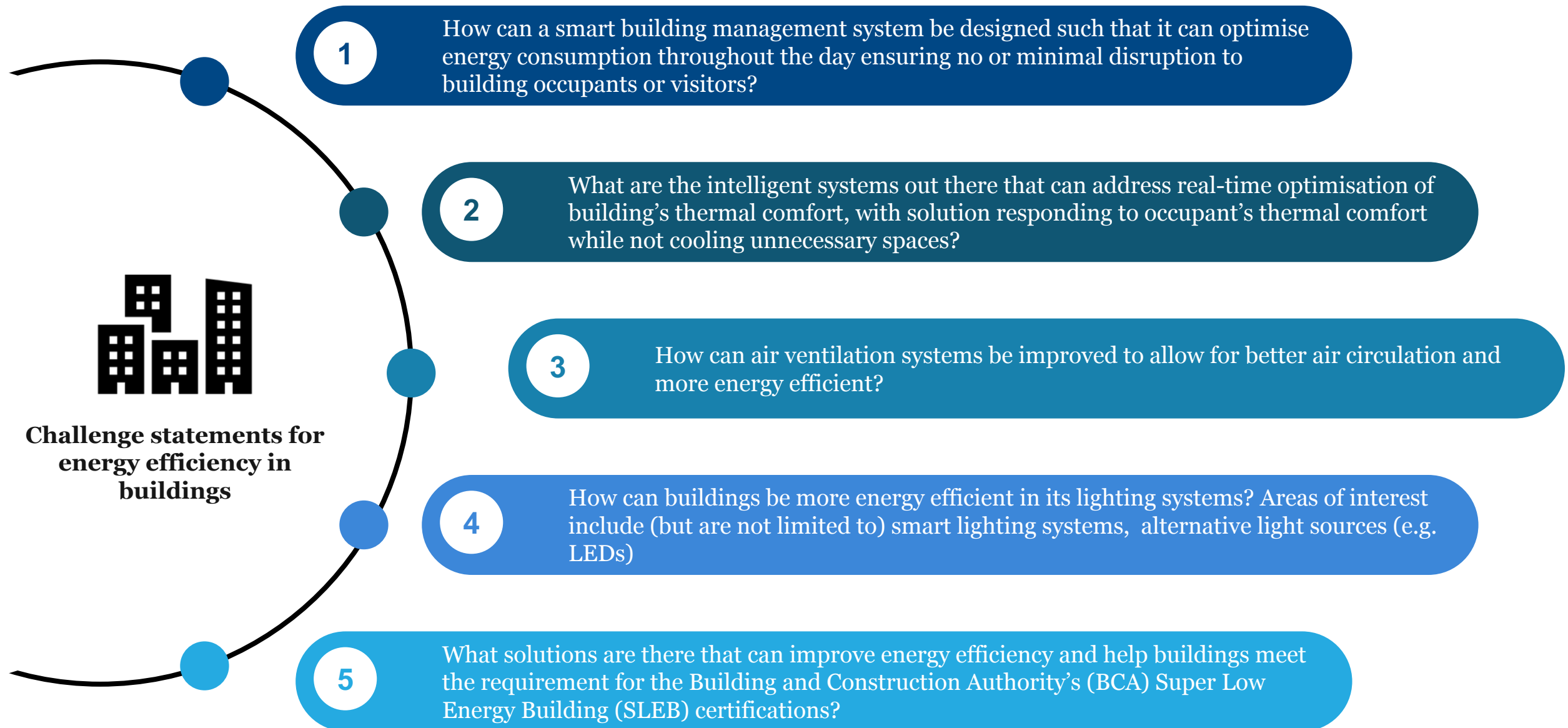
- The public sector will take the lead in purchasing products that meet high efficiency or sustainability standards (i.e. electrical appliances, water fittings, building materials, and electric vehicles)
- The public sector will factor in companies' sustainability-related policies and practices for government agencies' procurement decisions
- The public sector will incorporate sustainability features at public spaces to raise public awareness, and strive to incorporate sustainability in school curriculum

03

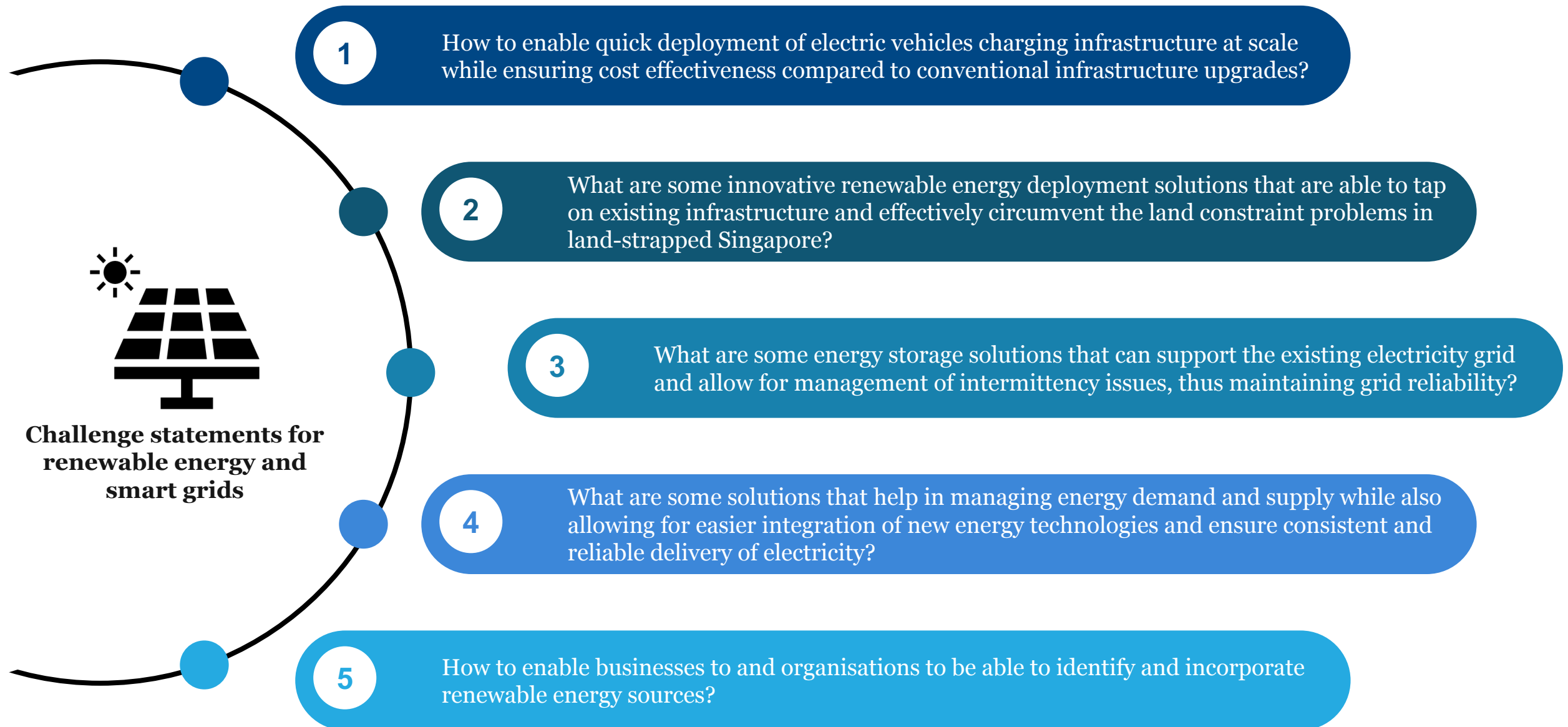
Excite public officers to contribute actively to sustainability in Singapore

- Regular sharing sessions organised within the public sector to promote the exchange of ideas, best practices, and the latest technological solutions, to inspire and support public officers to champion ground-up initiatives
- The public sector will organise campaigns to raise awareness and encourage public officers to take simple steps to lead a more sustainable lifestyle

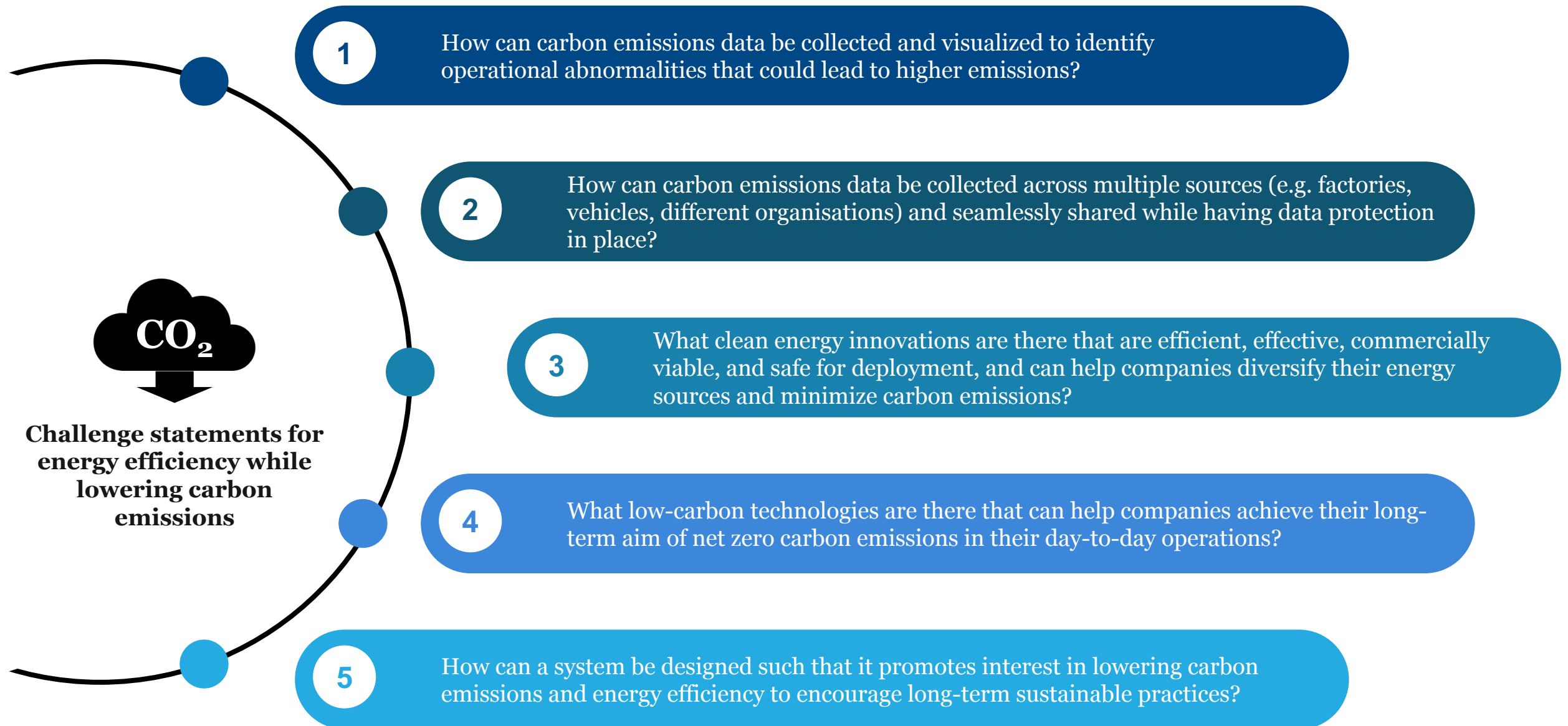
For buildings, solutions that allow for energy, heat, and lighting optimisation while bringing about energy efficiency are highly desirable



Beyond solar energy and electric vehicle solutions, technology that explore other renewable energy and the improvement of the grid reliability are also in demand




Singapore is looking for solutions and technologies that can help to improve energy efficiency across industries, thereby lowering carbon emissions







Both Public and Private sector companies work on achieving the energy efficiency targets

Public sector

Ministries



 Ministry of Sustainability and the Environment
 MND SINGAPORE
 MTI MINISTRY OF TRADE AND INDUSTRY SINGAPORE
 MINISTRY OF TRANSPORT


Statutory Boards



 National Environment Agency
 HOUSING & DEVELOPMENT BOARD
 ENERGY MARKET AUTHORITY
 Enterprise Singapore
 Building and Construction Authority
 EDB: SINGAPORE
 MPA SINGAPORE
 Land Transport Authority
 URBAN REDEVELOPMENT AUTHORITY


Private sector

Companies



 SPgroup
 CapitaLand
 Senoko energy
 TUAS POWER
 Ng Teng Fong General Hospital
 Keppel
 Jurong Community Hospital
 sembcorp

National Environment Agency






Overview




About

A statutory board under the Ministry of Sustainability and the Environment, it is responsible for improving and sustaining clean and green environment in Singapore; its role is to fight pollution, maintain public health and give meteorological information

