

SEAS White Paper 2019

Accelerating Singapore's
Decarbonization Efforts



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01 / INTRODUCTION

SEAS White Paper 2019
Accelerating Singapore's Decarbonization Efforts

Introduction

The purpose of this white paper is to identify key opportunities for Singapore to accelerate its decarbonization efforts across the energy value and supply chain.

The paper does not attempt to review the technology roadmap already developed by the government, nor address the suitable level of carbon tax within the stipulated period i.e., until 2030.

The paper is anchored around insights arising from an industry decarbonization survey conducted by SEAS which received 92 respondents comprising of senior and middle management as well as support staff from multinational corporations (MNC), large local enterprises (LLE) and small and medium enterprises (SME).
(See Annex 1)

The paper also reviewed Singapore's climate action plan with respect to other countries especially South East Asia (See Annex 2), The European Commission's Circular Economy action plan (See Annex 3), Article 6 of the Paris Agreement and connected carbon markets (See Annex 4).

On-going decarbonisation government initiatives

As a small low-lying city, Singapore is especially vulnerable to the effects of climate change, such as rising sea levels, changing rainfall patterns and rising temperatures. Therefore, the National Climate Change Secretariat (NCCS) launched a public consultation on measures that can be taken to contribute towards Singapore's long-term low carbon emissions strategy. The consultation focuses on measures that the Government, businesses, households and individuals can take.

Key Areas include:

- 1** The need to improve energy efficiency
- 2** Carbon pricing and offset strategies
- 3** Reducing emissions and utilising excess energy produced from power generation and other major industrial scale emitters
- 4** Tapping into alternative energy sources by utilising low-carbon technologies.

The long-term low emissions strategy builds on Singapore's on-going efforts to achieve its pledge under the Paris Agreement. Singapore has committed under the agreement to reduce its emissions intensity by 36 percent from 2005 levels by 2030 and stabilize emissions with the aim of peaking around 2030.

Singapore's energy strategy consists of six major components:

- 1** Promote increased competitiveness in Energy Markets
- 2** Appropriately diversify energy supply to ensure sustainable security of domestic energy supply
- 3** Improve Energy Efficiency
- 4** Continue to develop the Energy Industry based on up to date clean energy technologies where viable to do so and Invest in Energy R&D
- 5** Step Up International Cooperation
- 6** Develop Whole-of-Government Approach with the intent of ensuring that energy needs are met taking all aspects of government into account.

The Singapore Government has also pledged to reduce emissions by 16 percent below its business-as-usual levels by 2020. Therefore, it has recently rolled out a series of initiatives to assist industry to reduce carbon emissions and become more energy efficient in the form of enhanced energy efficiency grants. The grants are anticipated to increasingly kick in as Carbon Tax takes full effect. The Carbon Tax starting at \$3.67/GHG tonne (SG\$5/GHG tonne) will impact industry players that collectively account for 80 percent of national emissions. The Government is preparing to spend more than S\$1 billion in the first five years to support projects that reduce carbon emissions.

The manufacturing sector will also benefit from improved EDB and NEA grants. Under EDB's Resource Efficiency Grant for Energy and NEA's Energy Efficiency Fund, funding for energy-efficient technologies will be increased from 30 to 50 per cent of qualifying costs, which include manpower, equipment and technology fees.

Companies that achieve higher reductions will get more funding, while SMEs and companies that make early efforts to be energy efficient may also receive higher grants.

Industry Decarbonization Survey Findings – Overview and Summary

Key insights from the survey some of which will be addressed within this paper are:

- 1** Majority of the respondents felt decarbonization was important. However, respondents from LLEs and middle management across the board were more muted in their advocacy for the need of decarbonization within their organization. (Survey question 4)

- 2** A low response was registered across the board in terms of additional actions their organization could take towards decarbonization. This suggests that either much has been done or there is a lack of desire or knowledge as to what else can be achieved within their organization. (Survey question 5)

- 3** There was an overwhelming consensus that “**new energy efficiency initiative for equipment and processes**” as well as for the “**installation of smart monitoring and control systems**” would be pertinent to increasing operational energy efficiency. (Survey question 6). This suggests that the promotion of energy efficiency and digitalisation under the respective narratives articulated as part of the Singapore Sustainability Blueprint and Smart Nation has gained traction.

- 4** “**Changing consumption behaviour of the organisation and employees**” is considered a strong driver for increasing energy efficiency, which was echoed across all respondents which also agreed that “**Key Performance Indicators**” (KPI) is an important enabler for decarbonisation. (Survey question 7)

- 5** However, the opportunities around “**green procurement**” was not overwhelming but significantly higher when compared to other options like international credits and adoption of carbon instruments. This could be due to the lack of domestic systems in place to leverage of such decarbonization initiatives. (Survey question 7)

6 **Solar PV installation, waste heat recovery and electric vehicles** were the top three relevant opportunities for alternative fuels. (Survey question 8).

7 The **perception of higher cost of goods and services** is identified as the key barrier to organisations adopting green procurement practices. This is consistent across the board. (Survey question 9)

8 For MNCs, the **lack of consumer demand and legislative drivers and standards** were considered more influential than corporate demand and established green accounting systems. Whilst for SMEs, consumer and corporate demand as well as established accounting systems were more of a concern. The LLEs considered all three influences with similar importance. (Survey question 9)

9 The perception of higher costs of solar systems is still a key barrier to scaling up solar energy in Singapore, despite having achieved grid parity in Singapore. Other areas of concern are “**sustainability of supplier business**”, “**willingness to enter long term PPAs**” and “**lack of manpower and skills**”. (Survey question 10)

10 The perception of “**low return on investment**”, “**lack of awareness of the available opportunities**” and “**government grant processes not streamlined**” are the top 3 barriers to adopting energy efficiency. (Survey question 11)

11 **Consumer's lack of knowledge, poor availability** and **lack of an established distribution network** are the main barriers to adopting biofuels in Singapore. (Survey question 12)

In summary, the survey's **three key messages** are,

1 Decarbonisation is considered important to the industry reflecting the good traction from ongoing initiatives by the government and internal corporate strategies.

2 We need to increase the level of communication and training around the techno-economic case for the deployment of low carbon technologies and enhance decarbonisation related services to assist efforts and aspirations of the industry

3 There are untapped opportunities to push decarbonisation using non-technology base levers to deliver greater and faster impact.

Therefore, taking into consideration of the survey results cognizant of on-going efforts by the government and the above-mentioned reviews, this white paper focused on **three recommendations that will have a positive ripple effect across the low carbon economy ecosystem** and the decarbonization efforts in Singapore.

These three key recommendations are:

A. Close the gaps within Singapore's low carbon economy ecosystem

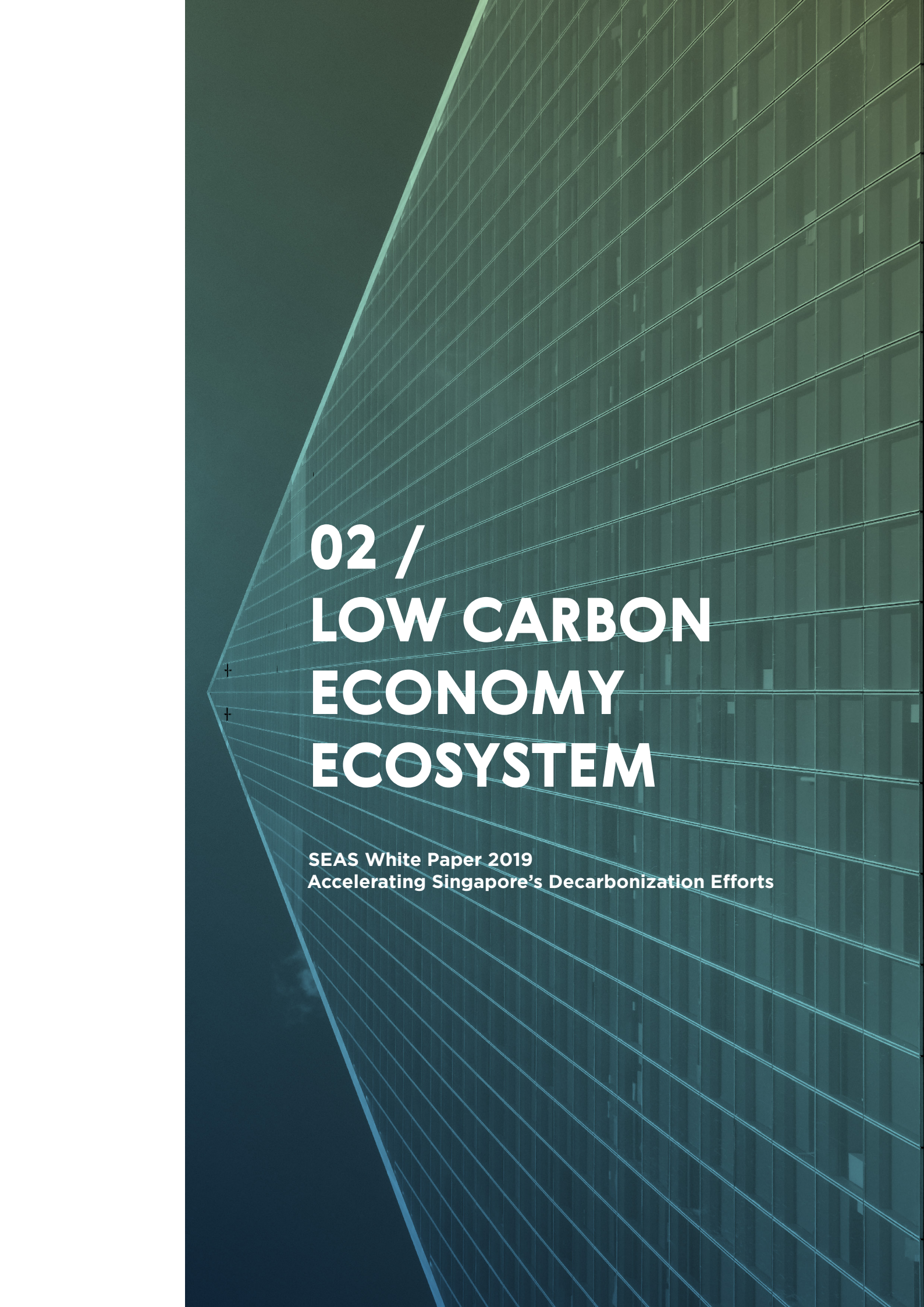
Note: We recognise that government agencies responsible for national policies, standards and guidelines are part of the low carbon economy ecosystem, we have not critically addressed current National policies, standards and guidelines in this paper.

B. Establish green procurement framework and practices

Note: We have focussed on Green procurement as a key enabler of the Circular Economy which is a much larger approach towards achieving resource efficiency

C. Strategically Position Singapore as a Regional Carbon Asset Finance & Management Hub

Note: We have primarily focused on accelerating decarbonisation using the market mechanisms described under Article 6 of the Paris Agreement to achieve emission reductions. While we understand that a hybrid of carbon taxation and domestic and regional ETS mechanisms through cap and trade are also measures to achieve emission reductions, we want to highlight the greater and inclusive opportunities of a wider and global connected carbon market that will grow the resilience of the Singapore economy in the face of a growing climate change crisis.



02 / LOW CARBON ECONOMY ECOSYSTEM

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A. Close the gaps within Singapore's low carbon economy ecosystem

Contributing to about 0.11 percent of global emissions, Singapore is not considered to be a large emissions country. Singapore's strategic switch in the 2000s from fuel oil to natural gas, a 'cleaner' alternative, has contributed to its relatively low emission rates albeit in 2012 Singapore's first coal-burning utility plant started operations, which not only sent confusing signals to the public but set our decarbonization efforts backwards.

Furthermore, courtesy of its strategic position in the intersection of global trade routes and attractive business environment, Singapore has become home to many multinational oil storage and refining facilities which have chosen to set up their regional headquarters here.

This **business supply network** includes petrochemical plants and is a significant source of Singapore's carbon emissions:

More than **95%** of **Singapore's greenhouse gas is carbon dioxide (CO₂)**. This is generated primarily from burning fossil fuels to power up industry, building, household and transport sectors.

The remaining percentages are made up of gases such as **methane**, **perfluorocarbons** and **nitrous oxide**.

A low-carbon economy, or decarbonized economy, is one that is based on low carbon power sources that generate greenhouse gas emissions at low or zero levels. Since the Paris Agreement was adopted in December 2015, almost 190 countries have submitted their Nationally Determined Contributions (NDCs) on national climate change solutions, including transiting to renewable energy, building low-carbon cities and increasing energy efficiency.

The returns potential of the low-carbon economy model is staggeringly high. According to the 2015 International Finance Corporation (IFC) report, more than \$23 trillion (about SG\$31 trillion) of climate investment opportunities will be available from now till 2030.

Therefore, to capture the potential economic value, **we need to ensure that Singapore's low carbon economy ecosystem is not only comprehensive but of high quality that will be able to capture economic value both domestically and abroad.**

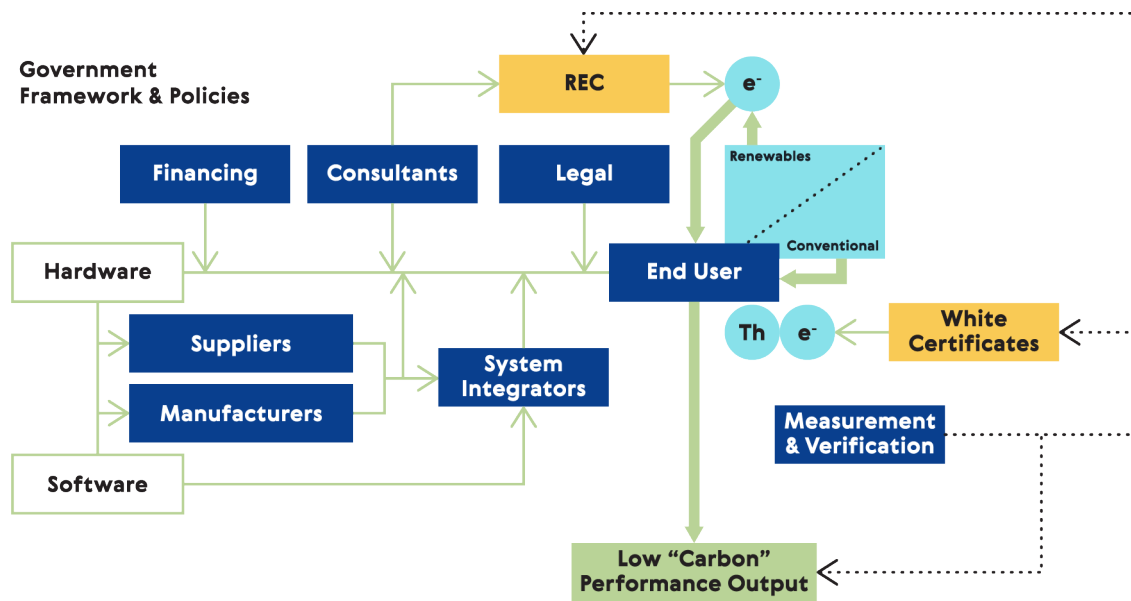


Figure 1: Structure of **Singapore's low carbon economy ecosystem**

Figure 1 attempts to illustrate the **key components of the low carbon economy system in Singapore**. This ecosystem is essentially made up of low carbon technology (LCT) providers (Hardware and Software) who are either suppliers, manufacturers or system integrators that sell these LCTs to end users who are supported by financing, consulting and legal service providers to assure the adoption of the LCT will deliver the desired impact.

Measurement and verification providers help track and verify the performance output of the LCT which can both validate the investment for the end user stakeholders and also provide a means to potentially leverage environmental attributes e.g., Renewable Energy and White certificates to enhance the returns of the LCT investments. Carbon Credits can also be produced to generate additional revenue streams via international frameworks such as the Clean Development Mechanism (CDM) or the Verified Carbon Standard (VCS). This ecosystem operates within the boundaries set by the government framework of policies.

However, our ecosystem still has gaps to be comprehensively effective and efficient. These areas of greater potential in Singapore's low-carbon economy have been identified in Table 1 below. Gaps in this ecosystem can be closed by especially focusing on local capacity building. Attracting specific foreign capabilities to enhance this experience is also desirable based on lessons learnt from previously-designed carbon markets as well as new initiatives designed since 2016. This will strengthen Singapore's ability to deliver its NDC goals and expedite even more ambitious goals that, in a leadership role, may influence other countries to update their initial NDCs submitted prior to the ratification of the Paris Agreement. In this manner, critical consensus can be made through sustainability initiatives that also drive short-to-long term economic growth.

Table 1:
Recommendations to address gaps within Singapore's low carbon economy ecosystem

Low-Carbon Economy Areas of Potential	Strengths	Weaknesses	Recommendations
Hardware Manufacturers		Lack of hardware manufacturers	Continue to encourage international technology suppliers that compiles to high energy efficiency standards or low carbon technology to establish either in partnership with SMEs and LLEs or as a local entity
Hardware Suppliers		There are no minimum energy efficiency standards for Industrial hardware	Minimum energy performance standards or labels for industrial hardware
Software Companies	Flourishing sector with many established companies and startups	Not enough companies with the capability to handle large scale integrated projects	Government should open up more district-level integrated projects Develop more capabilities locally, to handle scale complexity.
System Integrators	Range from design thinking to Implementation.	Lack of system-level design and execution Lack of market demand	Incentivise and promote system-level design and execution Stimulate market demand with policy interventions

Low-Carbon Economy Areas of Potential	Strengths	Weaknesses	Recommendations
Financing	Singapore is an established financial hub	Enable access to smaller funding size from finance companies Lack of expertise in green financing products Low level of understanding of green project financing by banks	Frameworks setting out market terms and standards for green finance. Tax incentives for green financing Match term loans to the maturity of the green projects
Energy Consultants		Limited expertise and consultants in energy efficiency for manufacturing sector	Incentives for specialist experts and consultants to conduct industry level training & consultancy
Legal Services	Strong legal community and judicial system	Lack of demand for legal services in the space	
Measurements & Verification (M&V)		Lack of quality and quantity of M&Vs evaluating outcomes from LCT deployment M&Vs overly complicated	To develop simpler M&V and Reporting processes using effective guidelines and standards.

Low-Carbon Economy Areas of Potential	Benefits	Weaknesses	Recommendations
Renewable Energy Certificates (REC)*	Allows non-building owners and even apartment-dwelling residents the ability to purchase clean energy Allows for tracking and accountability of the de-carbonisation of the grid	Lack of credible Renewable Energy Certificates	More awareness raising Standards to ensure the originality and quality of RECs Encourage and boost liquidity in REC trading through incentives and a cap and trade market system Blended finance (See Annex 5)
White Certificates	Allows for large scale building energy efficiency projects with more than 8600 high rise buildings in Singapore	Lack of awareness of white certificates Lack of issuing and regulatory authorities Lack of a trading platform White Certificates only traded in Europe, and not Asia	More awareness raising Standards to ensure the originality and quality of White Certificate Set up White Certificate trading Develop a cap and trade market combining REC, White Certificate and Carbon trading

*see Annex 5 for more information on what RECs, White certificates, Carbon offsets and Green financing.



03 / GREEN PROCUREMENT

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B. Establish green procurement framework and practices

Singapore is highly dependent on others for its basic needs - water, food and energy and this dependence, together with associated risks, lies at the heart of domestic political narrative today. Climate resilience and the added constraints that this now brings in terms of use of conventional technologies to satisfy these basic needs has in recent years added a new and more complex dimension to this dialogue. The city-state has laid out ambitious plans to produce more of its own food, have greater water security, and build a circular economy to reduce waste.

It is important to recognise that the focus on decarbonisation, whilst clearly a core component of climate-change mitigation, is not the only objective that needs to be considered within the context of developing a clean and green growth strategy. "Resource Efficiency" should also be considered as being of vital importance. Within this context, there is a need to recognise that the global supply chains that have been built up over the past century, particularly within the context of primary resource exploitation and utilisation must over time be significantly modified in the light of advances in technology and technological capability. To achieve this, producers of resources themselves must also be held more accountable for creating more resource-efficient solutions

The traditional economy is a linear one in which the cycle includes: making, using then disposing. The alternative model is a circular economy in which resources are kept in the economy for as long as possible and at the end of their service life recovered and regenerated for extended use. (See Annex 3)

The zero-waste circular economy advocates for everything produced and consumed to be produced and consumed in such a way that they can be returned to nature without negative consequences, such as plastic waste staying in the environment indefinitely or be recycled or reused.

Singapore has endeavoured to create a positive pathway towards the development of cleaner, greener and resource-efficient utilization of consumables. However, little action has been taken to change consumption behaviour at the organization and consumer level in the Government's move toward creating a more resource efficient community through increasing enforcement of Circular Economy principles.

Singapore's successful track record of dealing with waste and product/commodity recycling needs to be extended to paper, plastic, textile, food and non-ferrous material wastes. It will require a more proactive approach with consumers with the objective of creating greater resource efficiency and the pursuit of future recycling technologies that may assist in improving recycling rates.

Key focus is given to raw materials being produced from virgin resources, and the value bound in them, being kept in 'circulation' for as long as possible based on **five core principles**:

1 Preventing the generation of waste by means of planning to improve the material efficiency of products, production processes and services, designing products to be re-used, refurbished, re-manufactured and recycled; e.g. focusing on usage and service orientation instead of ownership,

2 Extending life cycles by allowing products to be modified, repaired and updated; e.g. multiple successive life cycles for different purposes enabled by high-quality and sustainable materials

3 Where possible, utilising renewable energy and resources and minimising consumption in all stages of the design, development, production and operations chains

4 System-level thinking, i.e. examining the parts and different material streams of the system as parts of a larger whole in order to perceive the various opportunities offered by a circular economy. This requires detailed review of the operating environment and conditions by multifunctional teams within an organisation. (See Annex 3)

5 Recycling biological material streams as efficiently as possible and ultimately returning them to the nutrient cycle

These **five core principles** are summarized in the table 2 below.

Product as a Service	• Total cost of ownership is borne by producers and retailers • Leasing and paying for use • Performance over quantity, sustainability over disposal
Circular Supply Chain	• Renewable, recyclable and biodegradable materials • Successive life cycles
Life Cycle Extension	• Active maintenance of products • Repair • Upgrading • Remanufacturing • Remarketing
Sharing Platforms	• Increasing utilization of goods and resources • Renting • Sharing • Exchange
Return and Recycling	• Waste is valuable raw material • Recycling and use for other purposes • Waste-to-energy

Source: Ellen Macarthur Foundation

Green procurement can be defined as:

The process by which such organisations procure works, goods or services that seek to contribute to close energy and material loops within supply chains whilst minimising - and in the best case - avoiding, negative environmental impacts and waste creations across their whole lifecycle.

For a Green Procurement policy to be **successful**, it must:

1 Demonstrate a **commitment to environmental leadership and influence industry** and citizens to use environmentally preferable goods, services and processes within this context.

2 **Stimulate innovation and market development of, and demand for, environmentally preferred goods and services**, making them available and mainstreaming them for other sectors of society

3 **Support** emerging environmental technologies

4 Benefit the environment by clearly and **transparently contributing to environmental objectives**

5 Result in demonstrably more **environmentally responsible planning, acquisition, use and disposal practices** in the government itself

6 Encourage suppliers of products and services to government to adopt practices that **minimise their environmental impact and deliver community benefits** in relation to their own operations and throughout the supply chains in which they operate

7 **Support all broader initiatives** relating to de-carbonisation, energy efficiency and sustainability

The following **recommendations** are submitted for consideration:

1 In order to support a systemic change, the governments should create a strong policy and legislative framework as a backbone of a successful transition towards a circular economy.

A comprehensive policy and legislative framework that supports adoption of a green procurement strategy within organisations should be developed. This includes a need to both audit and report against clearly stated objectives.

Green Procurement is a principal component in developing a Circular Economy and, within this context, we believe that the Singapore Government should develop a comprehensive framework aimed at developing Green Procurement policies throughout both Public and Private sector businesses.

Such a framework will need to be developed in close liaison with all appropriate stakeholders and would probably be best served by a series of pilots together with a well organised on- going consultative framework and process.

2 Businesses should increasingly be encouraged to take a significant part in the transformation towards a circular economy and be incentivised accordingly

By moving away from unsustainable production patterns, businesses can improve the efficiency of their resource use as well as reduce their environmental pollution load and waste generated.

The Government can support this transition by establishing strategic cooperation with businesses, providing necessary funding for a transition towards more green procurement (perhaps in the form of tax credits or training grants) and/ or cost-effective access to best available enabling technologies.

In addition to the introduction of green procurement financial incentives or tax breaks, regulatory authorities should ensure that organisations regularly report on all sustainability aspects of their operations including green procurement.

It is important to recognise that, to be successful, green procurement must consider **overlapping green procurement frameworks**:

- a. **Producer/Supplier Recycling** – Emphasis placed on reinforcing responsibility for circularity upstream
- b. **Buyer Recycling** – Emphasis place on recycling by customer /consumer at end of asset/product life.

Reinforcement /recognition of green procurement is also key. This can be appropriately achieved through the introduction of product certification and labelling as well as good practice recognition.

It is recommended that a proportion of Carbon Tax revenue be allocated to communications and training in the field of green procurement. This should focus on various levels from basic to more advanced functional supervisory level and auditing activity.

3 The Government should implement strong, leading-edge green procurement policies for all public procurement by government agencies and organisations.

By setting an example and influencing a considerable share of national consumption, public procurement practices supporting circular economy development are of crucial importance. In most countries, public procurement spending constitutes a considerable share of countries' Gross Domestic Product.

Green or circular procurement practices adopted by governments can be an efficient way by creating a critical mass for goods and services to motivate suppliers to implement more sustainable approaches as well as to set an example for the private sector.

4 Promote education amongst industry and consumers

To encourage the adoption of green procurement practices, the government could promote a number of targeted communications and skills' development programs aimed at raising awareness of the circular economy principles and green procurement.

Additionally, the government should produce more practical means of such communication through product labelling and passporting systems and practices. These can have a strong multiplier effect in terms of accelerating the pace of successful adoption.

With reference to Recommendation 2 above, we believe that appropriate education / training courses should be developed and introduced within the context of future Supply Chain Management activity. Attendance could be encouraged by offering access to appropriate incentivisation through grant schemes.

Potentially these training can be tiered accordingly:

Level 1 – Day-to-day operations and supervisory

Level 2 – Management / Policy Development

Level 3 – Specialist management and auditor level

5 Strategic monitoring to support policy formulation, implementation, to track progress towards and enable the review and revision of policy measures.

A set of core objectives and associated progress indicators tabulated below in table 3:

Table 3:

Circular Economy Process	Reduce	Synergise	Supply	Manage
Materials used	- Materials life-span analysis - Environmental Impact assessment & Performance Monitoring	- Encourage design for disassembly - Analyse theoretical reusability of materials / components at an equivalent level of quality - Analyse use of secondary materials as a replacement - Analyse opportunity of re-use of materials in alternative revenue streams	- Adapt policies for circular contracting and green procurement - Certification of materials - Create policies for use and re-use of scarce / critical materials	Create "Material Passporting" systems
Adaptability and Climate Resilience	- Analyse measures taken to reduce dependence on external materials, energy and water streams - Analyse climate resilience	- Flexible, redundant and adaptive design - Opportunity for savings through mass / scaled production		Upgrade information management systems aimed at monitoring all circular components and green procurement processes
Energy Use	Measure energy intensity and measures that can be taken to increase energy efficiency	Analyse opportunity for energy recovery / re-use	- Optimise use of renewable energy - Consider "Energy Matching" with related processes / operations	Develop and monitor energy management system

Circular Economy Process	Reduce	Synergise	Supply	Manage
Water Use	Measure water intensity and measures that can be taken to increase energy efficiency	Analyse opportunity for water recovery / re-use	- Optimise use of water and use of recycling where feasible - Consider "Water Matching" with related processes / operations	Develop and monitor water management system
Waste Management	- Analyse total recoverable irrecoverable waste over time - Cost benefit analysis of the potential for improving recovery	Analyse opportunity for integrated waste management		Develop and monitor waste management system
Ecosystem & Biodiversity	Analyse embodied biodiversity impacts	Consider ecosystem effects		Monitor and report on biodiversity issues as part of overall environmental impact

Source: Deloitte + Peter Godfrey – Energy Institute



04 / POSITION SINGAPORE'S LEADERSHIP FOR CAP AND TRADE ROLE IN ASEAN

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C. Position Singapore's leadership for cap and trade role in ASEAN

Carbon markets have evolved since the adoption of the Kyoto Protocol (KP), where they are currently governed under the Paris Agreement. Rather than the top-down implementation of the Kyoto Protocol, countries under the Paris Agreement (PA) have voluntarily submitted their Nationally Determined Contributions (NDC) in order to reduce the global average temperature increase above pre-industrial level to below 2 degrees Celsius and to pursue to limit the increase to 1.5 degrees Celsius. Singapore's NDC aims to reduce emissions intensity by 36 percent from 2005 GDP levels by 2030 and stabilize emissions with the aim of peaking around 2030.

Asia Pacific region is host to nearly 44 percent of CDM project origination in the world, which is the highest portion for any one region. This reflects the potential of the region to develop, attract new emission reduction technologies, generate revenue through green finance instruments, create jobs thereby resulting in growth of the economy. Singapore must understand the importance of complementarity and homogeneity. While we wait for the Conference of Parties (COP) to provide for an international regime on the carbon market, we must be prepared to adopt the best practices of the market mechanism established under article 6 of the PA.

Our **recommendations** include:

1. Creating a flexible market mechanism for carbon assets

It is important that along with the prevailing carbon tax for an approach to be adopted whereby Singapore can trade carbon with other countries through a system of A Flexible Carbon Pricing Mechanism (F-CPM).

This system allows companies to explore other complementary approaches that would reduce the negative impact of carbon taxation, while simultaneously providing a positive impact on the environment and the economy.