Key facts

-  **Established:** 2002
-  **Sector:** Environment, government
-  **Website:** <https://www.nea.gov.sg/>

As part of the whole-of-government approach to implement measures to improve the energy efficiency and to reduce the energy use of various sectors, NEA is responsible for the promotion of energy efficiency in the industrial, household, and public sectors through legislation, incentives, and public education



Key activities

Industrial Sector


- **Legislation on energy efficiency standards** – To ensure compliance in energy efficiency management, measurement, and reporting requirements (e.g. Energy Conservation Act)
- **Incentives and funds** – Designed to support companies to be more energy efficient or to develop local expertise and capability in energy efficiency
- **Partnerships** – Partnerships with stakeholders to explore opportunities in the energy efficiency space

Household Sector

- **Legislation on energy efficiency of household appliances** – Household appliances are subjected to requirements related to energy efficiency(e.g. Mandatory Energy Labeling and Minimum Energy Performance Standards)
- **Incentive schemes for adoption of energy-efficient appliances** – Vouchers and monetary incentives programmes that promote usage and retrofitting of energy-efficient appliances

Public Sector

- **Government-wide energy efficiency and sustainability projects** – Short and long term targets and roadmap for public sector agencies to lead the way in sustainable developments
- **Contracts and tenders with energy-efficiency in place** – Public tenders and contracts by the public sector are to be guided by requirements laid out according to contracting models with energy efficiency taken into account



Selected initiatives

Energy Efficiency Fund

- 1 Designed to support companies to be more energy efficient via monetary grants
- 2 Made up of 5 different grants that focuses on (i) Efficient energy design (ii) Energy assessment (iii) Energy efficient technologies (iv) Energy management information system (iv) Low-GWP refrigerants chillers


Climate Friendly Households Programme

- 1 Launched to encourage households to reduce their energy and water consumption
- 2 Eligible households in public housing estates will receive vouchers to offset the cost of purchasing energy or water efficient appliances


GreenGov.SG

- 1 Under this initiative, the public sector is tasked with spearheading efforts in sustainability adoption and promotion
- 2 Targets have been set to integrate energy efficiency into the public sector
- 3 Solar photovoltaics are targeted to be deployed wherever possible


Building and Construction Agency



Overview



Key activities






Selected initiatives



About

A statutory board under the Ministry of National Development, it champions the development and transformation of the built environment sector; its role is to develop and regulate Singapore's building and construction industry

Key facts

-  **Established:** 1999
-  **Sector:** Construction, government
-  **Website:** <https://www1.bca.gov.sg/>

The built environment sector plays an important role in achieving Singapore's vision of a greener and more sustainable country and as such, BCA is in charge of promoting energy efficiency in the buildings sector

Masterplans and Building Programmes

- **Green building masterplans** – Continually updated to encourage, enable, and engage industry stakeholders in adopting green buildings
- **Greening of existing buildings** – Efforts made to retrofit energy efficient solutions and change energy consumption behaviour of existing buildings

Green Mark Buildings and Certifications

- **Certification schemes for green buildings** – Rating systems designed to evaluate a building's environmental impact and performance, allowing compliant companies to be eligible for incentive schemes to aid in the development of such buildings
- **Regulation and legislation** – Legislation requiring selected buildings to comply with minimum environmental sustainability standards

Incentives and Capability Building

- **Green Mark Incentive Schemes** – Started to expedite adoption of environmentally friendly building technologies and building design practices
- **Recognition of Green Professionals** – Public tenders and contracts by the public sector are to be guided by requirements laid out according to contracting models with energy efficiency taken into account

Super Low Energy Programme (SLE)

- 1 The SLE programme was launched to encourage firms to go above and beyond existing standards to adopt energy efficiency in new building projects
- 2 SLE buildings feature best-in-class energy efficiency, the use of onsite and offsite renewable energy and other intelligent energy management systems


Green Mark Certification Schemes

- 1 Green building rating system that provides a comprehensive framework for assessing the overall environmental performance of new and existing buildings to promote sustainable design, and best practices in construction and operations in buildings
- 2 Green Mark Buildings are eligible for Green Mark Incentive Schemes

GMIS for Existing Buildings 2.0

- 1 \$63 million incentive scheme to raise the energy performance of existing buildings and accelerate green buildings
- 2 Cash incentive to lower upfront costs of energy efficiency retrofits for building owners who achieve higher energy performance standards (i.e. Platinum, Super Low Energy, and Zero Energy) for their buildings.

Energy Market Authority






Overview



About

A statutory board under the Ministry of Trade and Industry, its main goals are to ensure a reliable and secure energy supply, promote effective competition in the energy market and develop a dynamic sector in Singapore

Key facts

-  **Established:** 2001
-  **Sector:** Energy, government
-  **Website:** <https://www.ema.gov.sg/>



Key activities

One of the main issues the Energy Market Authority is tackling is building a dependable energy grid to guarantee citizens receive electricity while managing new energy sources for the national grid

Policy and Legislation

- **Policy administrator** – EMA introduces new policies and policy changes from time to time to keep pace with the changing environment in the energy market
- **Industry regulator** – EMA regulates the gas and electricity industries in Singapore, and issues licenses to companies involved in the generation, retail and transmission of electricity

Renewables

- **Solar Energy** – As one of the main sources of alternative energy in Singapore, EMA is involved with solar panels deployment and drafting regulations related to solar photovoltaic systems
- **Energy Storage System** – There are limitations to solar energy’s reliability on a large scale despite mitigation steps taken by EMA; hence energy storage systems are being utilized to capture energy produced at a particular time to be used later

R&D, Incentives, and Partnerships

- **R&D** – EMA works with the industry and research community to catalyse R&D and facilitate deployment of promising solutions
- **Incentives and Grant Calls** – Over \$100 million in grants awarded over the past few years for innovative energy-efficient technologies
- **Partnerships** – EMA has partnered industry stakeholders from private and public sectors to build sustainable energy solutions and capabilities

Open Electricity Market


- 1 Launched by the EMA to allow for all types of consumers to be able to buy electricity from a retailer of their choice
- 2 Allows for greater choice and flexibility for consumers as electricity can be purchased from the open wholesale market, allowing for price plans that suit various needs

Regulatory Sandbox

- 1 EMA offers sandboxes to participating companies to test innovative innovations for renewables, during which they may be granted temporary regulatory waivers to conduct their tests
- 2 An example would be EMA’s sandbox trial with SP on the usage of energy storage systems for residential peak load shifting

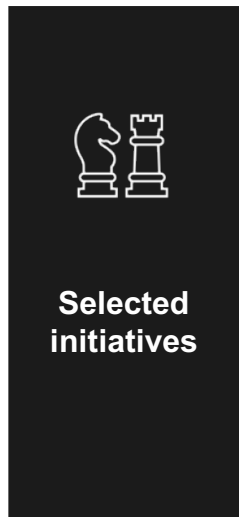
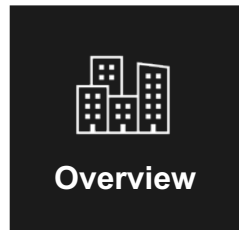
Singapore Energy Grand Challenge

- 1 Grant call for the stakeholders from the industry and from the research community to co-create energy efficient solutions to lower Singapore’s energy demand and improve Singapore businesses/ competitiveness
- 2 31 proposals from various teams across the industry and community were received



Selected initiatives

Private Stakeholders



CapitaLand is a Singaporean headquartered company focusing on investment, development and management of real estate. It is one of Asia's largest real estate companies and the owner and manager of a global property portfolio ranging from shopping malls to industrial assets

- Established:** 2000
- Sector:** Real estate
- Website:** <http://capitaland.com/>

- 1 CapitaLand Sustainability X Challenge** – A global search for innovations that make buildings more climate-resilient and resource-efficient; more than 340 entries from 50 countries were received in 2022
- 2 2030 Sustainability Master Plan** – Masterplan to accelerate CapitaLand's transition to a low-carbon business, improving water conservation and resilience, and enabling a circular economy
- 3 2050 Net Zero Emissions** – Targets set to reduce greenhouse gas emissions in its portfolio of buildings

Singapore Power is a government-affiliated electricity and gas distribution company in Singapore. It offers services for electricity and gas transmission, distribution, and market support as Singapore's only electrical grid and gas grid operator

- Established:** 1995
- Sector:** Energy
- Website:** <https://www.spgroup.com.sg/>

- 1 World's largest underground district cooling network** – Centralised production of chilled water to provide air-conditioning, which helps save energy and space, while reducing emissions by 20,000 tons yearly
- 2 Electric vehicle charging network** – SP is building Singapore's largest public EV charging network as part of the nation's push for EV adoption
- 3 Construction of urban micro-grid** – Singapore's first multi-energy micro-grid that integrates gas, electricity and thermal energy into a one smart energy network

Keppel Corporation is a Singaporean conglomerate with several affiliated businesses in offshore & marine, property, infrastructure, and asset management. The company strives to maintain sustainability at the core of their strategy to develop, operate and maintain their assets

- Established:** 1968
- Sector:** O&M, Property, Investments
- Website:** <http://www.keppelcorp.com/>

- 1 Decarbonisation of electricity generation** – Development of Singapore's first hydrogen-ready power plant (Keppel Sakra Cogen Plant), which would be the most energy efficient power plant in Singapore
- 2 Energy-efficient cooling** – Aggregated district cooling services that are more energy efficient than separate cooling units, keeping in line with the Singapore Green Plan 2030's target of more energy efficient buildings
- 3 M&A in cleantech space** – Investments in the cleantech space (e.g. Cleantech Renewable Assets, a solar energy platform)

Key takeaways

1



Lowering of Carbon Emissions

The reduction of carbon emissions through efficient energy consumption is seen as the key driver for Singapore's energy efficiency approach, with carbon taxes set to increase, increasing business needs to lower carbon emissions

2



Key Areas of Opportunity

As a result of resource and land constraints in Singapore, solar energy has been identified as a key renewable energy source in Singapore, with the government aiming to increase generation capacity for it

3



Opportunities in Energy Efficiency

The Singapore Green Plan 2030 and other initiatives provide key areas of opportunity for energy efficiency solutions in buildings, renewable energy, smart grids, and technology that reduce carbon emissions

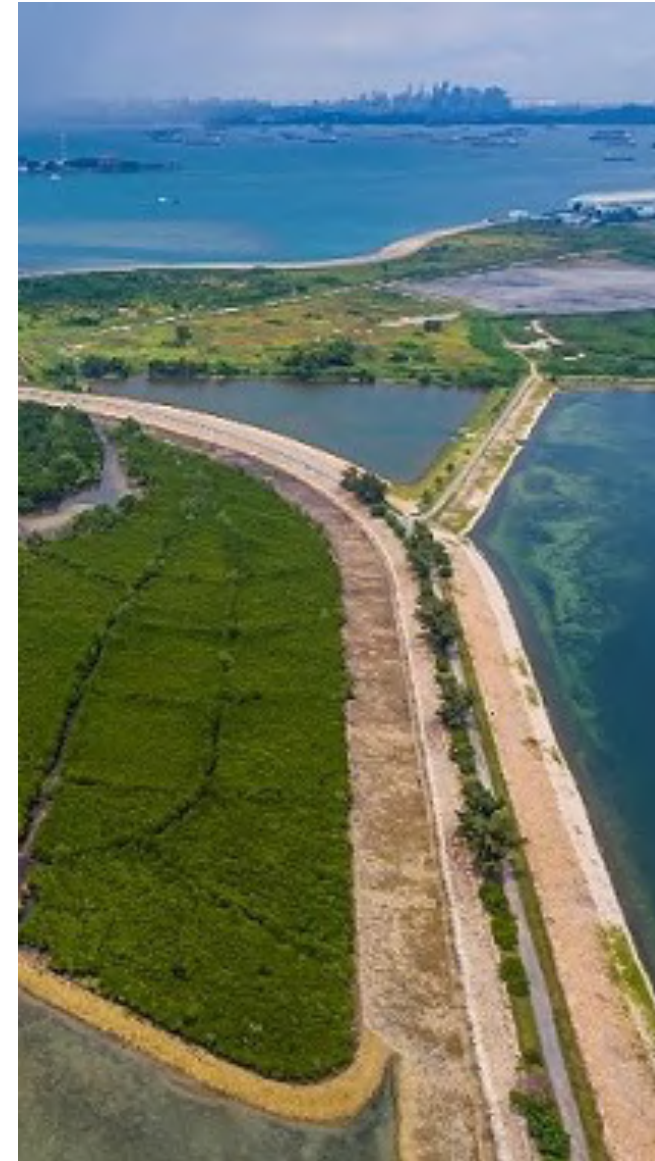
Agenda

- Introduction
- Singapore's business climate
- Singapore sustainability approaches
- Sub-sector 1: Energy Efficiency (by Business Sweden)
- **Sub-sector 2: Waste Value Optimisation
(by Embassy of Denmark in Singapore)**
- Sub-sector 3: Food & Packaging Waste Management
(by Innovation Norway)
- Grant, schemes, initiatives, and regulations
- Conclusion