A pilot cap and trade system should be established for the EITE companies that allows them to trade carbon credits among themselves in order to establish a pricing mechanism. These companies must be provided with opportunities to originate projects that are energy efficient and can generate carbon credits. Depending on the demand and supply of credits thus generated, a trading platform should be established.

Adopt standard and regulations for the carbon credits that are reliable, reputable, tradable and fungible. These standards/regulations should be developed in conjunction with NCCS, National Environment Agency (NEA), Monetary Authority of Singapore, Energy Market Authority (EMA) and any other relevant government agency, for them to be overarching and holistic.

Use advance technology such as distributed ledger technology to monitor, report and verify the credits generated.

2. Developing and promoting environmental attributes

Apart from Certified Emission Reduction (CER) and other forms of carbon credits, companies must also explore the domain of environmental attributes which are Renewable Energy Certificates. Renewable Energy Certificates (RECs) are certificates that represent 1MWh of clean energy used by a consumer.

Under this mechanism, an electricity generator registers his device with the different registry issuing the certificate, who then issues certificates based on the MW electricity produced by such device.

Many companies such as DBS Bank Ltd, Apple, Decathlon etc. have joined a group called the RE100 Companies who have vowed to use only renewable electricity. As the awareness on mitigation actions is increasing, more companies are joining this elite group of companies, thereby increasing the demand for instruments like RECs.

The standard /regulation for RECs should conform to those established for carbon credits.

3. Creating a market for green instruments and green finance

Develop a monetary system that backs reliable, reputable and tradable instruments.

Organise and develop a fund that provides monetary support to carbon trading, such as finance for project origination, monitoring and verification of carbon credits, sourcing and developing energy efficient technology etc.

Formulate structures for the flow of funds to EITE companies and trading of credits among such companies.

Encourage and provide specific guidelines for carbon financing, green financing, green bonds etc.

Promote tradable instruments such as carbon credits and RECs among government agencies, companies, organisations and individuals.

4. Proposing for an ASEAN wide cap and trade system after establishing proof of concept in Singapore.

Singapore should position itself as a leader in ASEAN for a cap and trade system after establishing as proof of concept from the national pilot programme between the EITE companies.

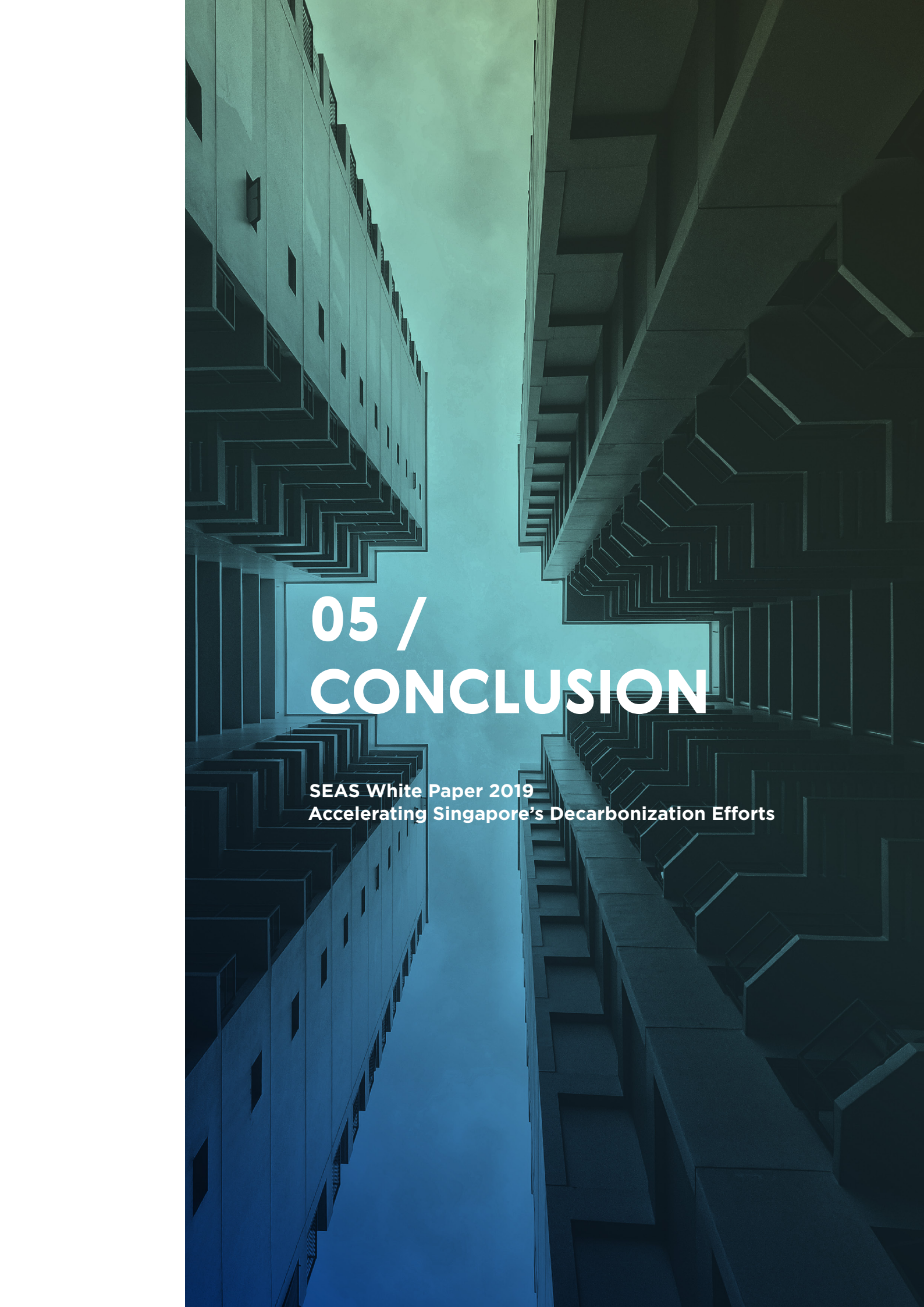
Singapore is the first ASEAN country to put a price on carbon, setting an example for other countries in the region. A structure where governments, businesses, individuals etc. can monetize from the trade of carbon should also be established. Developing an open trade policy and strategy to monetize on carbon and carbon assets will help Singapore attract foreign capital and green finance opportunities.

As seen in the section on the low carbon ecosystem, Singapore also has many of the components to develop a carbon trading hub. Whilst there is room for improvement, it has some of the best global accounting and legal firms along with the top MNC's who are standing strong on their environmental commitments. Singapore also has the technological advancement and platforms such as innovative labs required to support the growth of distributed ledger technology which has gained momentum in the path to de-carbonisation.

Looking forward,

Studies conducted by the International Emissions Trading Association and co-sponsored by Carbon Pricing Leadership Coalition, state that international cooperation under a well-functioning Article 6 of the Paris Agreement could save as much as \$250 billion per year by 2030. Reinvesting these savings in further emissions reductions could increase the potential for overall global reduction in greenhouse gasses by around 5 billion tonnes a year in 2030.

These outcomes rely on the adoption of a clear and transparent set of rules for international emissions trading on one side and on the inclusion of the use of Article 6 in countries Nationally Determined Contributions (NDCs). In this context, there is a great deal to look forward to from the Conference of Parties (COP25) in Santiago, Chile, in December 2019.



05 / CONCLUSION

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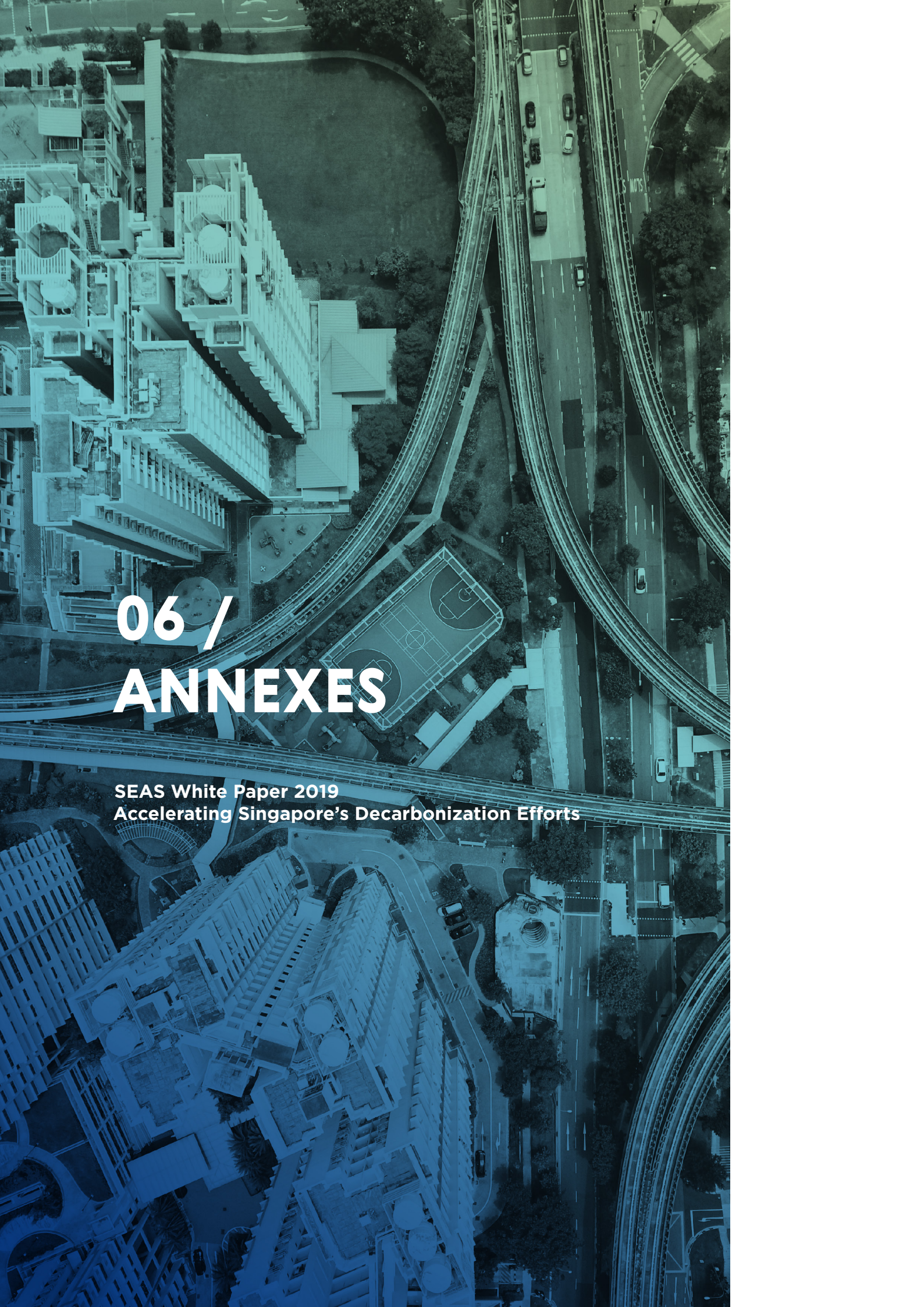
Final word

It is apparent that a collective collaborative effort across the ecosystem including the government is required to address the challenges brought about by anthropogenic climate change. Having a comprehensive vibrant, engaged and competent low carbon economy ecosystem is key to keep the momentum on decarbonisation in Singapore.

Whilst a fully functional Circular Economy is the ultimate expression of a resource efficient economy, green procurement is a major enabler towards attaining that goal. To that end public agencies can serve as lead demand to define the rules of engagement and spur prolific adoption of the practice.

Finally, monetising decarbonisation efforts by leveraging various financial instruments within and beyond the shores of Singapore will stimulate a collaborative global community to collectively address the impacts arising from climate change. These efforts working together will accelerate Singapore decarbonisation efforts building on the good work thus far.

We must continue to educate and build the ecosystem, communicate factually and dedicate our resources to address this existential threat; but we must journey together so we can journey far and we must have the courage to push forward ideas by leveraging our strengths and resolving our weaknesses and differences.

An aerial photograph of a city landscape, featuring a multi-lane highway interchange with several vehicles. To the left of the highway is a large, modern residential building with a complex, stepped design. Below the highway, there is a rectangular sports field with visible court markings. The foreground shows more residential buildings and greenery. The entire image has a blue tint.

06 / ANNEXES

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ANNEX 1

SUMMARY

Total Respondents: 92

No. of MNCs: 44 (6 support level, 31 middle mgmt, 7 senior mgmt)

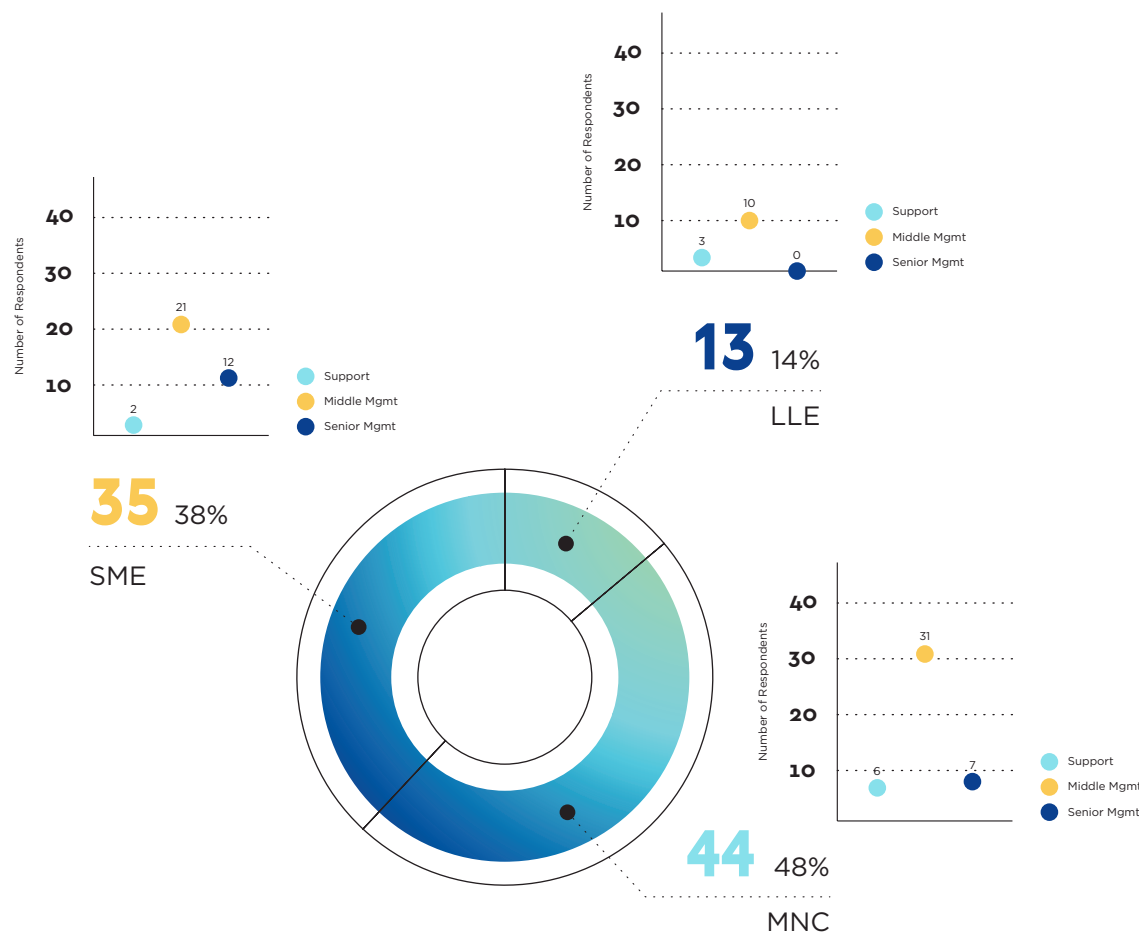
No. of SMEs: 35 (2 support level, 21 middle mgmt, 12 senior mgmt)