Semakau Landfill

- About 8 km south of Singapore, lies Semakau Landfill – the only offshore landfill in the world.
- It is constructed by a 7 km rock bund enclosing the sea and is lined with marine clay and an impermeable membrane to ensure containment.
- Ancillary facilities makes the operation self-sustainable.
- The landfill receives both incinerated ash from waste-to-energy plants and non-incinerable waste.
- The process:
 - The waste arrives at the landfill by barge berths, and is received in an enclosed transfer building.
 - From there, excavators unload the waste to large dump trucks.
 - The trucks then unload their payload at designated tipping sites, where bulldozers and compacters level and compact the waste.
 - When a cell is filled, it is covered with earth, and grass and trees take root to form a new green landscape.
 - New cells are opened by sealing the concrete pipes that connect it to the sea.
- At the current rate of waste generation, Semakau will be full by 2035 – so the ambition is to substantially reduce the overall amount of waste generated (i.e. through the Zero Waste Masterplan)



Total Waste Generated

- The amount of waste that is generated in Singapore is plateauing at 6-8 million tonnes annually after many years of growth.
- The amount of generated solid waste has increased from 4.6 million tonnes in 2000 to 6.94 million tonnes in 2021. The level peaked in 2018 with 7.8 million tonnes of generated waste.
- The amount of disposed waste has increased from 1,260 tonnes a day (1970) to 8,741 tonnes a day (2021) (NEA, 2021).
- Singapore disposes much of its waste through waste-to-energy initiatives.
- Every day, 79% of Singapore’s domestic waste generated will be incinerated at one of the four Waste-to-energy plants.

YEAR	TOTAL SOLID WASTE (000,000 tonnes per year)
2000	4.64
2005	5.02
2010	6.52
2015	7.67
2017	7.70
2018	7.76
2019	7.28
2020	5.88
2021	6.94

Estimated Annual Market Potential of 0.6 – 4 billion \$SGD

- Based on desktop research and engagement with NEA, there are no data available on the market potential and growth for waste value optimisation in Singapore.
- Therefore, a “bottom-up” methodology was adopted, where existing studies from comparable countries were used to assign values (\$SGD per tonne) to the individual waste streams in Singapore. By summarising across all waste streams, an estimate of the market potential can be obtained. The annual increase in Singapore’s total generated waste then becomes a proxy for market growth.

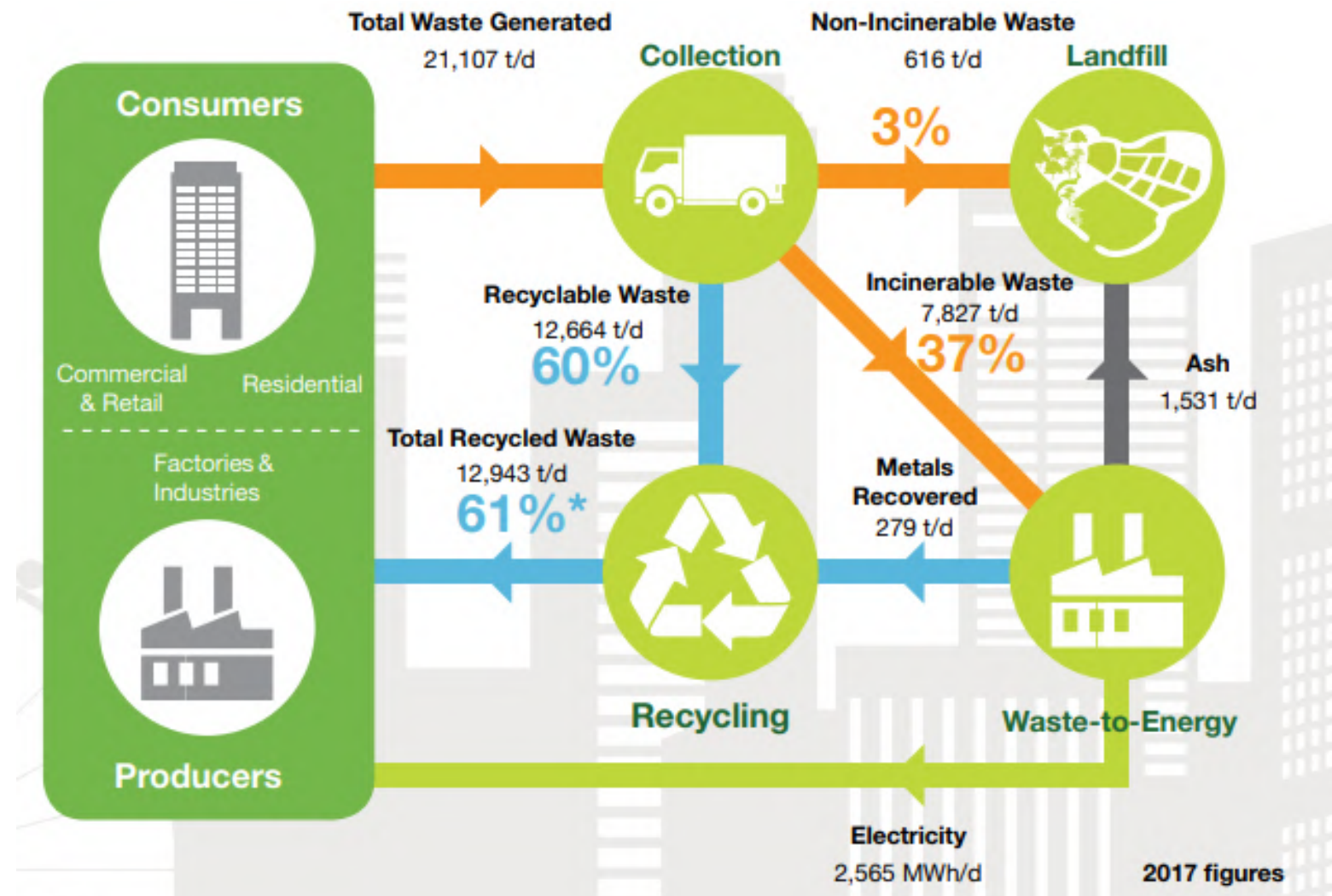
Waste Stream	Waste Amount ('000 tonnes per year*)	Waste Value (\$SGD per tonne)	Estimated value ('000,000 \$SGD)
Ferrous Metal	1312	195-500	256 – 656
Paper / cardboard	1136	0-260	0 – 295
Construction & demolition	1013	200	203
Plastics	982	140-1350	137 – 1326
Food	817	-68-85	-56 – 69
Horticultural	332	130-140	43 – 46
Wood	310	-70-30	-22 – 9
Ash & Sludge	249	1,5-3	0 – 1
Textile & Leather	189	80-890	15 – 168
Used Slag	182	8-120	1 -22
Non-ferrous metal	88	405-11190	36 – 985
Glass	74	-39-93	-3 – 7
Scrap tyres	27	270-400	7 – 11
E-waste	60	1-1100	0 – 66
Others (stones, ceramics)	233	Low value	0
Total			619 - 3864

Observations and Trends – Singapore’s Waste Sector

- Singapore’s waste sector is predominantly privately owned and run.
- Material Recovery Facilities (MRF) and Recycling Facilities are operated independently
 - Examples of MRF Operators: 800 Super, Sembcorp, Colex, V8 Environmental
 - Examples of Recycling Facility Operators: Alba (e-waste), Abraclean (glass waste), Ley Choon Group (Construction & Demolition waste)
- Government support of the sector is primarily targeted establishment of new facilities
- For upcycling specifically:
 - Upcycled items are commonly sold online (e-commerce)
 - Generally, difficult to scale up existing upcycling businesses due to:
 - Lack of supply of waste (many are dependent on donations and no infrastructure in place to receive a consistent stream of waste)
 - Mostly start-ups with no funding
 - Waste has to be clean – no system in place to clean waste, and it is time consuming if suppliers have to do it themselves
- Upcycled items are commonly created for the needy; low-income families, migrant workers, nursing homes. Often upcycling projects are started as a local community project (e.g. to activate the elderly, the lonely or children).

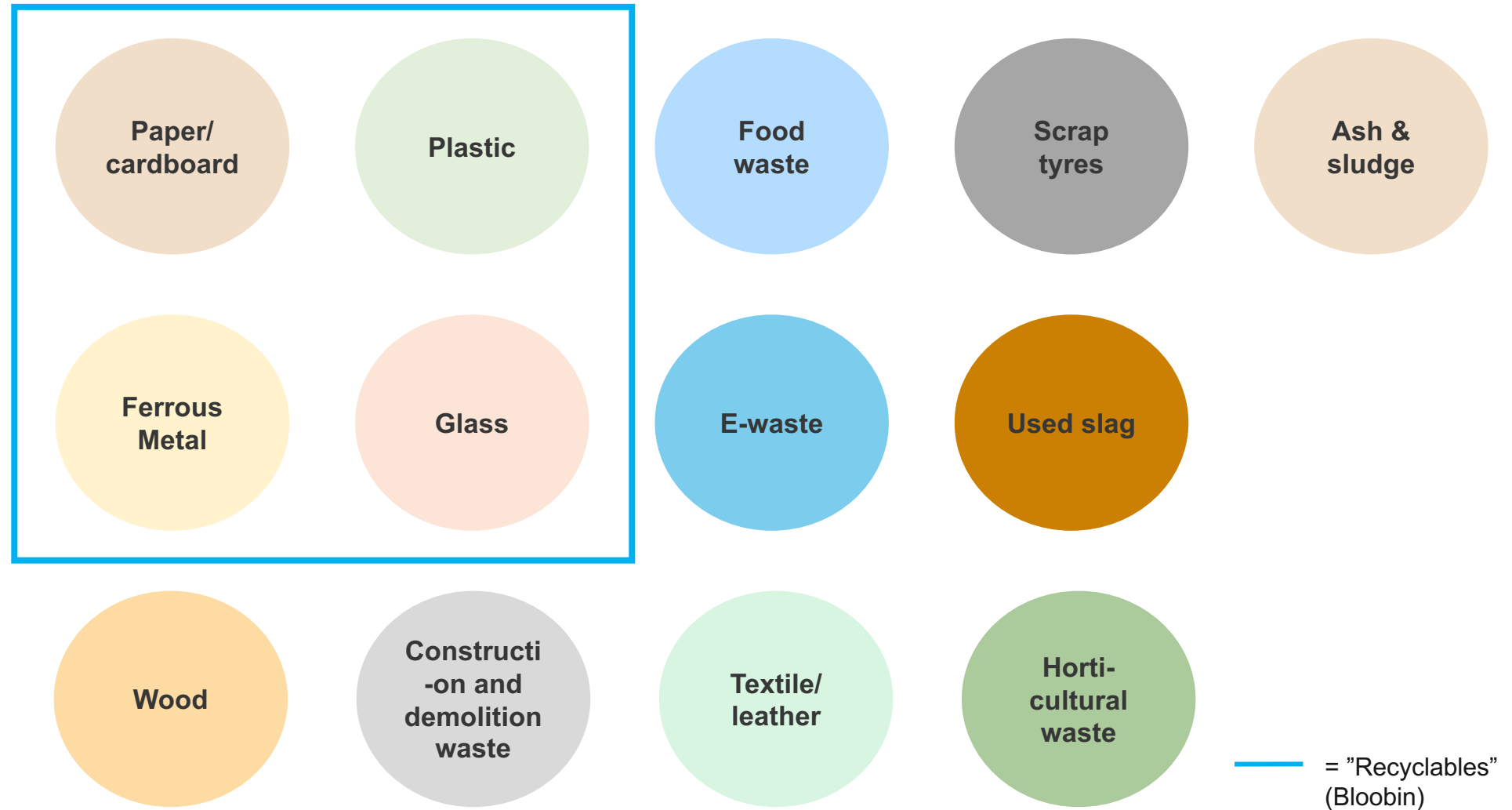
Singapore's Waste Management System

- Currently, about **37%** of Singapore's waste generation is incinerated at the 4 Waste-to-Energy (WTE) incineration plants.
- Another **60% is recycled**, while the remaining **3%** that is non-incinerable is landfilled.
- Incineration has enabled Singapore to reduce its waste by 90%.
- The amount of electricity generated by the four WTE plants meets up to **3% of Singapore's total electricity demand**.