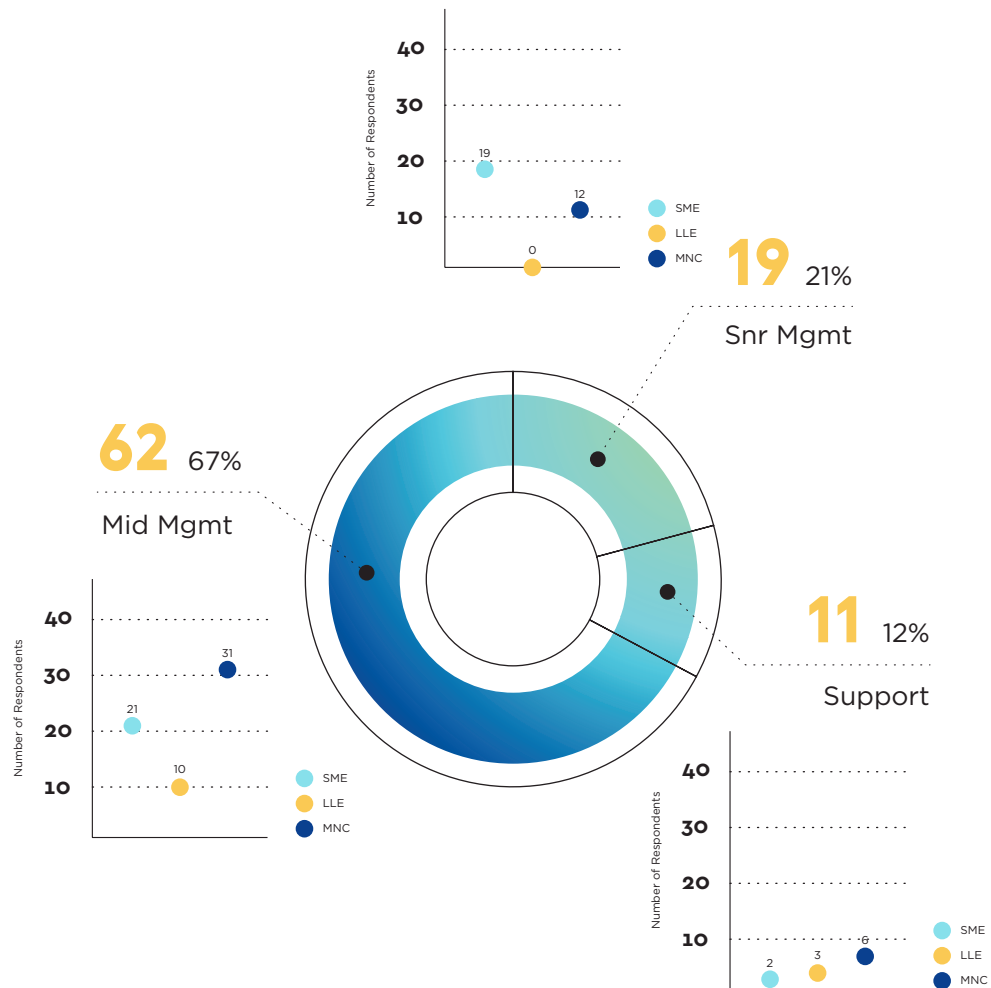
No. of LLEs: 13 (3 support level, 10 middle mgmt, 0 senior mgmt)

INDUSTRY SURVEY FINDINGS

Interpretation of results:
Questions with rating outputs i.e., “least to most”, scores of 4 and 5 are considered as favourable where 3 and below are unfavourable

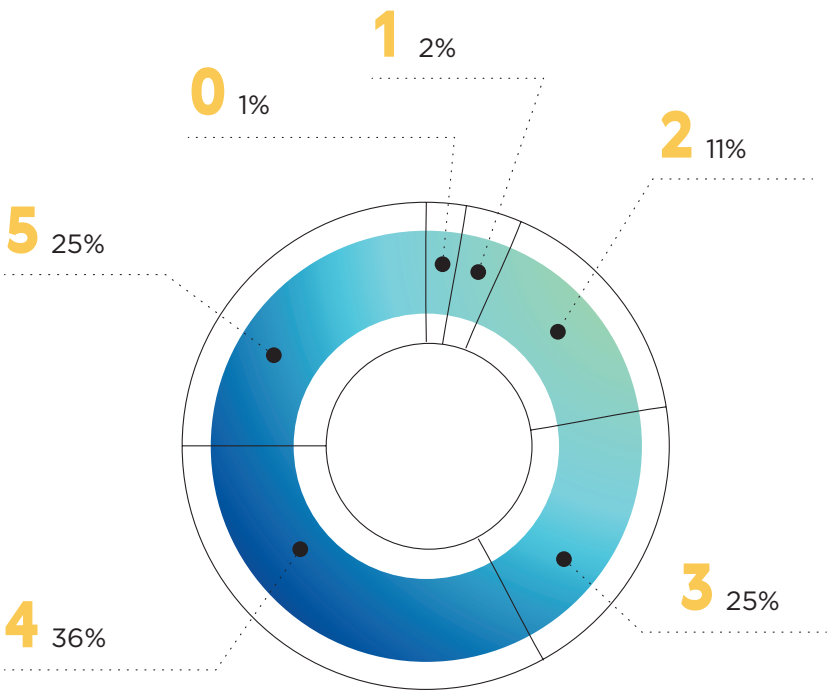
Questions with votes on suggested options, aggregated responses of above 60% is considered strongly supported and differences between categories of more than 10% as significant.

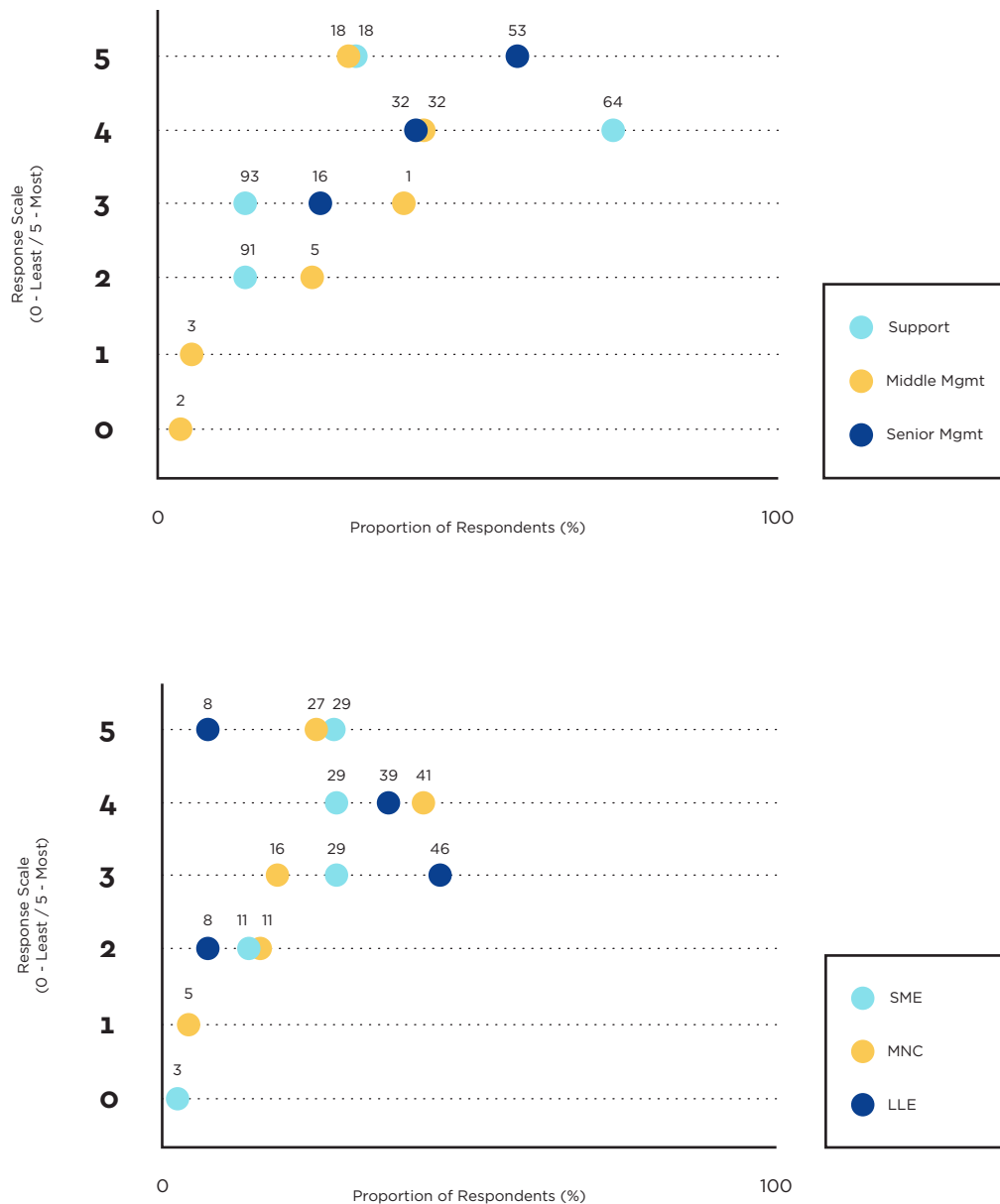




Question 4 Responses

How important do you think decarbonisation is to your organisation?

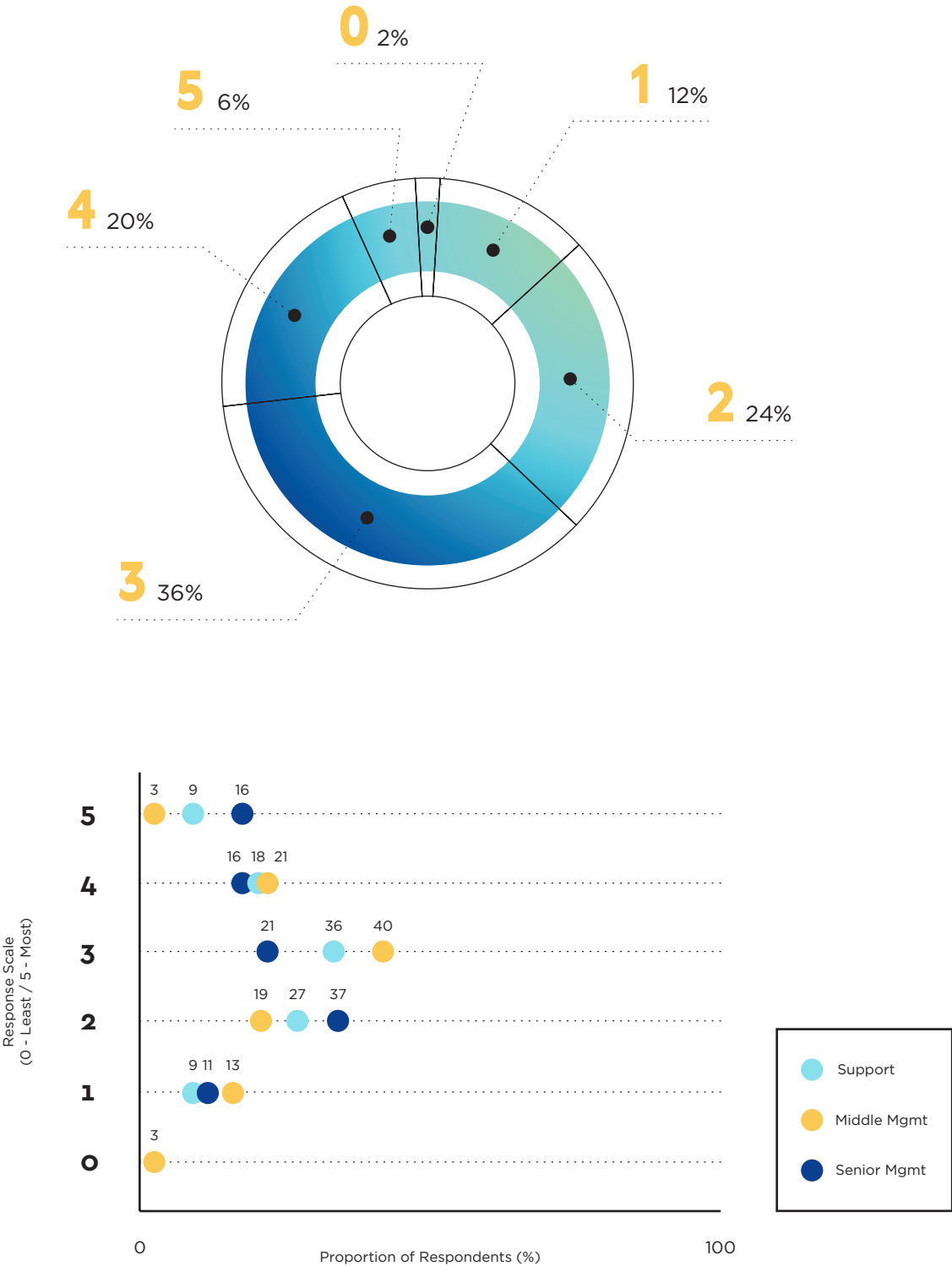


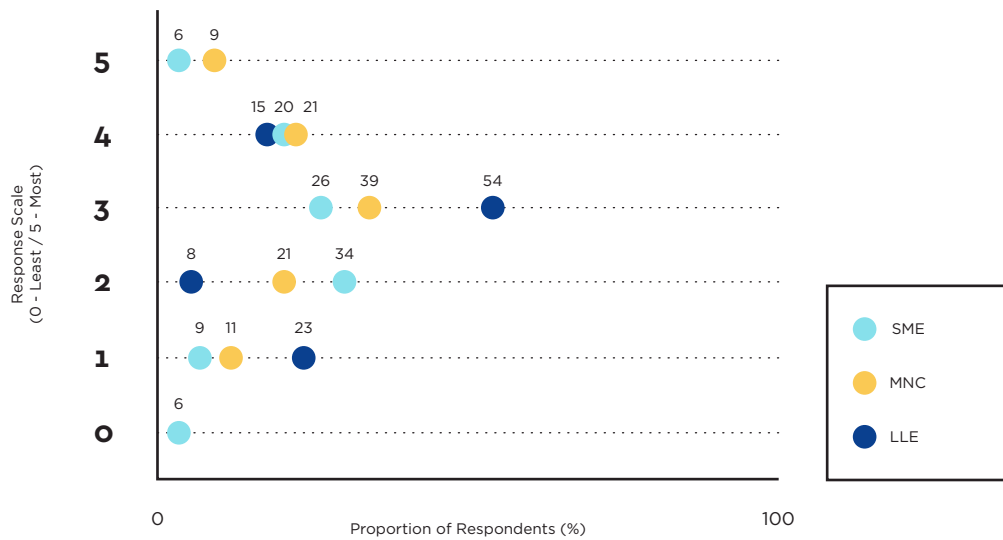


60.9% of total respondents felt that decarbonisation was important. This high response rate was seen across SME (57.2%), MNC (68.2%) whilst LLE were relatively more muted in the need for decarbonisation (46%). It is also interesting to note that the middle management (50%) was most lukewarm to decarbonisation versus support staff (71.8%) and Senior management (84.2%)

Question 5 Responses

How much more decarbonised do you think your organisation could be?