Singapore's Waste Streams – Waste types

- Singapore has various waste types. However, only 4 types are considered recyclables.
- The recyclables are collected together in commingled recycle bins provided to all residential estates (Bloobins)
- Other waste types are being exported and most are being incinerated and end up as landfill.

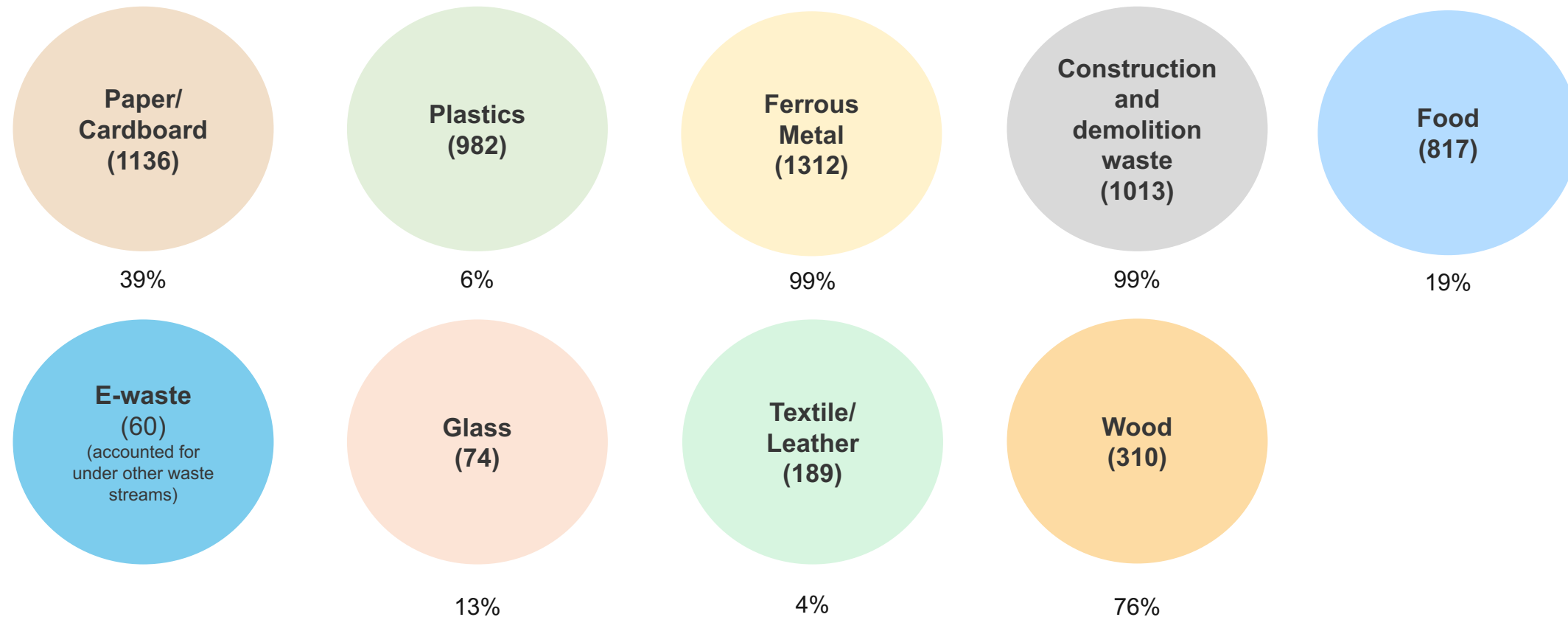


Singapore's Waste Streams – Recycling rates and waste amounts

Recycling rates and waste amounts ('000 tonnes in 2021)

Singapore's overall recycling rate in 2021 was 55%, which was an increase from 52% in 2020.

In 2021, the domestic recycling rate was 13% and the non-domestic recycling rate was 70%



Singapore's Waste Streams - Recyclables

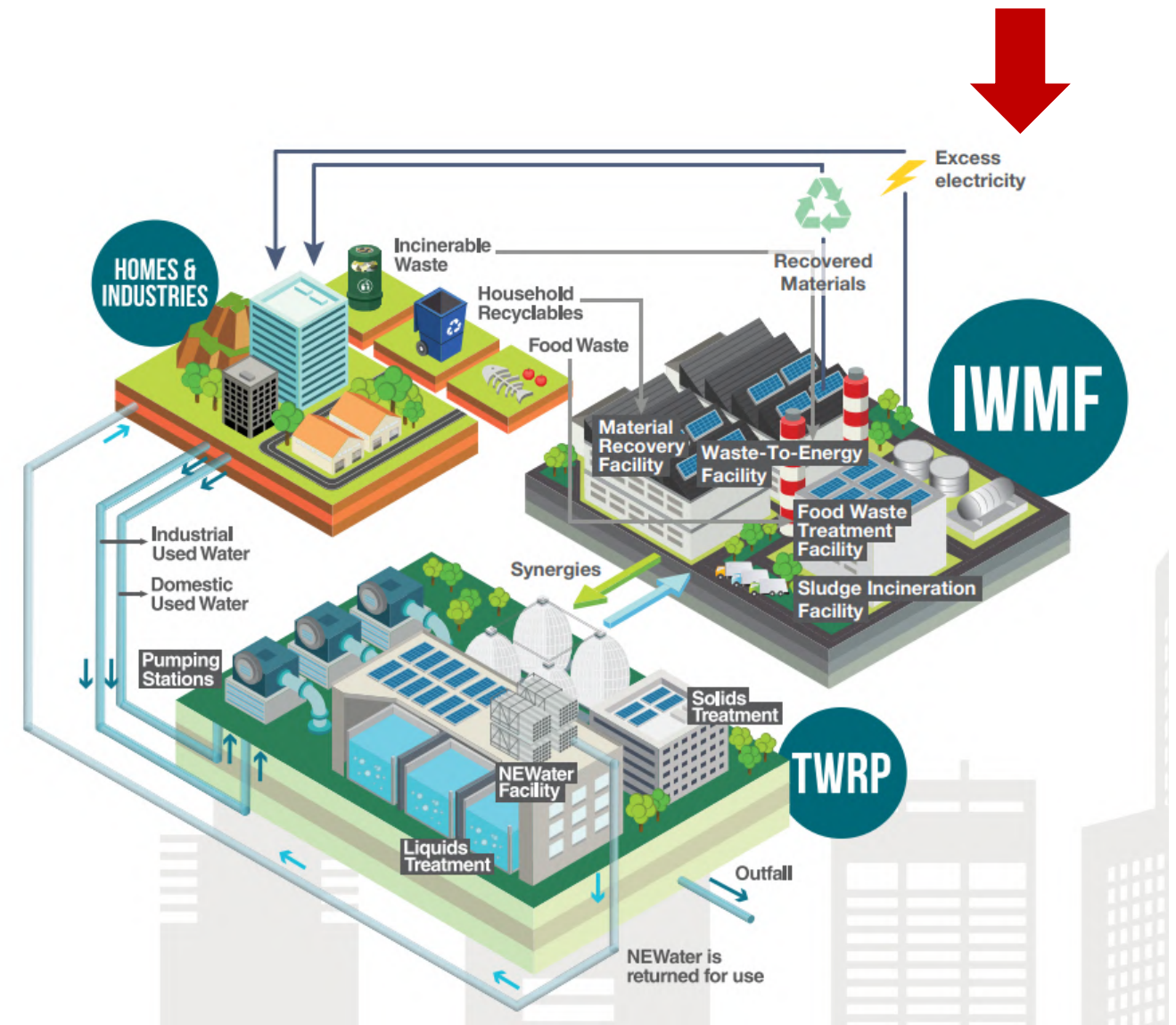
- The recyclables are collected by a recycling truck and sent to privately owned Materials Recovery Facilities (MRF)
- The recyclables are then sorted into different waste streams and sent to privately owned local and/or overseas recycling plants
- Singapore's upcoming Integrated Waste Management Facility (see next page) will include a dedicated Materials Recovery Facility



The Integrated Waste Management Facility (IWMF)

The Integrated Waste Management Facility is yet to be constructed in Singapore. However, the plan is for the IWMF to be able to effectively process the following key waste streams per day:

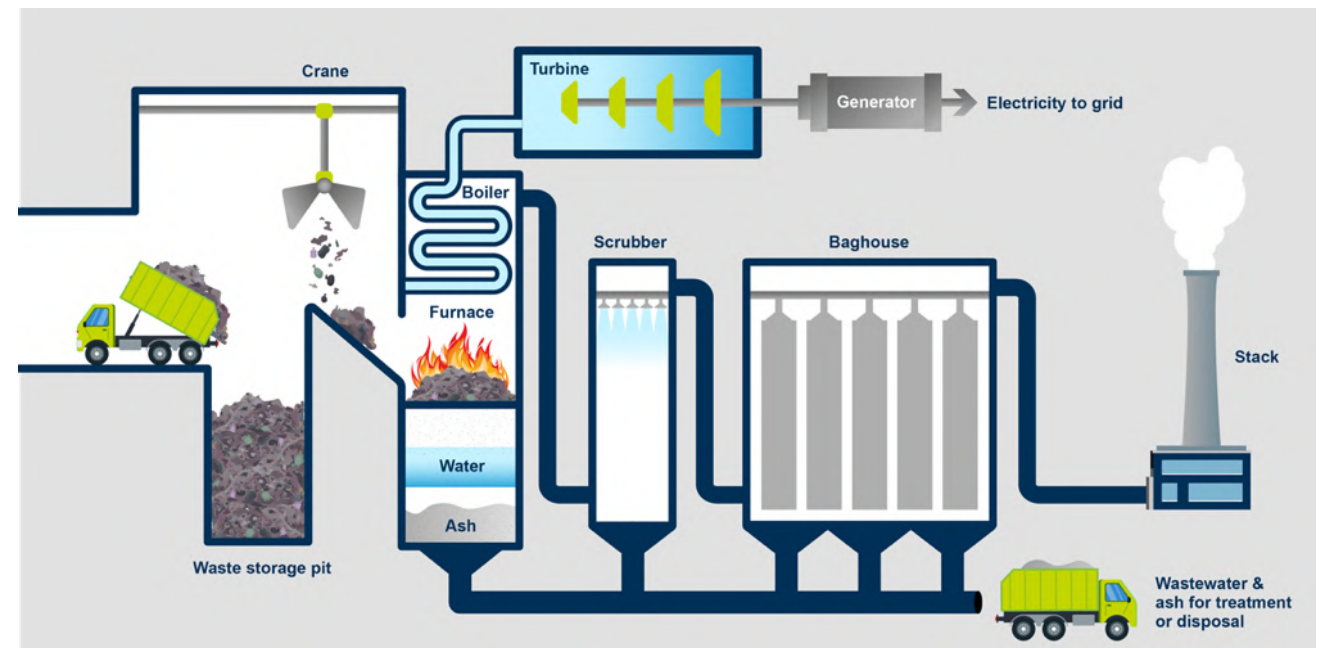
- 
Incinerable waste
5,800 tonnes
- 
Household recyclables
250 tonnes
- 
Source-segregated food waste
400 tonnes
- 
Dewatered sludge from TWRP
800 tonnes



Waste - Incineration plants and the process

In the late 1970s, NEA adopted Waste-To-Energy (WTE) incineration to reduce waste volume and reduce landfill space. Today, there are four WTE plants for incineration located at Tuas and Senoko, and a single off-shore landfill, Semakau.

- The incineration process begins by designated vehicles (trucks) collecting incinerable waste and carrying it to the WTE plants. Here, the waste is offloaded into large refuse bunkers. To keep track of the amount of waste that was discharged by each vehicle, the trucks will be weighed before and after discharging.
- At the WTE plants, the waste will be broken down by rotary crushers. The waste is then fed into the incinerator, which is operating at temperatures of between 850 and 1,000 degrees Celsius, turning the waste into ashes. The incineration process reduces the waste to only 10% of its original mass.
- The process of turning waste into ash also allows for the generation of electricity. The combustion process is creating heat which is used to generate steam in boilers. The steam then drives the turbo generators that produce electricity.
- After the incineration process, there will be ferrous scrap metal left in the ash. This is recovered and recycled.
- The ash is then sent to the Tuas Marine Transfer Station for disposal at the offshore Semakau Landfill.



Plastics Waste Stream



- Currently, only around 4% of plastics are recycled in Singapore.
- One reason is the public's lack of awareness of recycling. Most Singaporeans are unaware which types of plastics can be recycled and how to do so.
- Many plastics are difficult to recycle, due to contamination and mixing of different types of plastics.
- Most prominent is the issue of Singapore lacking the proper infrastructure to recycle plastics locally.
- Therefore, most plastics are currently exported for processing after being sorted in Singaporean facilities.
 - Once abroad, the process is as follows: the plastics are crushed into smaller pieces, blended to form a mixture of uniform homogenous quality, then melted and going through an extrusion process. After cooling, the plastic strands are cut into pellets to be used as material for new products.
- There are high ambitions to increase the level of plastics recycling.
- Part of the Singaporean-German Chamber of Industry and Commerce, the Plastics Recycling Association Singapore (PRAS), is piloting a project to make a PET bottle-to-bottle recycling plant.
- Furthermore, Singapore is aiming to start a drink container return scheme in 2024
- There are lots of plastics available, but the quality of recycled material might be limited.
- Therefore, there are large open gaps in the market, for firms that can help in the areas like cleaning and processing of plastics for recycling.