47.3% of senior management was quite certain there was limited opportunity compared to 35.5% from middle management and 36.4% from support staff.

However only 26.1% of total respondents felt more could be done within their own organisation. This is consistent across the board i.e. SME (25.7%), LLE (15.4%) and MNC (29.6%).

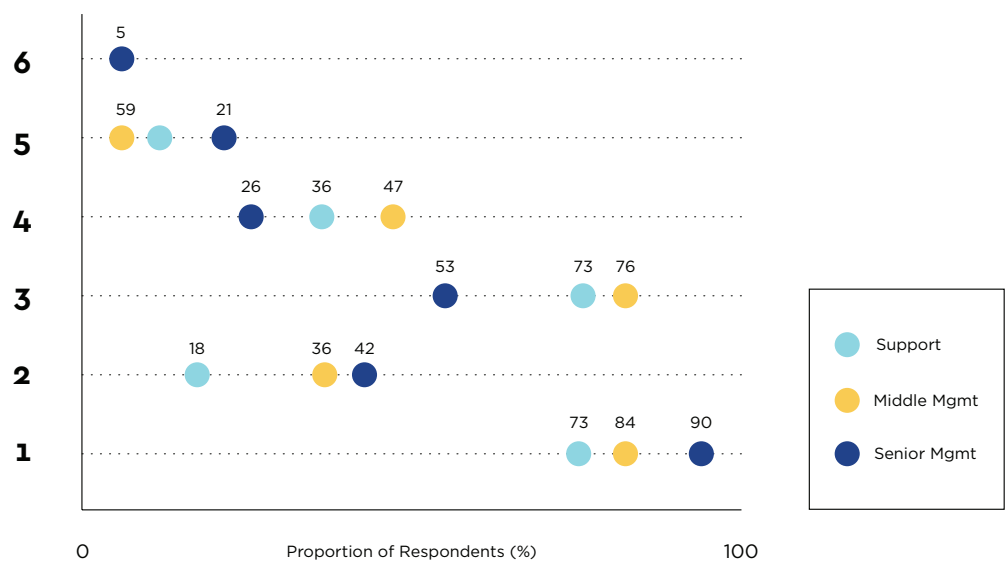
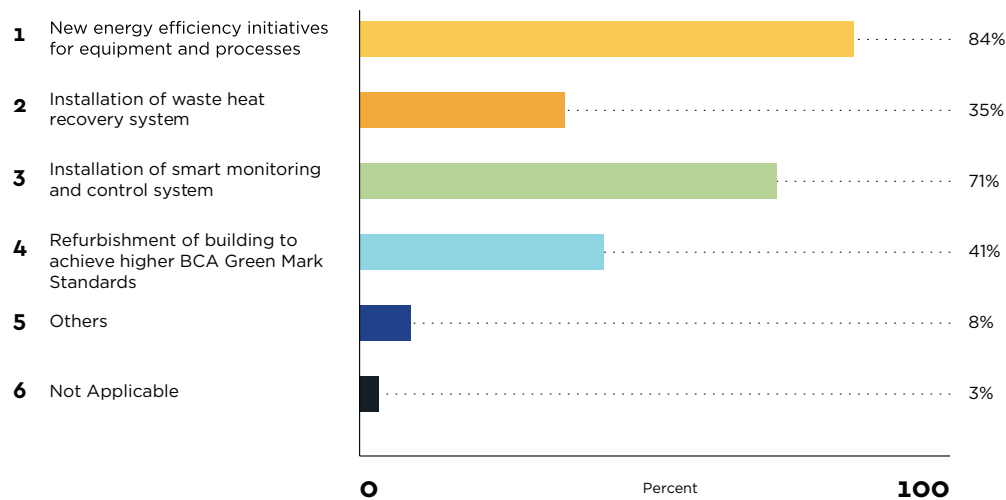
This could either mean that much effort has already been done to decarbonise, noting the importance, and not much more can be done based on their operations.

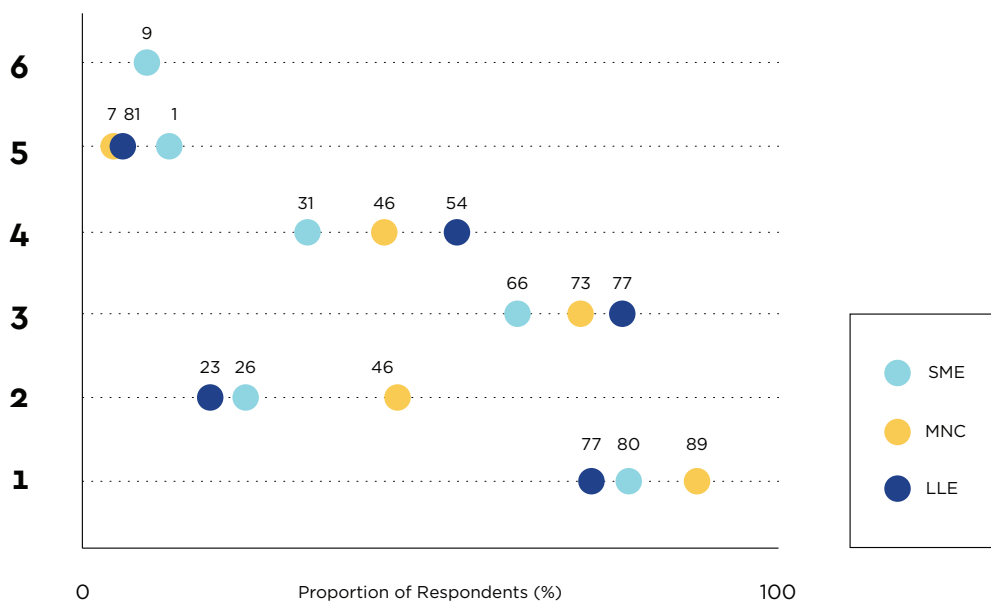
It is also interesting to note that 38.1% was uncertain by scoring a 0 or 3 for this question. This was also true across the different companies groups with SME at 31.7.3%, LLE at 53.8% and MNC at 38.6%.

However, at the organisational level the uncertainty was less so amongst the Senior Management with 21.1% versus support level at 36.4% and middle managers at 43.5%

Question 6 Responses

Which of the following initiative(s) do you think is/are relevant to your organization in increasing energy efficiency in its operations? Check all that are applicable.





1	New energy efficiency initiatives for equipment & processes
2	Installation of waste heat recovery systems
3	Installation of smart monitoring and control system
4	Refurbishment of building to achieve higher BCA Green Mark standards
5	Others
6	Not applicable

There was an overwhelming (i.e., 83.7%) consensus that “new energy efficiency initiatives for equipment and processes” as well as (i.e., 70.7%) for the “installation of smart monitoring and control systems” would be pertinent to increasing operational energy efficiency.

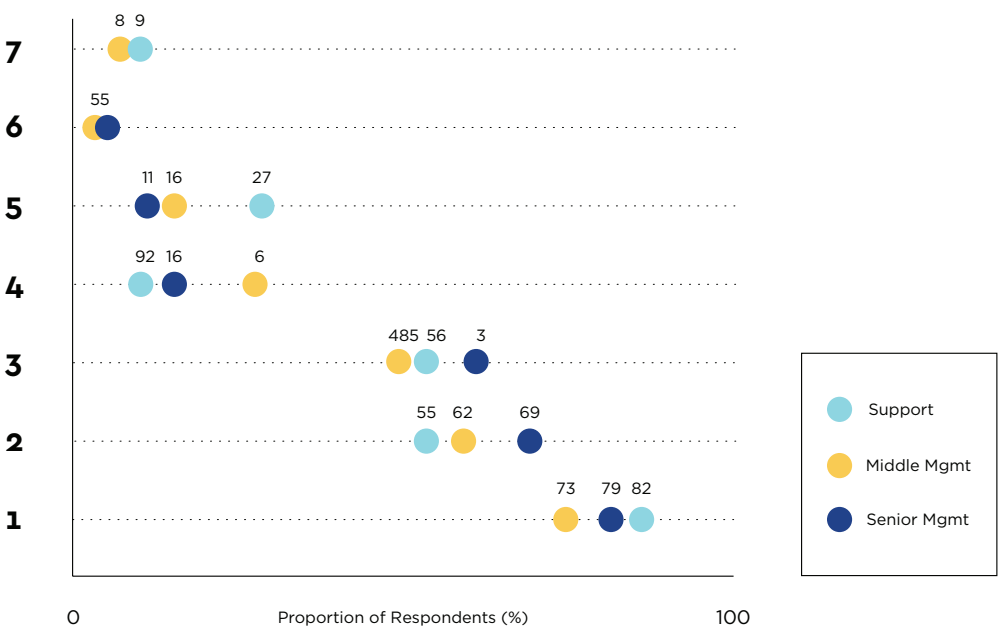
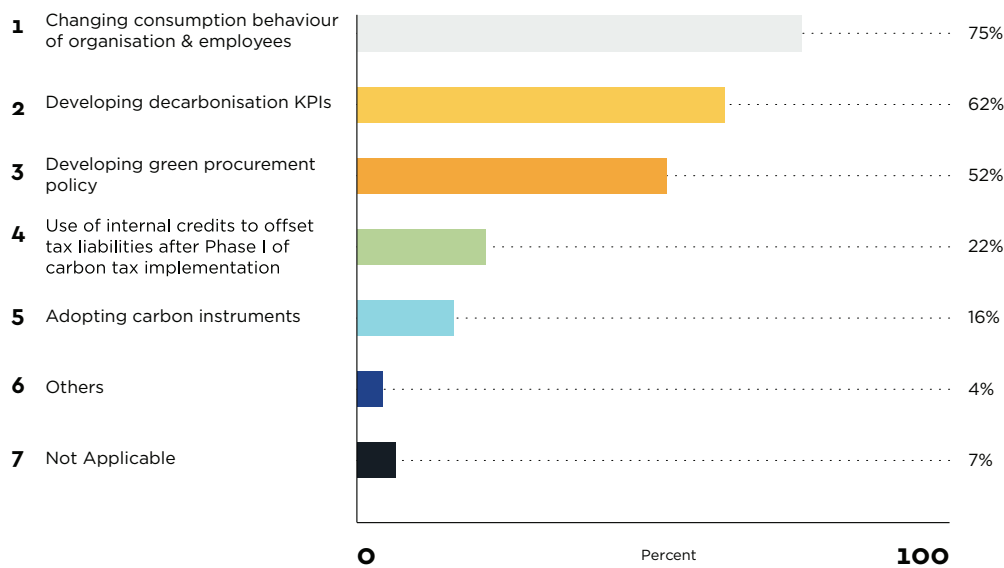
This was similarly reflected by SMEs (80%; 65.7%), LLEs (76.9%, 76.9%) and MNCs (88.6% and 72.7%). This was also consistent across the organisation amongst support staff (72.7%, 72.7%), middle managers (83.9%, 75.8%) and senior managers (89.5%, 52.6%).

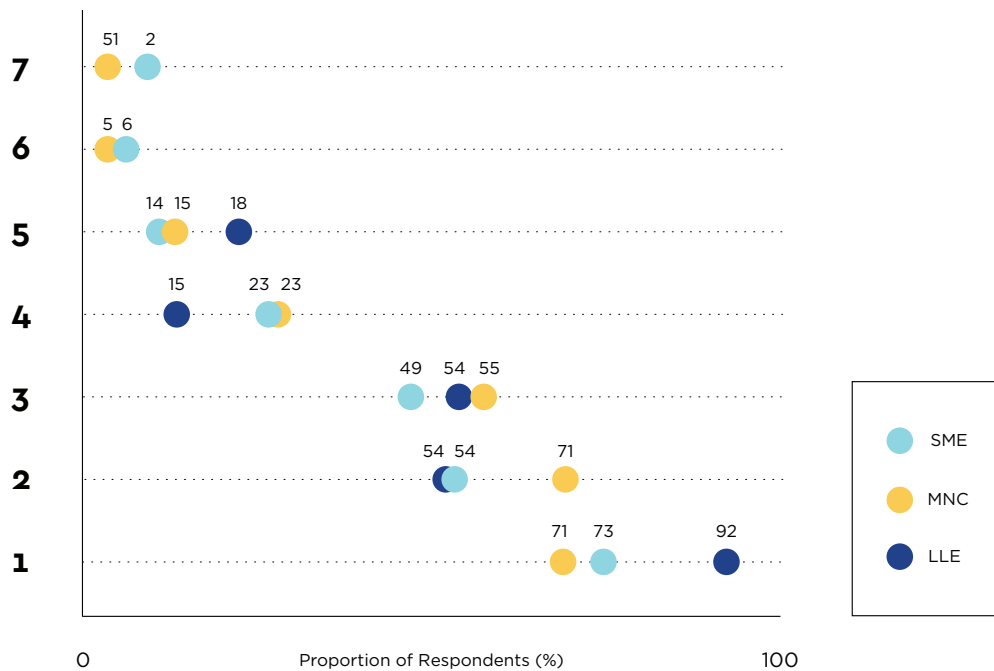
Whilst MNC (45.5%) and LLE (53.8%) considered upgrading their existing building to a higher BCA green mark standard, SMES at 31.4% was lukewarm to the opportunity. However within the organisations, support staff (36.4%) and senior managers (26.3%) were colder to the idea versus middle managers (46.8%).

With respect Waste Heat Recovery systems, the mixed response probably reflects the nature of operations within SMEs (25.7%), LLEs (23.15%) versus MNCs (45.5%). Stakeholders within the organisation was also mixed with support staff at the lowest (18.2%) versus middle managers (35.5%) and senior managers (42.1%)

Question 7 Responses

Which is/are relevant to your organization in increasing energy efficiency in the area of governance and policy-making?
Check all that apply.