Metal Waste Stream



- Metal is cleaned and crushed into smaller pieces. Then, the materials gets melted to form new products.
- 99% of both ferrous and non-ferrous metals are recycled in Singapore
- This is possible, in part, due to a metal recovery facility which take in incineration bottom ash (IBA), from already incinerated waste.
- The facility uses special magnets, micro-grain eddy current separators and multi-stage sieving techniques to extract metals from IBA.
- The process typically involves
 - Collection of metals.
 - Sorting the metals into different categories.
 - Metals are melted.
 - Purification is done to ensure that the metals are free of contaminants.
 - Metals are heated at high temperatures, poured and cooled in a cast, and moulded into metal sheets or bars for manufacturing new products.
- Most metals do not degrade in quality and can be recycled into metal bars, sheets and ingots that is used in the production of new products on the same level as new metal
- Some metals, notably iron is purified at a metal processing plant adjacent to the ash recovery facility
- Purified ferrous metals are then transferred to Malaysia before being sold to international buyers.
- Scrap metal has a market value already. Businesses can use scrap metal at the same rates as other firms buying it.

E-waste Waste Stream

- Singapore has a regulated system for managing e-waste.
- This follows the Extended Producer Responsibility (EPR) approach, where producers bear the responsibility for the collection and treatment of their products when they reach end-of-life
- Furthermore there is a National Voluntary Partnership for the Proper Management of Non-regulated Used Household Electrical/Electronic Products
- These approaches are needed as e-waste consists of various mixed materials, often including hazardous substances
- Furthermore, much e-waste has components that include very valuable resources which can be extracted
- E-waste requires specialised equipment to dismantle, shred, process and extract the constituent materials that can then be turned into new products
- Meanwhile, the process has to be performed within a controlled system to prevent pollution and ensure workplace safety
- 60,000 tonnes of electronic waste (e-waste) is produced in Singapore annually
- There are no official numbers of how much of this is recycled
- E-waste processing is highly regulated, and opportunities in this space should chiefly be considered by those firms with experience in the field. However, those with high expertise may be able to use this as an advantage.

Glass Waste Stream



- In Singapore, glass is recycled by depositing them into the blue recycling bins. It is then sent to a recycling facility and sorted based on colour. Contaminants such as paper and metal are removed, and the glass gets crushed into cullet and melted in a high temperature furnace to make new glass products. The cullet can also be turned into glass fiber or powder and used as material in bricks, tiles, abrasives and replacement of sand.
- Compared to making glass from raw materials for the first time, cullet melts at a lower temperature. Thus, the advantage of glass recycling is the cost saving in reduction of energy use.
- In Singapore, the glass waste is sorted and exported overseas for recycling as there are no glass recycling plants in Singapore.
- It is also common for beer bottles to be collected from restaurants, hotels and food outlets for reuse in a local brewery (these are not included in the recycling figures).
- An example of a Singaporean company that upcycles glass (from Malaysia) is Glimex. They use recycled glass to create interior glass and mirrors for use in facades or electronics.

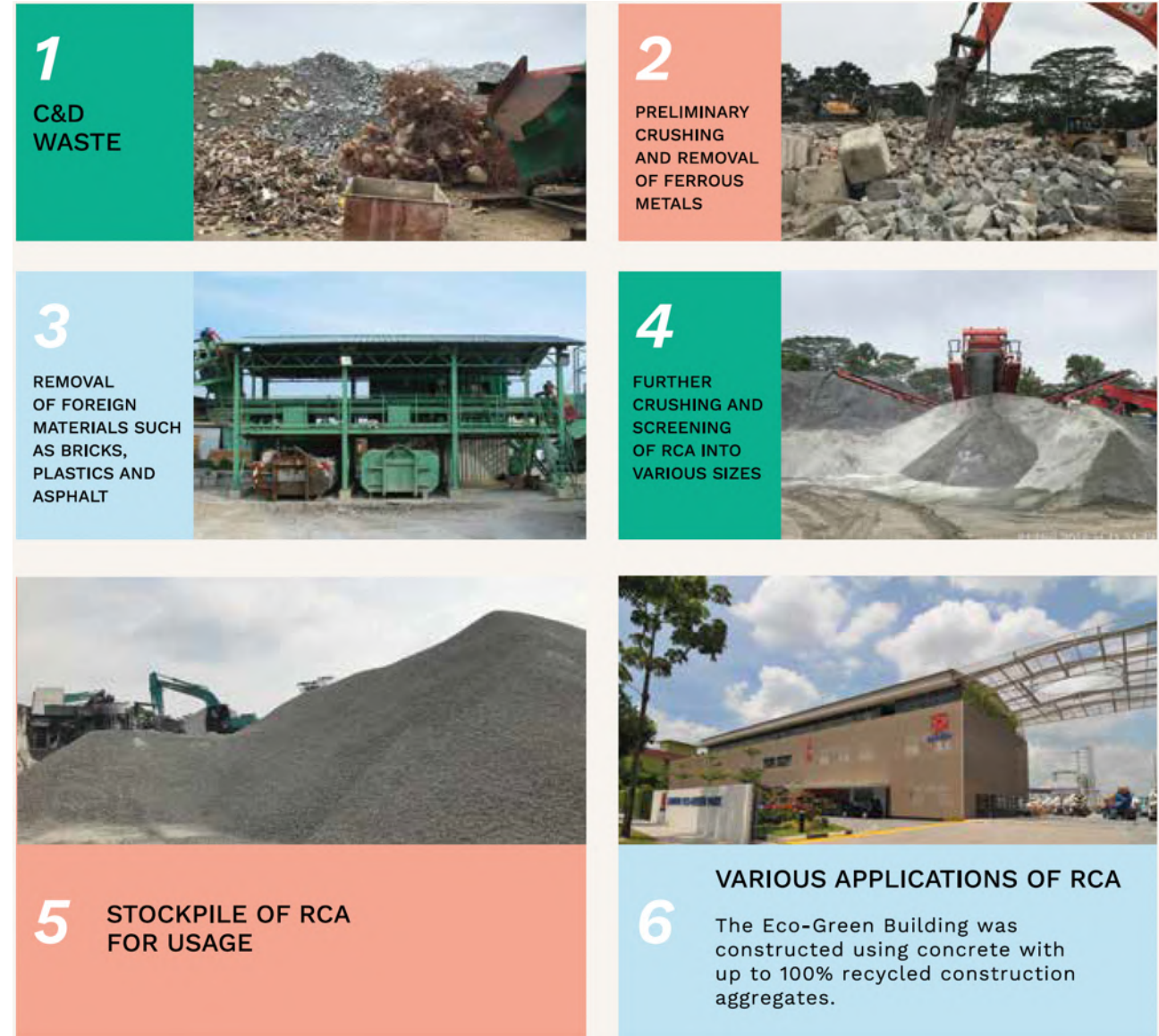


Facade made of recycled glass by Glimex.

Source: <https://www.glimex.com.sg/about-us/>

Construction & Demolition waste

- Despite recycling rates are not overall great, the recycling rate of construction/demolition material is still upwards of 99%.
- Demolition waste is mostly turned into recycled concrete aggregate (RCA), which is a product of inferior quality to natural aggregate – so it is in effect downcycled.
- To help demolition contractors plan their demolition procedures to maximise C&D waste recycling, the Demolition Protocol was implemented by the Building and Construction Authority (BCA) in Singapore.
- The Demolition Protocol prescribes that reusable and non-reusable parts of a building have to be identified, then separately dismantled and removed.
 - Reusable parts include piping and wiring, which are placed in separate bins and sent to a recycling facility.
 - Non-reusable parts that contaminate the concrete debris, such as ceiling boards and tiles, are discarded. Only when the building has been stripped to its bare frame can demolition start.
- The material RCA (recycled concrete aggregate) is made up of more than 70% demolition waste, reclaimed from waste concrete made with natural aggregates.



Paper and Cardboard

- The recycling rate of Paper/Cardboard was 39% in 2021. It remains below 2019's 44% as less Paper/Cardboard recyclables are exported than in 2019 while there is an increase in Paper/Cardboard waste disposed of.
- According to a Strait Times report, about 6 out of 10 household do recycle, but more than half of them may not know what can or cannot be recycled. This results in organic or food wastes being thrown into recycle bins which will in turn cause the recyclables to be contaminated and dealt with as general wastes. Paper waste will be the worst hit as once they are soiled, they will no longer be recyclable.

Paper and cardboard can be recycled by depositing them into blue recycling bins.

1. Papers are sorted and sent to a recycling facility.
2. Papers are shredded and soaked in vats to become pulp.
3. After screening and refinement processes, the pulp is fed into a machine to form sheets of paper.
4. The sheets are rolled and dried to make paper again



Wood

- 76% of wood waste is recycled in Singapore (2021)
- Wood waste is generated by a variety of sources, including construction and demolition projects, manufacturing and production facilities, and horticulture landscaping. It includes industrial wooden pallets, used packaging like wooden crates, fallen trees, leftover timber, and old parts from doors and furniture.
- In Singapore, the National Environment Agency (NEA) is responsible for regulating the disposal of wooden waste. There are several wood disposal and recycling facilities available in Singapore.
- Wood waste recycling plants can transform the wood waste into recycled wood products known as Technical Wood (or engineered compressed wood), to be used as wood chips for wood pallets and crates. These wood products can be used in a variety of applications, including animal bedding and landscaping mulch.
- Another option is disposing the wood waste to Waste-to-energy plants. Here, the wooden waste is incinerated to generate electricity. The heat produced during the burning process is used to create steam, which drives a turbine to generate electricity.



Source: Waste Disposal @ SG

Textile and Leather

- Only 4 per cent of textile and leather waste in Singapore is recycled (2021)
- According to the NEA, many people in Singapore are unfamiliar with what they can do with their old clothing, shoes, bags and other household items. Some discard them or even place them in blue recycling bins, which are meant for recyclables.
- There are several avenues for donating, reselling or repairing textiles and other clothing items in Singapore. Examples are:
 - NGO's that offer social service programs, where donated clothes are redistributed.
 - Several high street shopping stores such as H&M and UNIQLO offer to take your unwanted textiles in order to recycle them (e.g. to create new clothes).
 - Textile collection bins and door-stop pick ups. The companies behind these will commonly sort the collected textiles in Malaysia for reuse and resale where possible. For items that cannot be reused, part will be extracted for recycling or upcycling, while the remainder will be used at waste-to-energy plants.
- Textile and leather waste which is not segregated at source for recycling or reuse will be sent to the incineration plant. The incinerated waste is then transported to Semakau Landfill.



Source: Zerrin.com

Business Opportunities in Singapore

- Singapore is systematically and purposely transforming its industries towards Industry 4.0. The waste management industry is no exception with a demand for solutions to automate processes resulting in decreased dependency on manual labour and improved working environments. In a sector that is primarily operated by private players, any solutions that improve efficiency and drive down operating costs are of interest.
- Based on our analysis of waste streams and interviews with key players, we see business opportunities within the following waste streams:
 - Ferrous metal
 - E-waste
 - Plastics
 - Wood
 - Food
 - Textiles & Leather
 - Construction & Demolition
- There is no lack of potential raw materials for recyclers and upcyclers in Singapore. However, the challenge is to avoid contamination of the materials as there is a lack of infrastructure (and behavioural efforts) to effectively separate waste streams and clean the waste materials. Hence, the majority of immediate business opportunities are expected within sorting, cleaning, and processing of waste into suitable raw materials.

Stakeholder mapping: Singapore's waste management sector



Stakeholder profiles



- The leading public organisation responsible for ensuring a clean and sustainable environment for Singapore. Its key roles are to improve and sustain a clean environment, promote sustainability and resource efficiency, maintain high public health standards, provide timely and reliable meteorological information, and encourage a vibrant hawker culture.



- Not-for-profit trade association for solid waste management with an aim to advocate best practices, transfer of knowledge amongst industry player. Founded in 2001.
- Membership covers a wide spectrum of the industry including waste collection, recycling and recovery, e-waste, hazardous and biohazardous waste, and ranges from large MNCs, SMEs, equipment and service providers, and more.



- Focus on enhancing waste management capacity and capability by improving collection, sorting, processing, and recycling systems, especially in underserved regions (not only Asia). Wants to enable a circular economy.

Stakeholder profiles



- Charity and non-governmental organisation leading the drive towards zero waste in Singapore through education and advocacy.
- Focuses on engaging the public and corporates on the 3Rs (Reduce, Reuse and Recycle) in areas of: Food Waste, Plastic Disposables, Household Recycling, and Organisational Waste. They do this through educational talks, workshops, capacity building training, and experimental activities.



- Independently managed, non-profit, and non-governmental organisation with a vision to be a trusted leader in environmental sustainability.
- They do this through collaborations with people, industries and governments; setting sustainability standards for green consumerism; educating and empowering communities to lead green lifestyles; promoting biodiversity in the urban environment; and recognising environmental excellence by individuals and organisations.



- NGO and not-for-profit business association. PRAS represents the interest of companies in the Plastics Recycling sector to meet, discuss, collaborate and undertake viable projects together.
- Aims to identify pilot projects in recycling and utilise the knowledge gained in the implementation for the establishment of a Plastics Recycling Centre of Excellence (PRCOE). The PRCOE will develop solutions for recycling challenges in Singapore and for Southeast Asia.

Stakeholder profiles



- Environmental services provider in Singapore. Provides a broad range of environmental services such as waste management and treatment, cleaning and conservatory, and horticultural services.
- Operates a self-sustaining integrated energy and resource recovery facility that house biomass plant, sludge treatment plant, industrial laundry plant, animal feed processing and sterilising facility, and third-party ISO tank container heating facility.
- Founded in 1986 as a waste management company and owned by Harmony Infrastructure Pte. Ltd today.



- Seeks to be a leading provider of sustainable solutions. Everything they do centres around sustainability.
- They have several subsidiaries, both in and outside of Singapore. SembWaste is their waste and recycling management arm, which does waste collection in Singapore (one of three appointed by the NEA). They also provide recyclables management, material recovery and handling for downstream recycling, conversion of waste-to-resources, including waste-to-energy, and final waste disposal.
- SembCorp was incorporated in 1998 and employs over 5600 people. 50.4% of their shares are owned by public, and 49.6% by Temasek Holdings.



- Works towards a zero-waste society. Their business areas include smart city solutions, plastic recycling, green gas technology, green fuel technology, and hazardous waste recycling and management.
- ALBA E-Waste is focused on e-waste collection and recycling, and is appointed by the NEA as the Producer Responsibility Scheme Operator for Electrical and Electronic Waste.
- Founded in Germany in 1968 as a waste disposal firm. Has been in the Asian market for more than 20 years.
- ALBA WH Smart City PTE Ltd is the public waste collector for the Jurong and Woodlands-Yishun sector.

Stakeholder profiles



- Provides reliable and effortless waste management solutions in Singapore.
- Have 50 vehicles, two (solar powered) Material Recovery Facilities (with AI robotics), and two waste reception areas. Provides a broad range of services (organic, inorganic and sewage management).
- Licenced by the NEA.
- Started in 1999



- Provides end-to-end service for corrosion prevention for high-end costumers working in marine or oil and gas and civil constructions and directly linked to the infrastructure industry.
- ABRABLAST does glass-recycling using abrasive blasting. Will produce ABRABLAST (for the blasting and coating industry) using mainly glass waste materials.
- Established in 2007 in Singapore.



- Underground Utilities Infrastructure Construction and Road Works service provider.
- Operates an asphalt plant.
- Founded in 1990 and headquartered in Singapore. Also works in China and Sri Lanka.

Stakeholder profiles



- Specializes in waste disposal, but provides cleaning services as well (IPM).
- Colex Environmental Pte Ltd (CEPL) is their subsidiary that works with waste management and recycling services (licenced by the NEA). In 2014, they installed the Material Recovery Facilities to sort recyclables from the waste collections.
- 40-year-old veteran in Singapore. They are an investment and holding company.



- Provides sustainable technology lifecycle solutions: end-to-end partner for the commissioning, deployment and retirement of technology assets.
- Does e-waste and battery recycling, as well as IT asset disposition.
- Runs the TES Battery/Energy Storage System (ESS) in Singapore.

Stakeholder profiles

TuasOne Waste-to-Energy Plant (TWTE)

- Singapore's sixth waste-to-energy (WTE) plant that can incinerate 3,600 tonnes of waste and generate 120 megawatts of electricity daily. The electricity produced is sufficient to power about 240,000 HDB flats.
- TuasOne has appointed Mitsubishi Heavy Industries Environmental & Chemical Engineering ECO Creation Singapore Co. Ltd (MHIEC ECO Creation) as its long-term operations and maintenance contractor on 22 July 2022. Prior to the appointment of MHIEC ECO Creation, Mitsubishi Heavy Industries Asia-Pacific Pte. Ltd. (MHIAP) had been operating the plant.

Tuas South Incineration Plant (TSIP)

- Designed to incinerate 3000 tonnes of refuse per day, making it the largest refuse incineration plant in Singapore.
- Completed in 2000.

Keppel Seghers Tuas Waste-To-Energy Plant (KSTP)

- Operated by Keppel Seghers. Operational since 2009. Contract with NEA until 2034.
- The plant is able to treat 800 tonnes of solid waste daily to generate about 22 MW of green energy.

Senoko Waste-To-Energy Plant (SWTE)

- Operated by Keppel Seghers who acquired Senoko WTE from the Singapore Government in Sep 2009 and started providing Operations and Maintenance (O&M) services to the National Environment Agency under a 15 years contract.
- Has a capacity of 2,310 tonnes per day. Together with Keppel Seghers Tuas WTE plant, Keppel can treat almost half of Singapore's total volume of incinerable waste

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Market Size and Growth

- The Singapore food waste recycling market is estimated to garner a revenue of S\$44.0mil by the end of 2030, growing at a CAGR of 5.8% over the forecast period, i.e., 2021 – 2030. In 2020, the market in the nation registered a revenue of S\$25.2 million. The growth of the market can be attributed to the expanding food & beverage sector in the nation, which is raising the need to focus on lowering food waste.
- Singapore population has increased to more than 5.9 million in 2022 which contributed to about 7-fold increase in the amount of solid waste disposed. The total amount of food waste generated in 2021 was 817,000 tonnes, which was 23 per cent more than the 665,000 tonnes generated in 2020. While the amount of food waste generated increased, the amount of food waste recycled remained at 19%.
- In 2021, about 6.94 million tonnes of solid waste was generated, of which 3.83 million tonnes were recycled. Waste generated by the non-domestic and domestic sectors both increased in 2021, from 4.12 million tonnes and 1.77 million tonnes respectively in 2020, to 5.12 million tonnes and 1.82 million tonnes respectively in 2021. Recycled waste attributed to the non-domestic and domestic sectors likewise increased, from 2.81 million tonnes and 0.23 million tonnes respectively in 2020, to 3.58 million tonnes and 0.24 million tonnes respectively in 2021.

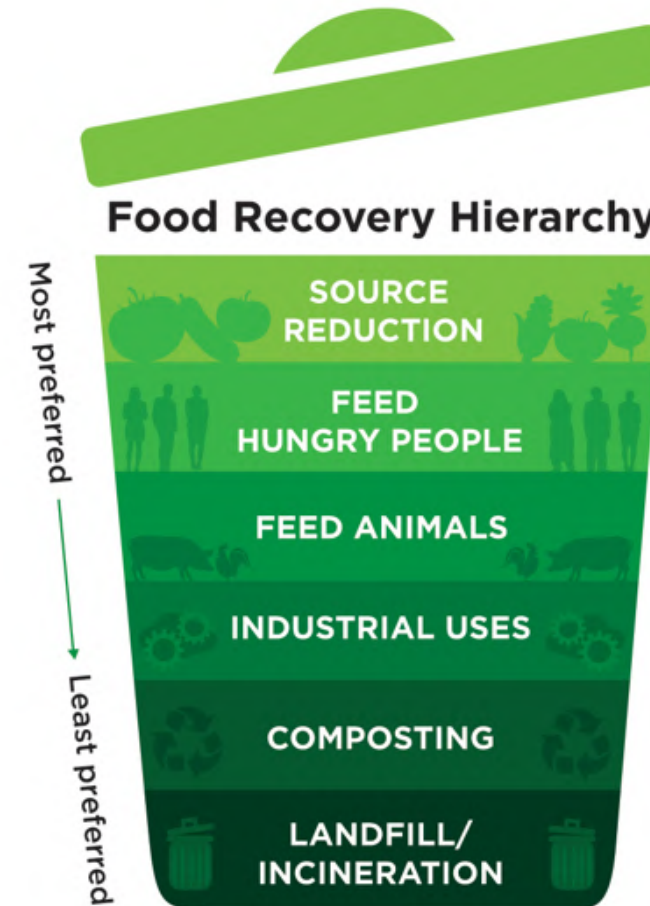
Year	Food Waste Disposed of ('000 tonnes)	Food Waste Recycled ('000 tonnes)	Total Food Waste Generated ('000 tonnes)	Recycling Rate (%)
2021	663	154	817	19%
2020	539	126	665	19%
2019	607	136	744	18%
2018	637	126	763	17%
2017	677	133	810	16%

Waste Type	Total Generated ('000 tonnes)	Total Recycled ('000 tonnes)	Recycling Rate	Total Disposed ('000 tonnes)
Ferrous metal	1,312	1,306	99%	6
Paper/Cardboard	1,136	437	39%	699
Construction & Demolition	1,013	1,011	99%	2
Plastics	982	58	6%	924
Food	817	154	19%	663
Horticultural	332	277	83%	55
Wood	310	234	76%	76
Ash & sludge	249	22	9%	227
Textile/Leather	189	7	4%	182
Used slag	182	181	99%	1
Non-ferrous metal	88	87	98%	1
Glass	74	9	13%	65
Scrap tyres	27	26	95%	1
Others (stones, ceramics, etc.)	233	18	8%	214
Overall	6,944	3,826	55%	3,118

Identification of market drivers

With limited space for waste disposal and an increasingly carbon and resource constrained future, the Ministry of Sustainability and Environment (MSE) and The National Environment Agency (NEA) are pushing for a wider adoption of circular economy approaches, where resources are used over and over again, and waste is designed out of the system.

- A major factor in the growing food waste is the increasing population. In Singapore, the popularity of convenience meals has grown significantly over the recent years and there is also a growing Food and Beverage sector in the country.
- Singapore households generated 1.82 million tonnes of waste in 2021, of which 523,000 tonnes or S\$1.8 billion worth, comprised domestic packaging waste. There's a need for circular packaging solutions.
- There is increased focus by the NEA in reducing food waste and to manage food waste holistically. Reducing food wastage, redistributing unsold or excess food, and recycling/treating food waste are important components of the national waste management strategies
- Lack of transportation methods for food waste handling
- Lack of infrastructure and recycling facilities
- Labour crunch – need for automation and robotic solutions



Resource Sustainability Roadmap

The Resource Sustainability act was enacted in 2019 to impose obligations relating to the collection and treatment of electrical and electronic waste and food waste, to require reporting of packaging imported into or used in Singapore, to regulate persons operating producer responsibility schemes, and to promote resource sustainability. The Singapore Government has taken lead since 2020 in implementing EPR laws and has prioritised 3 Waste Streams: Food Waste, E-Waste and Packaging Waste (including Plastics).



Resource Sustainability Roadmap

Food Waste: Segregation for Treatment

- Food waste is one of the major waste streams identified with high generation tonnage and low recycling rate. From 2024, it will be mandatory for the owners and operators of commercial and industrial premises, where large amounts of food waste are generated, to segregate their food waste for treatment. Such premises include large hotels and malls, large industrial developments housing food manufacturers, food caterers or food storage warehouses.
- It is mandatory for developers of new developments, where large amounts of food waste are expected to be generated, to allocate and set aside space for on-site food waste treatment systems in their design plans from 2021. They will also be required to implement on-site treatment of food waste from 2024. The adoption of such systems will allow for the closed-loop management of food waste at these premises, where the food waste could be converted to compost for landscaping purposes or water for non-potable uses.

Types of Premises	Threshold		Exemptions
Shopping Malls	F&B Area	> 3,000 sqm	NA
Hotels	F&B and Function Area	> 3,000 sqm	NA
Single-user Factory (SUFs)	Large Food Manufacturers	Operation area > 750 sqm	Manufacturers of spices, dried foodstuffs, additives, bottled water, high pressure processing
Multi-user Factory (MUFs)	GFA and food tenants	GFA > 20,000 sqm and with > 20 food tenants	NA
	At least one large food manufacturer	Operation area > 750 sqm	Manufacturers of spices, dried foodstuffs, additives, bottled water, high pressure processing

Identification of market opportunities



Primary Opportunities (Reduce & Reuse)

- Product out of specifications; Insufficient demand from market
- Loss of production – protection against pest etc.
- Loss during transportation, storage, sorting, packing, conditioning – better design packaging, optimise use of controlled environment, reduce transportation lead time, maintenance of equipment etc.
- Cancellation of order, insufficient shelf life, unwanted good - optimise purchase of food based on demand, to rely on ecosystem of organisation that can reuse products
- Mishandling of goods by staff or consumers –training for staff on food handling and packing
- Food waste from consumers – awareness campaigns, incentives, ban buffet dining etc.