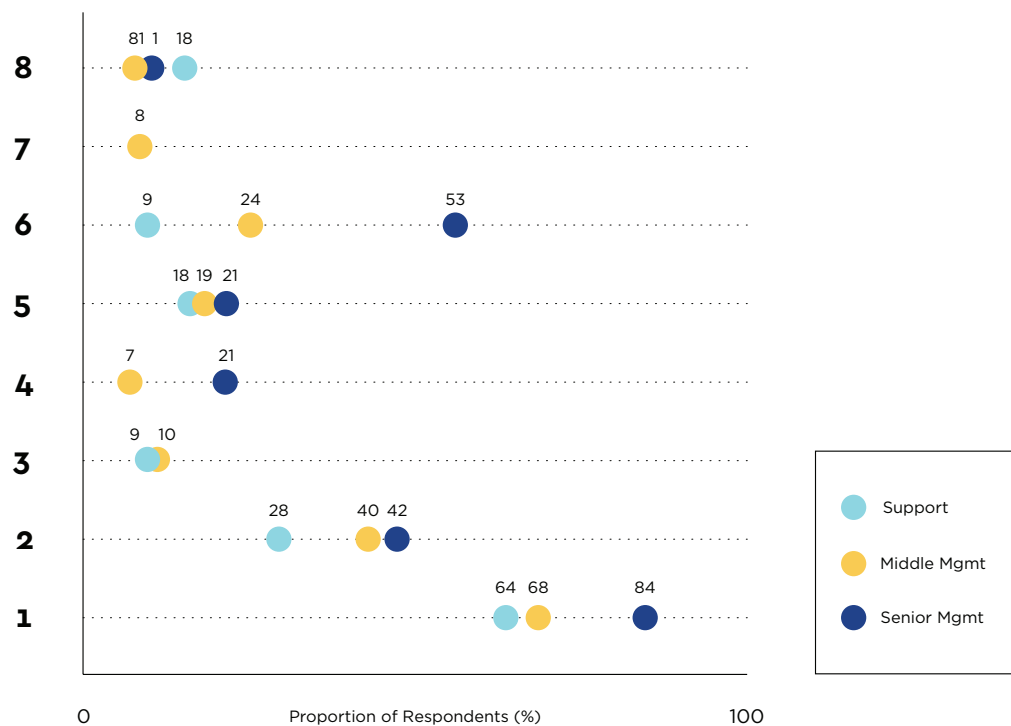
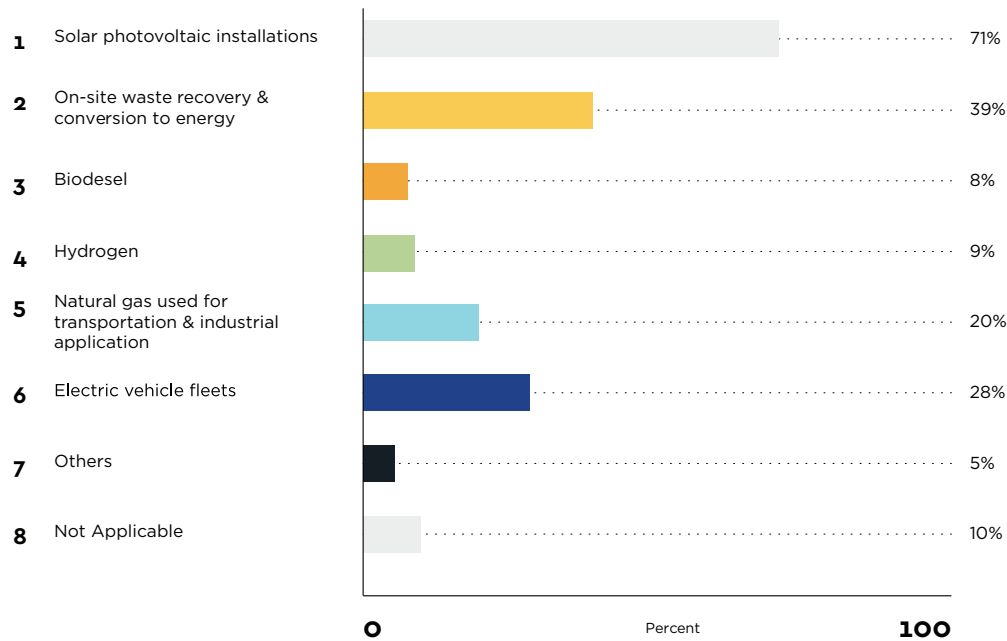


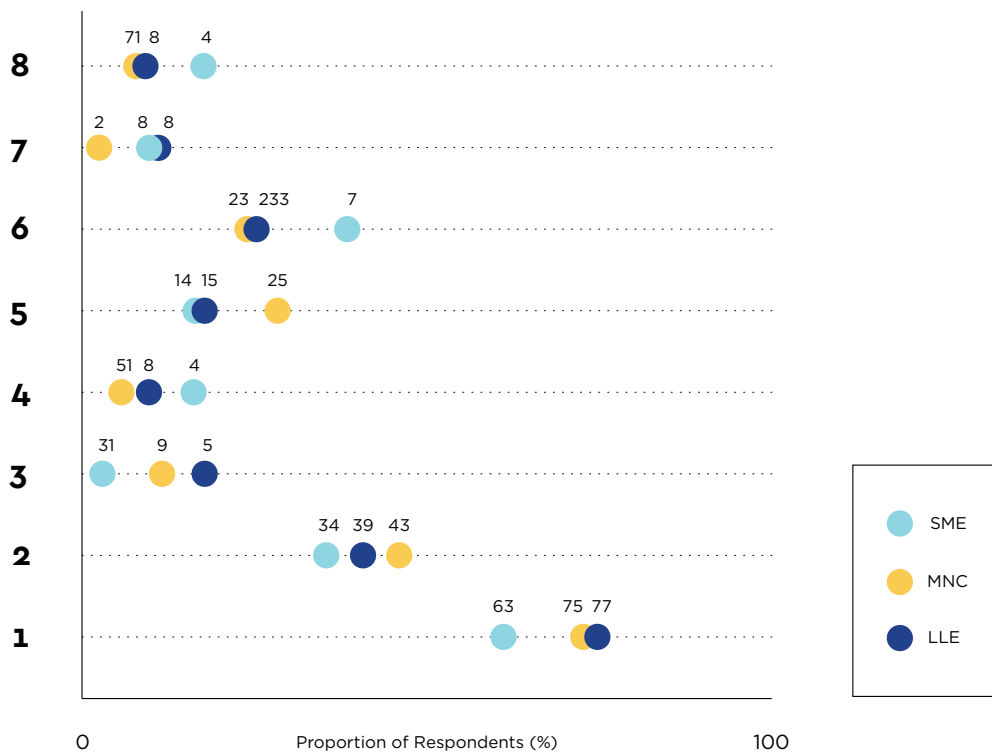
1	Changing consumption behavior of organization & employees
2	Developing decarbonization KPIs
3	Developing green procurement policy
4	Use of international credits to offset tax liabilities after phase I of carbon tax implementation
5	Adopting carbon instruments
6	Other

- Changing consumption behaviour of the organisation and employees is considered a strong driver for increasing energy efficiency with a return of 75%. This was consistent across all segments i.e., SME (71.4%), LLEs (92.3%) and MNC (72.7%) and within the organisation i.e., support staff (81.8%), middle manager (72.6%) and senior managers (78.9%).
- Key Performance Indicators (KPI) has always been a key enabler on behavioural change and therefore its consistent to see a high return across the board of 62%. MNC recognised this more (70.5%) than SMEs (54.3%) and LLEs (53.8%) where Senior managers (68.4%) and middle managers (61.3%) saw this more importantly than Support staff (54.5%)
- Establishing green procurement policy received fair attention with 52.2% and this was also consistent amongst SMEs (48.6%), LLEs (53.8%) and MNC (54.5%).
- The lack of understanding and availability of the use of international credits to offset tax liabilities (21.7%) and adopting carbon instruments (16.3%) highlights the need for creating awareness and opportunities to supply such solutions. This low priority was common across all company segments and stakeholders in the survey

Question 8 Responses

Which do you think is/are relevant to your organization in increasing energy efficiency in the area of alternative fuel sources? Check all that apply.



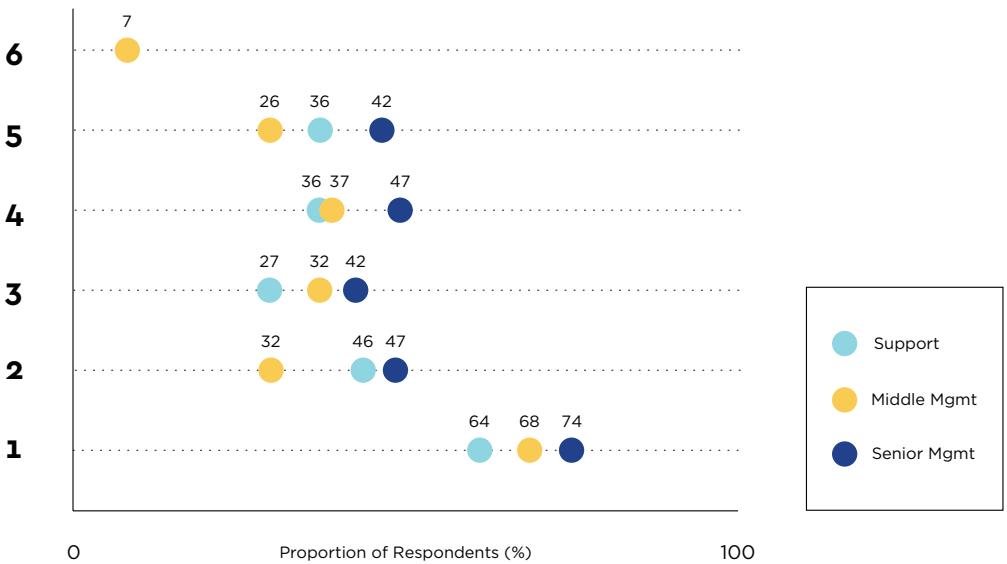
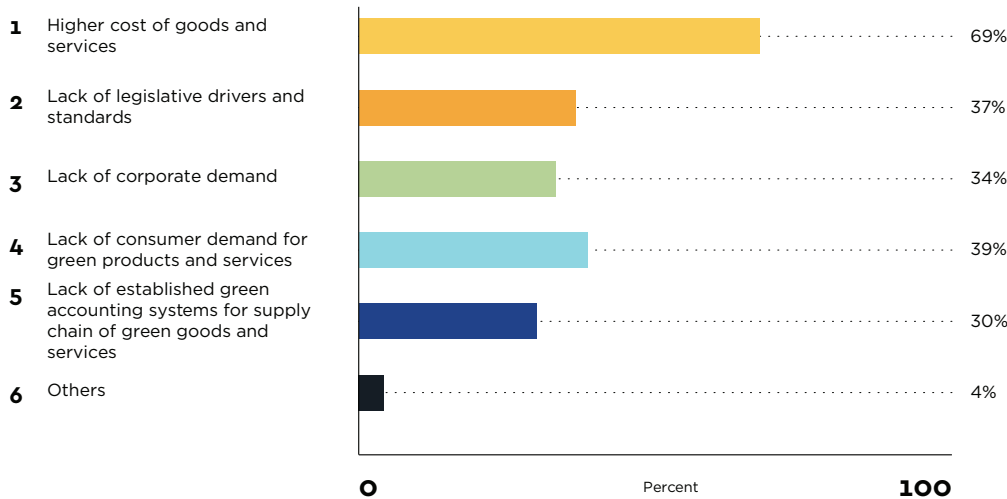


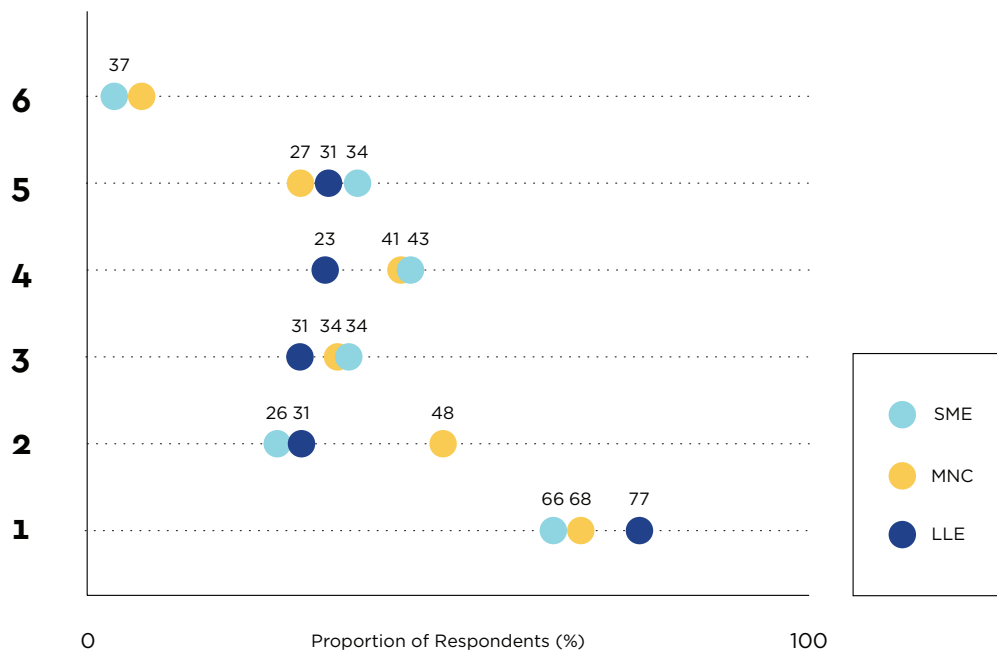
1	Solar photovoltaic installations
2	On-site waste recovery & conversion to energy
3	Biodiesel
4	Hydrogen
5	Natural gas used for transportation & industrial application
6	Electric vehicle fleets
7	Others
8	Not Applicable

- Solar (70.7%) remains the key solution to tap on to alternative fuel energy source with almost double the response versus the next two highest options i.e., waste heat recovery (39.1%) and EV fleets (28.3%). This distribution is similarly observed across company segments but MNCs also considered the use of natural gas for transportation and industrial applications.
- The low consideration of biodiesel is further analysed in Q12 whilst hydrogen remains farther off possibly due to the cost and infrastructure limitations.

Question 9 Responses

What do you think is preventing your organization from adopting green procurement practices? Check all that apply.



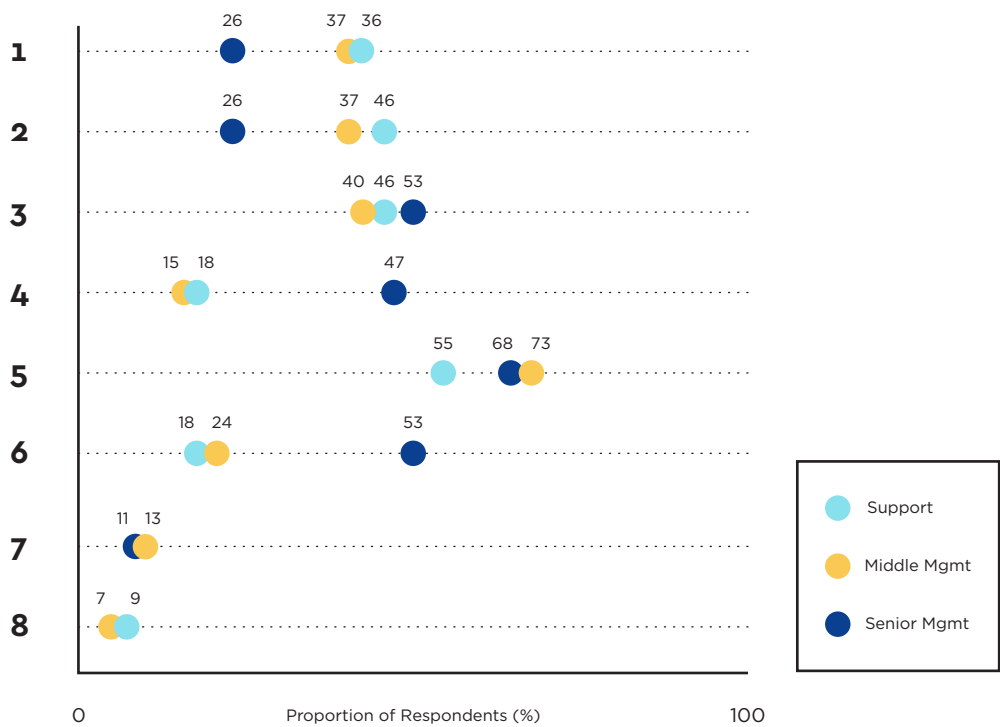
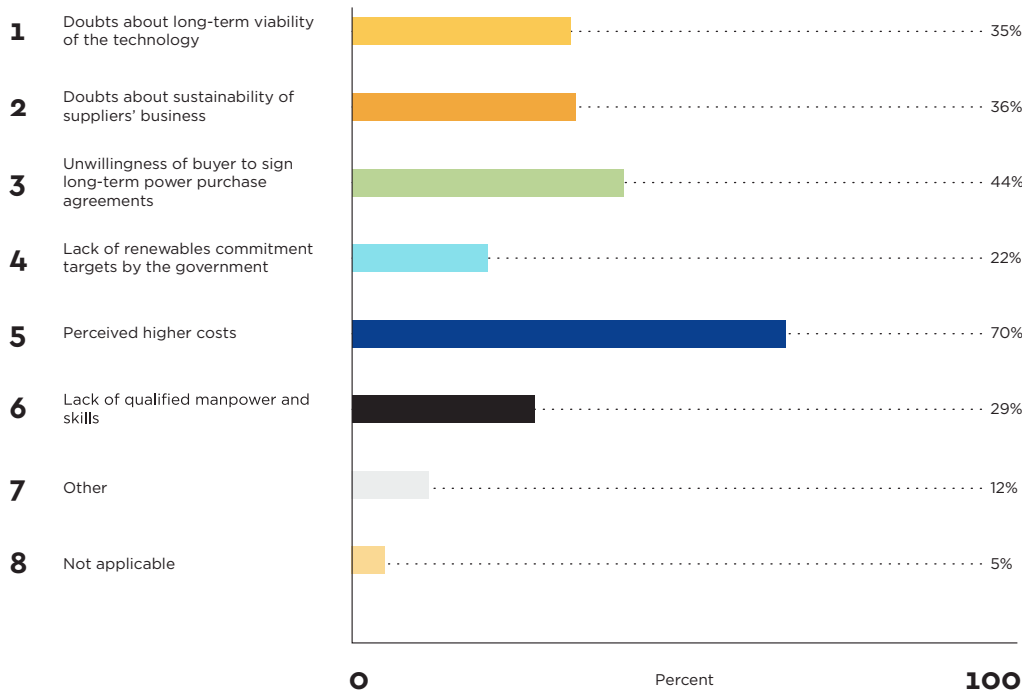


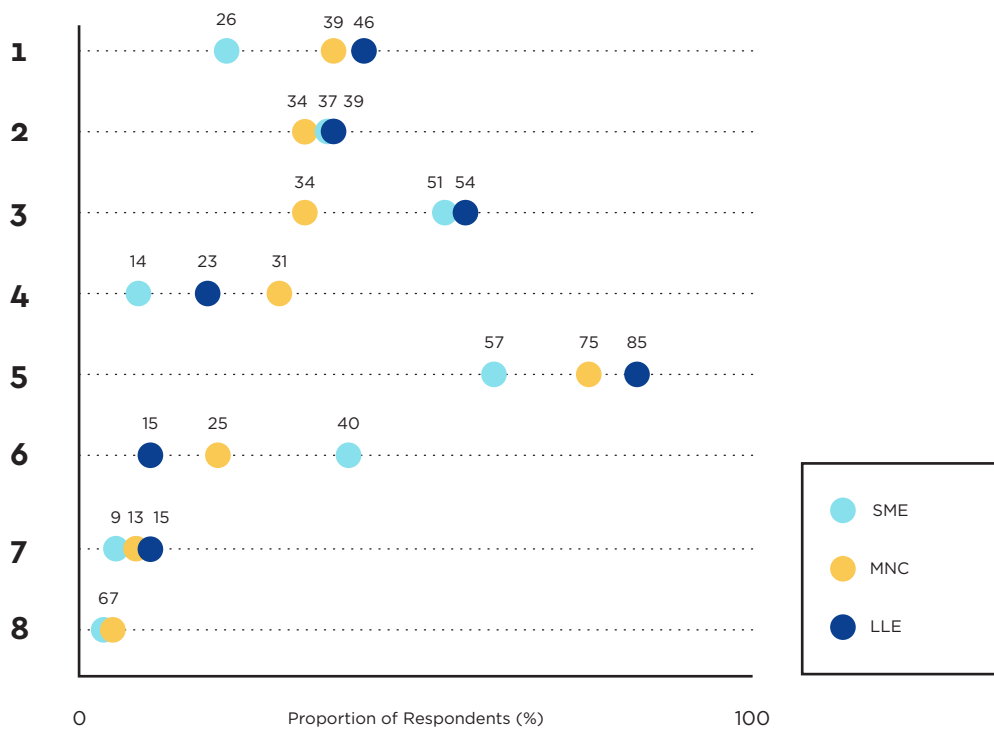
1	Higher cost of goods and services
2	Lack of legislative drivers and standards
3	Lack of corporate demand
4	Lack of consumer demand for green products and services
5	Lack of established green accounting systems for supply chain of green goods and services
6	Others

- The perception of higher cost of goods and services is identified as the key barrier to organisations adopting green procurement practices. This is consistent across all segments and felt by all stakeholders with the organisation. The case for green procurement needs to be made.
- For MNCs the lack of consumer demand and legislative drivers and standards were considered more influential than corporate demand and established green accounting systems. Whilst for SMEs consumer and corporate demand as well as established accounting systems were more of concern than legislative drivers. The LLEs saw all these three influences with similar importance.
- There was equal consideration across other challenges that would limit the adoption of green procurement

Question 10 Responses

What do you think are the barriers to scaling up solar energy in Singapore? Check all that apply.





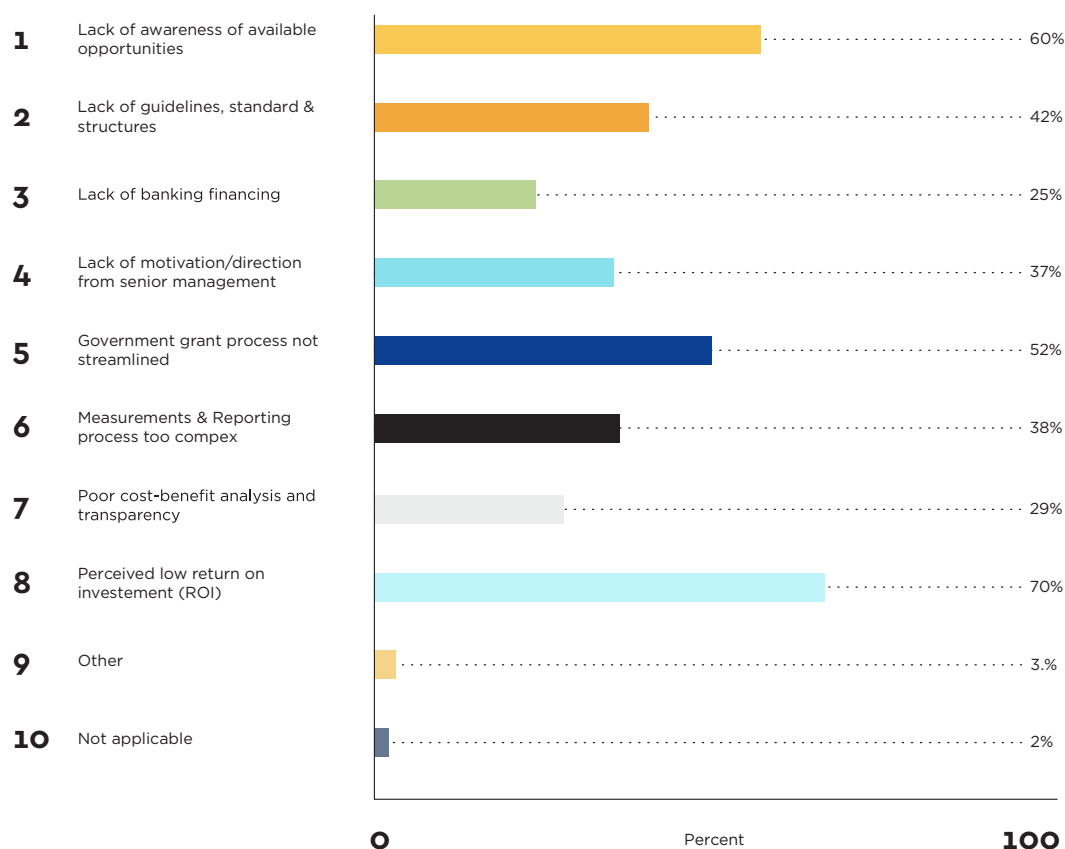
1	Doubts about long-term viability of the tech
2	Doubts about sustainability of suppliers' business
3	Unwillingness of buyer to sign long-term power purchase agreements
4	Lack of renewables commitment targets by the government
5	Perceived higher costs
6	Lack of qualified manpower and skills
7	Others
8	Not Applicable

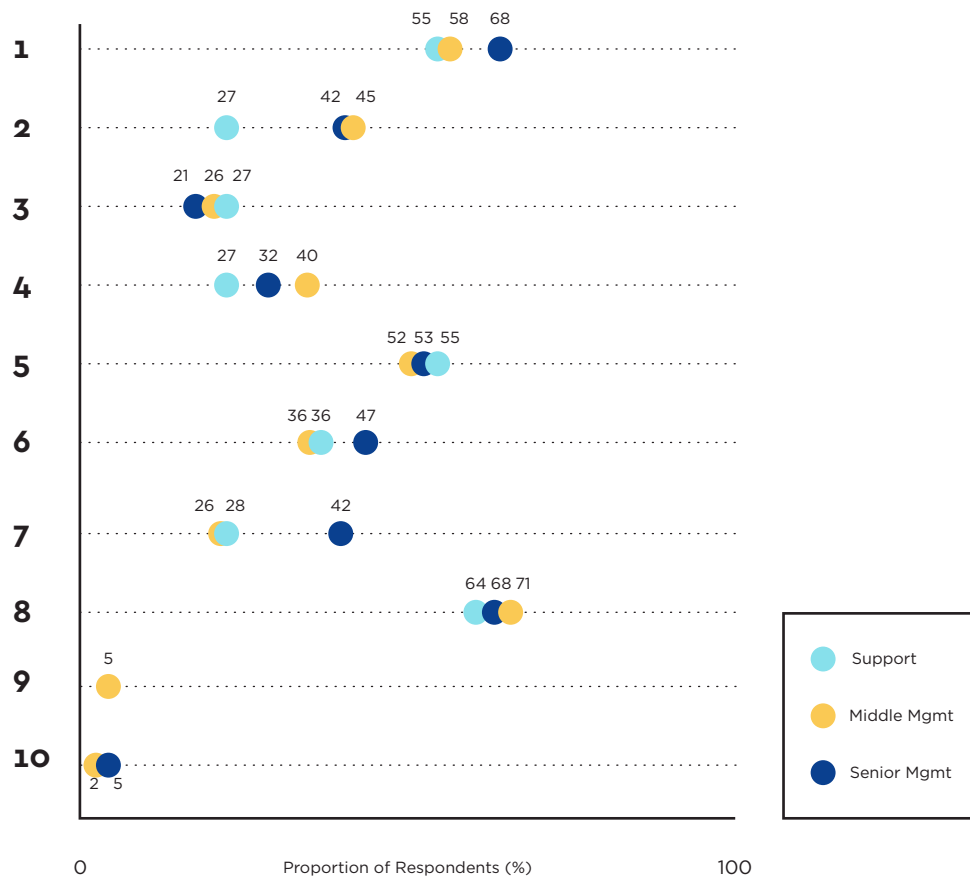
- Although global trends reflecting the lowering of solar PV prices, locally these trends have not been so prominent due to the limit of the size of solar installations thus making the balance of system cost a significant portion of unit generation costs. However solar prices in Singapore reached grid parity.
- Despite the grid parity, the main barrier identified by respondents is the perceived higher costs (69.6%). This is observed particularly in the responses from LLEs (84.6%) and MNC (75.0%) and much less so with SMEs (57.1%).

- Amongst stakeholders, the support staff consider perceived higher cost (54.5%) not too different from the “sustainability of supplier business” and “willingness to enter long term PPAs”.
- However, price concerns were ranked higher by middle managers (72.6%) and senior managers (68.4%) over “sustainability of suppliers” (MM:37.1%, SM: 26.3%) and “willingness to enter long term PPAs” (MM: 40.3%, SM: 52.6%)
- Whilst the long-term viability of the technology is undifferentiated concern amongst all segments and stakeholders; there was differentiated concerns around the lack of manpower and skills. This was apparent amongst SME (40.0%) versus LLE (15.4%) and MNC (25.0%).
- Amongst stakeholders senior managers (52.6%) see the lack of manpower and skills as a greater concern compared to support staff (18.2%) and middle managers (24.3%)

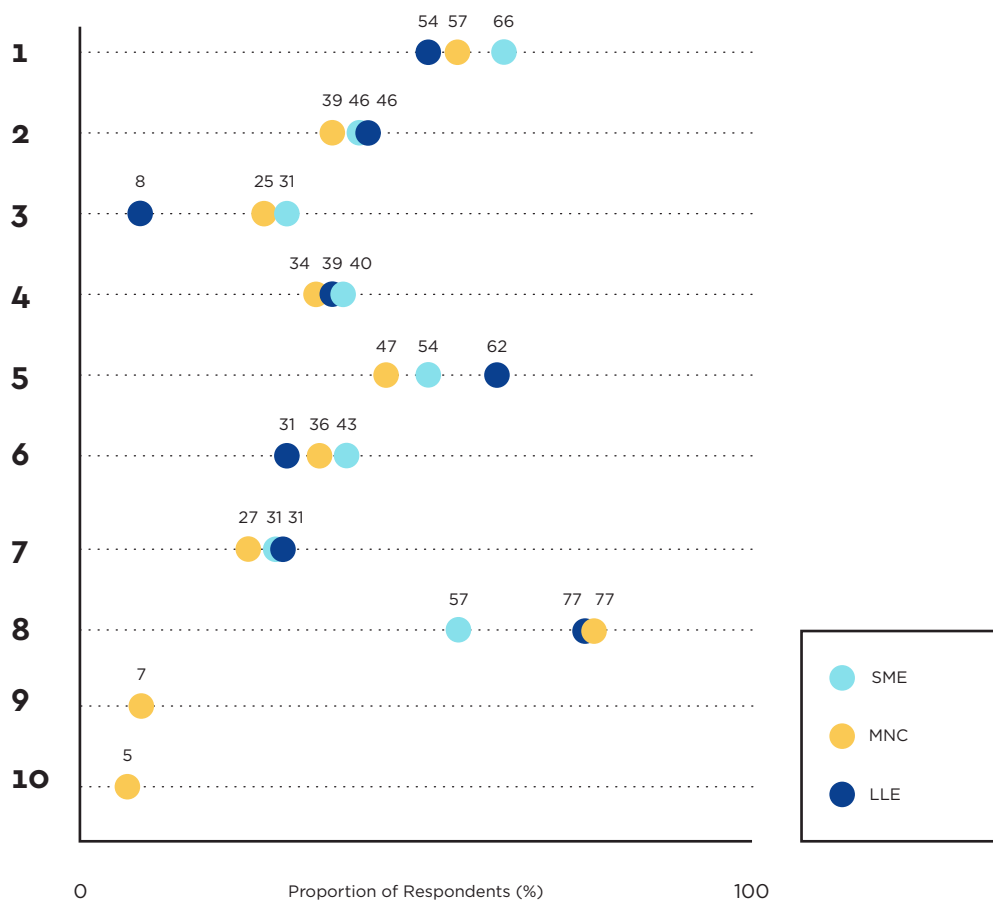
Question 11 Responses

What do you think the barriers to adopting energy efficiency solutions are? Check all that apply.