Secondary Opportunities (Recycle & Upcycle)

- Feeds for animal
- Composting/Fertilising
- Anaerobic digestion - process used for industrial or domestic purposes to manage waste or to produce BioGas/BioFuel/BioEnergy
- New food / Edible protein

Key technology needs



Food Waste

- Agrifood Waste Valorisation, including side streams that can be converted into higher value products
- Agricultural Biostimulants
- Alternative Proteins (Plant & Cell based) - where is the need?
- Digitalisation & automation in farm operations and food manufacturing
- Extraction of valuable ingredients (e.g. proteins) from Black Soldier Fly larvae suitable for use in other industry (e.g. aquaculture/animal feed manufacturing)
- Farm Waste Management & Valorisation
- Farming Inputs Technology (e.g. feed, fertilisers etc.)



Waste Water

- Functional Ingredients, particularly tech to extract from food by-products
- Integrated Pest Management Technologies
- Macro & Micronutrients in Fertilizers
- Microbes as Biofertilisers
- Microbiome, particularly on the elderly
- Specialty Feed & Additives
- Water & wastewater treatment, particularly resource recovery from wastewater and solid waste
- Self-healing material for heat rejection/ reflection coating on transparent substrates

Key technology needs



Packaging

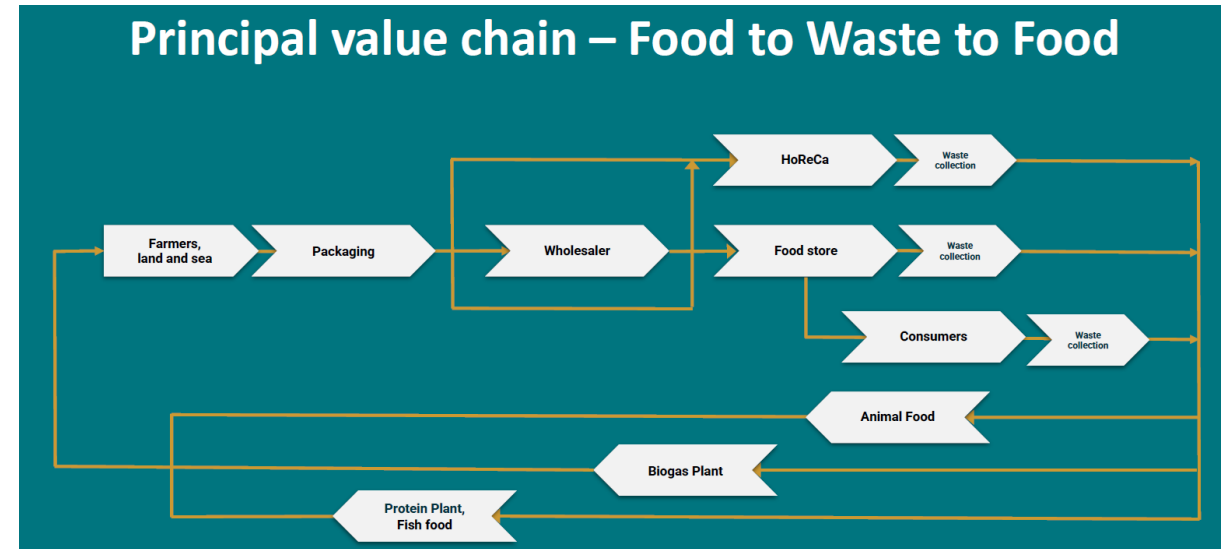
- Strengthen and acquire “recyclability” of products through incorporating post-consumer plastic resins into new products or manufacturing technique
- To work with companies with innovative materials and explore co-innovation opportunities with brand owners
- Tech sourcing for more innovative solutions
- Source new cost-effective solutions
- Governments and companies are demanding for green suppliers and green solutions for a low-carbon future
- Coatings for paper and flexible packaging to improve barrier properties (WVTR and OTR)
- Cost-effective, sustainable hard and flexible packaging materials, including bioplastics, natural and biodegradable materials
- Recyclable packaging materials (e.g. mono-materials) that have no impact on national waste streams
- Smart and functional solutions for printed packaging, i.e. specialty inks, digital technologies such as for anticounterfeit, gamification
- Upcycling of packaging into new products/packaging

Stakeholders identification

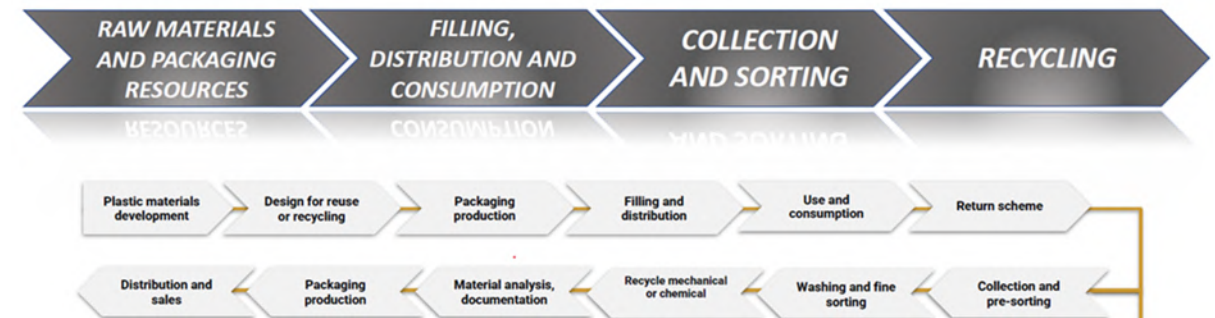


In Singapore, the National Environment Agency (NEA) is the regulatory body in charge of the enforcement of the law for waste management.

Leveraging the technologies and expertise of organisations across the value chain can help accelerate a circular economy for food and plastics waste. With a broader scope, food and plastic waste can be turned into new products instead of ending up in the environment, incineration or landfill.

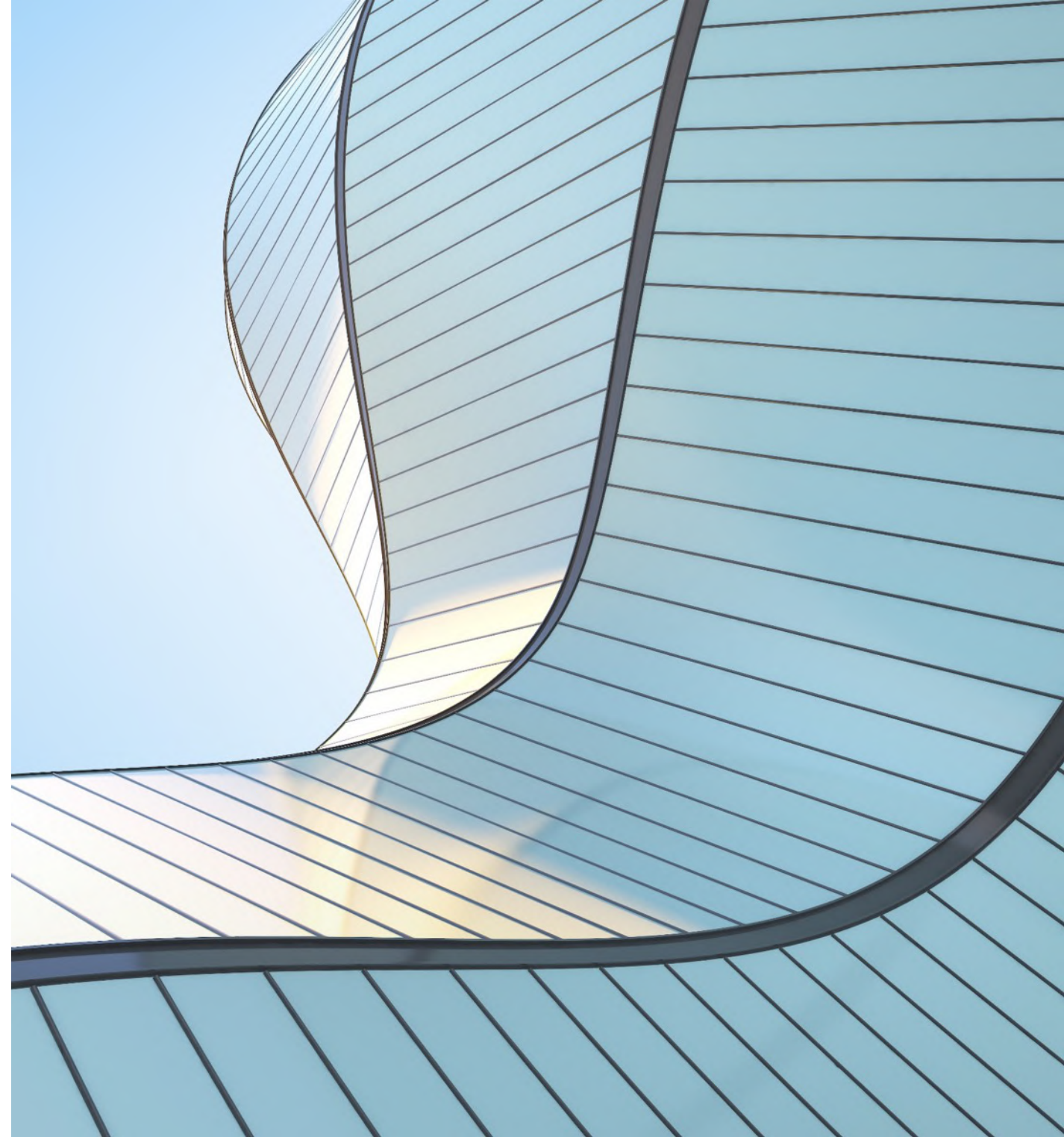


Principal value chain for plastic packaging



Agenda

- Introduction
- Singapore's business climate
- Singapore sustainability approaches
- Sub-sector 1: Energy Efficiency (by Business Sweden)
- Sub-sector 2: Waste Value Optimisation (by Embassy of Denmark in Singapore)
- Sub-sector 3: Food & Packaging Waste Management (by Innovation Norway)
- **Grant, schemes, initiatives, and regulations**
- Conclusion



List of grants, schemes, initiatives and regulations

Sub-sector	Item	Type	Industry	Description
Energy efficiency	Energy Conservation Act (ECA)	Regulation	Industrial	<ul style="list-style-type: none"> ECA was enacted in June 2012, and the Energy Conservation (Energy Management Practices) Regulations came into force on 22 April 2013 Through the ECA, mandatory energy management practices were introduced, aiming to focus management attention on proper energy management, as well as to level up laggards that manage energy use inadequately Enhanced in June 2017 including <ul style="list-style-type: none"> Strengthening the measurement and reporting requirements for greenhouse gas emissions Requiring companies to implement energy management system Undertake regular energy efficiency opportunity assessments or implement energy performance monitoring Introducing minimum energy efficiency standards for common industrial equipment and systems
Energy efficiency	Minimum Energy Efficiency Standards for water-cooled chilled water systems in industrial facilities	Regulation	Industrial	<ul style="list-style-type: none"> The Minimum Energy Efficiency Standards (MEES) will cover electrically-driven, water-cooled chilled water systems in industrial facilities that: <ol style="list-style-type: none"> has a total installed capacity(1) of 1055 kW (300 RT) or more; and produces chilled water at a temperature of 3°C or higher Chillers solely utilising brine or glycol and air-cooled chillers that form part of the water-cooled chilled water system will be exempted. The MEES will be applied to a water-cooled chilled water system, comprising, among others, chillers, chilled water pumps, condenser water pumps and cooling towers that uses chilled water as the medium to transfer heat. An industrial facility refers to: <ol style="list-style-type: none"> any single-user facility that has a business activity attributable to any of the following industry sectors: <ol style="list-style-type: none"> manufacturing and manufacturing-related services; supply of electricity, gas, steam, compressed air and chilled water for air-conditioning; and water supply and sewage and waste management any multi-user facility that is sited on URA Masterplan B1 or B2 zone.

List of grants, schemes, initiatives and regulations

Sub-sector	Item	Type	Industry	Description
Energy efficiency	Minimum Energy Performance Standards for industrial equipment and systems	Regulation	Industrial	<ul style="list-style-type: none"> The introduction of MEPS for common industrial equipment and systems will lead to the phase out of inefficient models from the market and catalyse the transformation of the market towards more efficient models. Besides enjoying life-cycle cost savings from lower energy consumption, companies will also reduce their carbon footprint. Three-phase 50 Hz induction motors With effect from 1 October 2018, single speed, three-phase 50 Hz induction motors must have a minimum energy efficiency level of IE3. Three-phase Variable Refrigerant Flow (VRF) air-conditioners With effect from 1 April 2021, all three-phase VRF air-conditioners must comply with MELS and MEPS.
Energy efficiency	Energy Efficiency Fund (E2F)	Incentives / Grants	Industrial	<ul style="list-style-type: none"> Designed to support companies in the industrial sector to be more energy efficient. It encourages owners and operators of facilities to: <ul style="list-style-type: none"> Design for Efficiency: Integrate energy and resource efficiency improvements into their development plans early in the design stage; Energy Assessment: Conduct a detailed energy assessment for their facilities to identify energy efficiency improvement opportunities; Energy Efficient Technologies: Invest in energy efficient equipment or technologies; and Energy Management Information System: Invest in an Energy Management Information System (EMIS) to plan, monitor and take action to continually improve and maintain energy performance; Low-GWP Refrigerants Chillers: Switch to water-cooled chillers using refrigerants of low global warming potential (GWP)
Energy efficiency	Singapore Certified Energy Manager Training Grant	Incentives / Grants	Industrial	<ul style="list-style-type: none"> Co-funding scheme administered by the Employment and Employability Institute to develop local expertise and capability in professional energy management. The scheme is targeted at engineers / managers who manage manufacturing facilities or provide energy consulting services
Energy efficiency	Resource Efficiency Grant for Energy	Incentives / Grants	Industrial	<ul style="list-style-type: none"> The Resource Efficiency Grant for Energy (REG(E)) supports manufacturing facilities and data centres to be more energy efficient and improve competitiveness. The REG(E) is part of the Enhanced Industry Energy Efficiency package, with EMA, EDB and NEA each rolling out initiatives to extend stronger support to companies in their drive to become more energy efficient and reduce carbon emissions. Grant support for REG(E) will correspond to the amount of carbon abatement, up to the maximum cap of 50% of qualifying costs.

List of grants, schemes, initiatives and regulations

Sub-sector	Item	Type	Industry	Description
Energy efficiency	Energy Efficiency National Partnership	Partnership	Industrial	<ul style="list-style-type: none"> Voluntary partnership programme to support companies in their energy efficiency efforts through learning network activities, energy efficiency-related resources, incentives and recognition
Energy efficiency	Energy Services Company Accreditation Scheme	Promotion	Industrial	<ul style="list-style-type: none"> A company dedicated to provision of energy efficient technology and services including financing, design, implementation and management of projects
Energy efficiency	Energy Efficiency Promotion Centre	Promotion	Industrial	<ul style="list-style-type: none"> Serves as a convenient one-stop centre for providing industrial energy efficiency related resources. Companies may contact EEPC for assistance on the mandatory energy management requirements under the Energy Conservation Act, energy efficiency investments, information on energy efficiency measures, available incentives, energy efficiency training, or to link up with knowledge partners
Energy efficiency	Mandatory Energy Labelling (MELS) and Minimum Energy Performance Standards (MEPS)	Regulation	Household	<ul style="list-style-type: none"> MELS was introduced for regulated goods to help consumers compare the energy efficiency and make more informed purchasing decisions MEPS aims to raise the average energy efficiency of regulated goods in the market They help to improve the energy efficiency of a range of household appliances. By switching to more efficient models with better energy efficiency ratings, households can consume less energy, save money on their electrical bills, and help to reduce carbon emissions
Energy efficiency	Climate-Friendly Households Programme	Incentives / Grants	Household	<ul style="list-style-type: none"> CFH Programme is a joint effort by NEA and PUB which aims to encourage households to take on climate-friendly action as individuals to reduce energy and water consumption, while saving costs in the long run All smaller sized public housing (1-, 2-, 3-room HDB flats) will be provided with vouchers to offset the cost of energy and water-efficient household products

List of grants, schemes, initiatives and regulations

Sub-sector	Item	Type	Industry	Description
Energy efficiency	Guaranteed Energy Savings Performance (GESP) contracts	Regulation	Public	<ul style="list-style-type: none"> Currently, building owners carry out replacement of their equipment without considering life cycle cost, energy and cost savings maximization, and have no assurance of improved energy performance after retrofits, no accountability, and no tracking and verification of the performance of new equipment over the long term Public sector agencies are now required to adopt the GESP contracting model when undertaking chilled water plant retrofit projects, whereby an accredited Energy Services Company is engaged to: <ul style="list-style-type: none"> Carry out an energy audit and identify energy savings measures Implement the recommended energy savings measures Guarantee the chilled water plant or air-conditioning system efficiency, and the annual energy savings from the implementation of other energy savings measures over the contract term (i.e. typically 5 years) Provide comprehensive maintenance to the retrofitted equipment during the contract term
Energy efficiency	Building Retrofit Energy Efficiency Financing (BREEF) Scheme	Incentives / Grants	Building	<ul style="list-style-type: none"> The BREEF scheme, facilitated by BCA and participating financial institutions, offer financing to pay the upfront costs of energy retrofits of existing buildings, through an energy performance contract arrangement. BREEF can cover the cost of equipment, installation and professional fees. The maximum loan quantum is up to \$4 million or 90% of costs, whichever is lower
Energy efficiency	Built Environment Transformation Gross Floor Area Incentive Scheme	Incentives / Grants	Building	<ul style="list-style-type: none"> The Built Environment Transformation Gross Floor Area (BE Transformation GFA) Incentive Scheme ("Scheme") aims to encourage greater adoption of enhanced Construction Industry Transformation Map (ITM) standards in areas of digitalisation, productivity and sustainability ("ITM Outcome Requirements") in private sector developments. Under the Scheme, developers/building owners can enjoy up to 3% additional GFA allowed beyond the Master Plan Gross Plot Ratio (GPR) for delivering the stipulated ITM Outcome Requirements in their building development on private sites of at least 5,000sqm GFA.
Energy efficiency	Green Mark Incentive Scheme for Existing Buildings 2.0 (GMIS-EB 2.0)	Incentives / Grants	Building	<ul style="list-style-type: none"> As part of the Singapore Green Building Masterplan, BCA introduced the \$63-million Green Mark Incentive Scheme for Existing Buildings 2.0 ("GMIS-EB 2.0" or "Scheme"), with the objective to raise the energy performance of existing buildings and step up the pace to green 80% of Singapore's buildings by 2030 The Scheme will provide grant support to building owners on their goals to attain higher energy performance by lowering the upfront capital costs for energy efficiency retrofits and improve the returns on investment, particularly for buildings meeting Super Low Energy or Zero Energy standards

List of grants, schemes, initiatives and regulations

Sub-sector	Item	Type	Industry	Description
Energy efficiency	Mandatory Submission of Periodic Energy Audits	Regulation	Building	<ul style="list-style-type: none"> Periodic energy audits are required to ensure that cooling systems continue to operate efficiently throughout a building's lifespan, allowing building owners to continuously reap energy saving benefits The following buildings are applicable: <ul style="list-style-type: none"> New buildings whose application for planning permission is submitted on or after 1 December 2010 Existing buildings that have undergone a major energy-use change on or after 2 January 2014 and are required to meet the prescribed Green Mark standard for existing building
Energy efficiency	SolarNova	Initiative	Building	<ul style="list-style-type: none"> Whole-of-government effort to accelerate the deployment of solar PV systems in Singapore, particularly on top of public housing blocks The programme will generate an estimated 420 GWh of solar energy annually, which is about 5% of Singapore's total energy consumption
Energy efficiency	Electric Vehicle Common Charger Grant	Incentives / Grants	Transport	<ul style="list-style-type: none"> The Electric Vehicle Common Charger Grant (ECCG) was launched to encourage the installation of electric vehicle (EV) chargers in non-landed private residences (NLPRs), such as condominiums and private apartments. This grant will co-fund installation costs of 2,000 EV chargers at NLPRs, as an early adoption incentive.
Waste Value Optimisation	3R Fund	Incentives / Grants	Waste	<ul style="list-style-type: none"> The 3R fund is a co-funding scheme to encourage organisations to reduce waste disposal through the implementation of waste minimisation and recycling projects. Any organisation located in Singapore can apply for the 3R fund. Participation is on a first-come, first-served basis, subject to the availability of funds. Eligibility for the funds can be reached by living up to these criteria: <ul style="list-style-type: none"> The project must result in an increase in the quantity of solid waste recycled or a reduction in the quantity of solid waste generated. The minimum tonnage eligibility is 100 tonnes reduced, reused or recycled over the whole project duration. 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. The funding level depend on quantity and type of waste reduced or recycled as well as time duration of the projects and its cost are taken into consideration.

List of grants, schemes, initiatives and regulations

Sub-sector	Item	Type	Industry	Description
Food & Plastic Waste Management	Resource Sustainability Act	Regulation	General	<ul style="list-style-type: none"> Legislation passed in 2019 that imposes obligations relating to the collection and treatment of electrical and electronic waste, and good waste; also includes requirements on packaging reporting, and regulations on producer responsibility schemes
Food & Plastic Waste Management	Eureka Eurostar Funding	Incentives / Grants	General	<ul style="list-style-type: none"> Eurostars is part of the European Partnership on Innovative SMEs. The partnership is co-funded by the European Union through Horizon Europe. Eurostars is a funding instrument that supports innovative SMEs and project partners (large companies, universities, research organisations and other types of organisations) by funding international collaborative R&D and innovation projects. By participating, organisations can access public funding for international collaborative R&D projects in all fields The project consortium must involve at least one company from Singapore and one company from another Eurostars country, independent from each other. Each project partner should contribute no more than 70% of the total project contribution. The consortium must cooperate on a new product, process, or solution that can be rapidly commercialised in global markets with a civilian purpose Under this programme, Enterprise Singapore will support up to 70% of the Singaporean company's total qualifying project costs
General	Carbon Tax	Regulation	General	<ul style="list-style-type: none"> Singapore implemented a carbon tax, the first carbon pricing scheme in Southeast Asia, on 1 January 2019. The carbon tax provides a broad-based price signal to encourage companies to reduce their emissions, yet gives them the flexibility to take action where it makes the most economic sense. The carbon tax level is set at S\$5/tCO_{2e} in the first instance from 2019 to 2023, to provide a transitional period to give emitters time to adjust. The carbon tax will be raised to \$25/tCO_{2e} in 2024 and 2025, and \$45/tCO_{2e} in 2026 and 2027, with a view to reaching \$50-80/tCO_{2e} by 2030. This will provide a strong price signal and impetus for businesses and individuals to reduce their carbon footprint in line with national climate goals.
General	Use of International Carbon Credits	Regulation	General	<ul style="list-style-type: none"> As announced at Budget 2022, companies may also surrender high quality international carbon credits to offset up to 5% of their taxable emissions from 2024. This will cushion the impact for companies that are able to source for credible carbon credits in a cost-effective manner. This will also help to create local demand for high-quality carbon credits and catalyse the development of well-functioning and regulated carbon markets.

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The 3 focus subsectors provide exciting business opportunities for Nordic companies in Singapore



Energy Efficiency

- The reduction of carbon emissions through efficient energy consumption is seen as the key driver for Singapore's energy efficiency approach, with carbon taxes set to increase, increasing business needs to lower carbon emissions
- Singapore's resource constraints have seen solar energy emerging as a key renewable source of energy in Singapore
- The SG Green Plan 2030 and other initiatives have encouraged companies to explore and invest in energy-efficient technologies, providing business opportunities for Nordic companies

Waste Value Optimisation

- Singapore's waste streams have an estimated market potential of S\$0.6 – 4 billion in material value alone
- The Zero Waste Masterplan is the main driver and it was formed as a result of a lack of future capacity of Singapore's only landfill
- There is no lack of potential raw materials for recyclers and upcyclers in Singapore, the challenge is the avoid contamination of the materials to effectively separate and clean the waste

Food and Packaging Waste Management

- Food waste recycling market is estimated to garner a revenue of S\$44.0mil by the end of 2030, growing at a CAGR of 5.8%
- Growing population, coupled with the lack of food waste recycling infrastructure (e.g. recycling facilities) have led to the growing food waste
- The Resource Sustainability Roadmap provides a blueprint for sustainability efforts in Singapore and helps to promote resource sustainability



Key Insights



Business Opportunities

- Green buildings
- Renewable energy
- Smart grids
- Carbon emissions reduction

- Sorting waste
- Cleaning waste
- Processing of waste into suitable raw materials

- Reducing, reusing, recycling, and upcycling food waste, waste water, and packaging