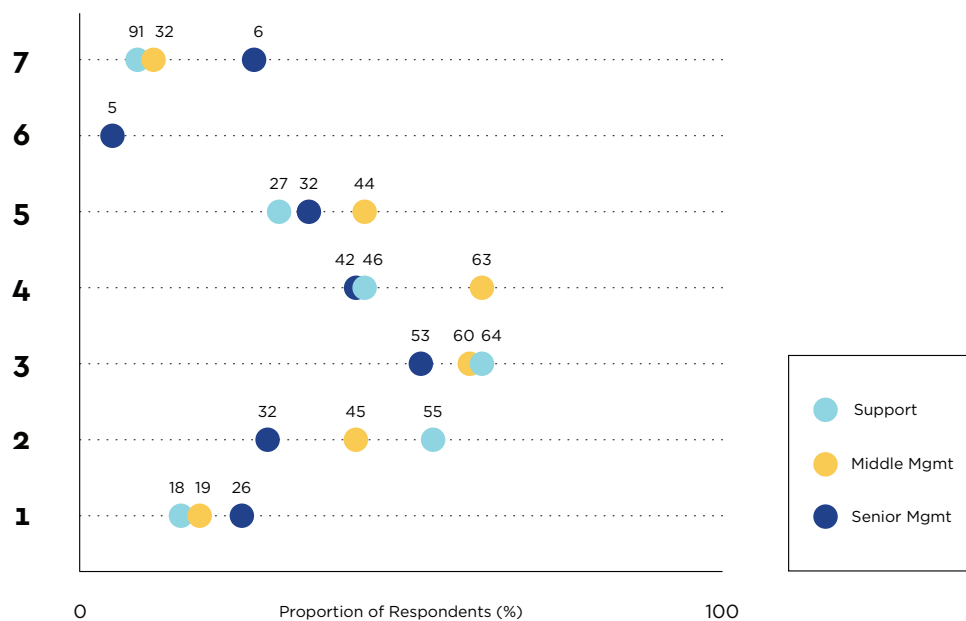
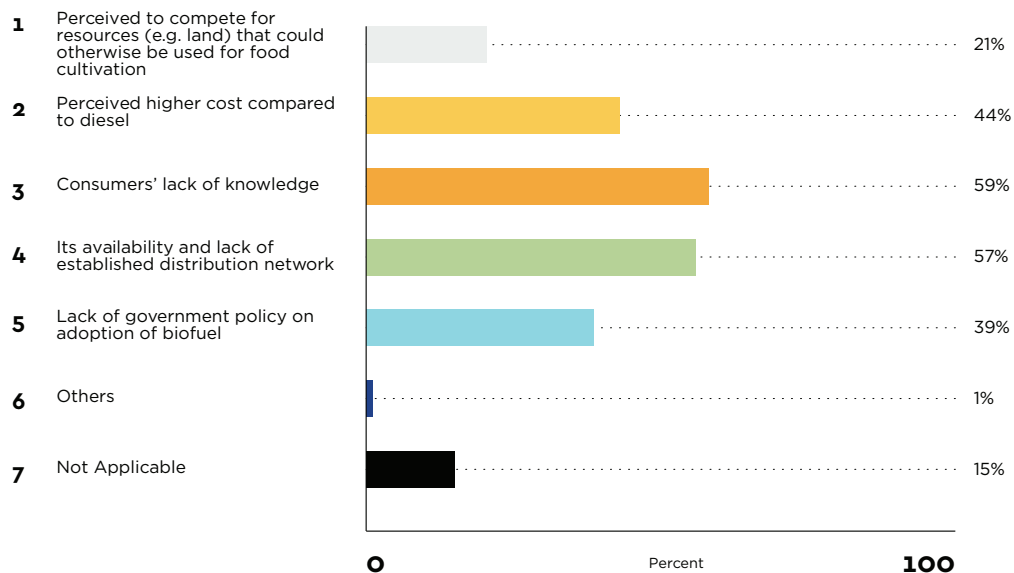
1	Lack of awareness of available opportunities
2	Lack of guidelines, standards & structures
3	Lack of bank financing
4	Lack of motivation/direction from senior management
5	Government grant process not streamlined
6	Measurement & Reporting process too complex
7	Poor cost-benefit analysis and transparency
8	Perceived low return on investment (ROI)
9	Others
10	Not Applicable

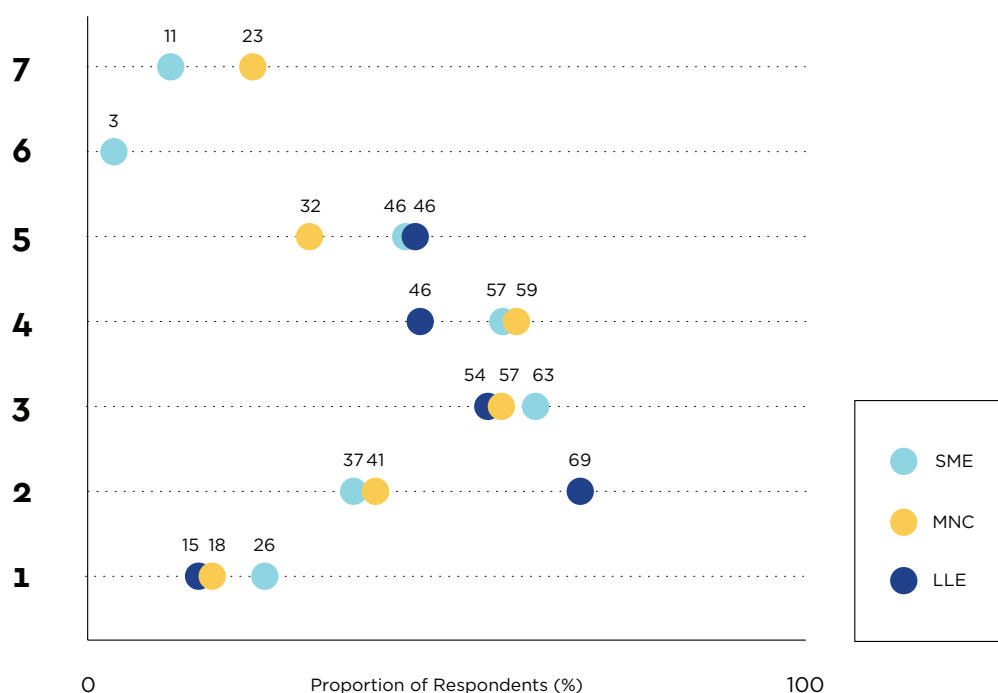


- A perceived low return on investment (69.6%) is the primary barrier to adopting energy efficiency. This is particularly significant amongst LLEs (76.9%), MNCs (77.3%) versus SMEs (57.1%).
- All stakeholders, senior managers (68.4%), middle managers (71%) and support staff (63.6%) have concerns about return on investments.
- This is also supported by low ranking of poor cost benefit analysis which indicates the cost benefit analysis is generally accepted as good. This is less pronounced amongst SMEs and senior management.
- This perception is also supported by the lack of awareness of the available opportunities (59.8%). This is particularly prominent amongst SMEs (65.7%) and senior management (68.4%).
- Across all respondents there is agreement that current government grant processes are cumbersome, thus a top 3 barrier to adoption.
- The lack of awareness could arise from the lack of motivation/direction from senior management (37%). This is true for SMEs (40%), LLEs (38.5%), but less so with MNC (34.1%). This is echoed more so by middle managers (40.3%).
- There is a consistency across segments and stakeholders for the need for guidelines, standard and structures as well as simpler Measurement and Reporting processes.

Question 12 Responses

What do you think the barriers to the adoption of biofuels in Singapore are?





1	Perceived to compete for resources (e.g., land) that could otherwise be used for food cultivation
2	Perceived higher cost compared to diesel
3	Consumers' lack of knowledge
4	Its availability and lack of established distribution network
5	Lack of government policy on adoption of biofuel
6	Others
7	Not Applicable

- The consumers lack of knowledge, poor availability and lack of an established distribution network are the main barriers to adopting biofuels in Singapore.
- In the case of LLEs, the perception of higher cost compared to diesel is significantly ranked first (69.2%).
- Amongst all the stakeholders “consumer’s lack of knowledge” is seen as the main barrier whilst cost, availability and distribution network next two main barriers.
- The lack of government policies for the adoption of biofuels is unanimously considered as the 4th important barrier to the adoption of biofuels in Singapore

ANNEX 2

SINGAPORE CLIMATE ACTION PLAN REVIEW AND REGIONAL SUMMARY

The Singapore Government in collaboration with the private sector and public have put in place the following initiatives:

- 1** Aiming to **generate around 350MW of solar power** for consumption by 2020
- 2** **Implementing the SolarNova Singapore Programme**, encouraging solar deployment and solar leasing in Housing Development Board (HDB) estates and government buildings
- 3** **Establishing and dispersing government grants** for R&D, capacity development and demonstration projects. Examples of such grants are:
 - a. National Environmental Agency (NEA) energy efficiency (EE) programmes and projects
- 4** **Providing tax incentives** such as corporate tax reduction or exemption for specified supported R&D activities in the renewable energy sector
- 5** **Setting up the Asia Infrastructure Centre of Excellence**, a joint initiative between IE Singapore, Asian Development Bank, and the Canada Department for Foreign Affairs, Trade and Development
- 6** **Open Electricity Market:** Offering Green Solar Energy plans to residential customers
 - a. Retailers offering electricity contracts with solar energy components to encourage more adopters of clean energy, even among residential market
 - b. Some retailers offer plans that includes carbon offsets

- 7** Singapore Power (SP) Group **launched its blockchain marketplace platform** to promote transactions of renewable energy certificates (REC) or tradable certificates of energy generated by renewable sources
 - a. Through the platform, REC buyers and energy generators can buy, sell, and issue a REC transaction
 - b. First global marketplace platform powered by blockchain

- 8** **Launched Tradable Instruments for Global Renewables (TIGRS)**, a platform for the issuance of TIGRS generated by solar projects located in Singapore. This was a partnership between Sunseap, one of Singapore's most well-established solar power developer, multi-national corporate buyers, the Solar Energy Research Institute of Singapore (SERIS) and APX

Benchmarking against neighbouring countries

Malaysia	Indonesia	Thailand
- National Renewable Energy Policy and Action Plan 2009 aims to increase renewable energy to 21% by 2050 - Feed-in-Tariff (FiT), tax incentives (e.g., 10-year pioneer status) - Renewable Energy (RE) Fund – RM300 million seed funds and annual RM 325 million contribution - Green technology financing scheme – RM 1.5 billion soft loan - Aims to generate 1,250MW solar power by 2020	- National Energy Policy- aims to achieve 40% renewable power generation development - Implementing Ministry of Finance and Ministry of Energy and Mineral Resources regulations – guarantee of PLN contracts and mandatory utilization of renewable resources - FiT, tax incentives, e.g., corporate tax reduction - Aims to generate 620MW solar power by 2020	10-year Alternative Energy Development Plan 2012-2021 (AEDP) - Achieve 25% renewable energy by 2021 - Providing funding – ENCON, Energy Soft Loan (Revolving Fund), ESCO, IFC-backed Clean Tech Fund - Aims to generate 3GW solar power by 2021MW solar power by 2020
The Philippines	Japan	China
- Philippines Energy Plan 2012-2030 - Triple renewable energy by 2030 - FiT, tax incentives, e.g., 7-year tax holiday - Implemented renewable energy act of 2008 - Renewable energy trust fund - Clean Tech fund – USD 250 million - Aims to generate 285MW solar power by 2021	4th Strategic Energy Plan (issued in April 2014) 20% renewable energy - FiT (2012-2012) – supply grants, financial aids for R&D, demonstration/field test programmes and market stimulation - Financial incentives – estimated at JPY 779 million target energy storage systems - Aims to generate 49GW solar power by 2020	3th Five-Year Plan (2016-2020) – targets 35GW by end of 2015 and additional 65GW from 2016-2020 - FiT, tax incentives, e.g., corporate tax, reduction, export credits, low-interest loans - Renewable energy development fund - Special fund for construction with renewable energy - Green subsidy – 70% for independent power projects (IPP) in remote areas - Aims to generate 50GW solar power by 2021

Country	Policy	Description	Impact
European Union	EU ETS	An emissions trading scheme ratified by all EU countries. Sets a certain limit to emissions to larger installations and has created a market for carbon	Phase 1 proved to reduce between 100-200mil tonnes of carbon, Phase 2 being evaluated while currently in phase 3. Has created small economically adverse impacts on ETS sectors vs non-ETS such as a small increase in unemployment and higher costs. There was a rise in stock prices during phase 1
London	Congestion Charge	Daily charge for any driver that drives in the congestion zone between 0700-1800 on weekdays. Have to pay day of travel or charged penalty	37% increase in bus users, 16% GHG reduction 2002-2003, 18% and 22% NOx and PM10 Reduction, 122 million euro generated, in 2006, congestion was found to have decreased by 26% from 2002 levels, there was a significant decrease in accidents on the road, minor cost implications
Denmark	Energy Tax (2nd Most efficient in world)	All sources of non-renewable energy, fossil fuels, are taxed based on energy content, have a CO2 tax based on sources carbon content, fossil waste is taxed as an input and output, and electricity output is taxed	Denmark's Green Energy Package resulted in a total 5% decrease in CO2 emissions from 1996-2005. Denmark's total CO2 emissions decreased 14% from 1990-2012
USA	California Cap and Trade Program	Trading scheme similar to EU ETS that applies to installations that emit more than 25,000 ton CO2/yr, connected with Canadian provinces Quebec and Ontario to expand market and boost economic incentives	Expected to reduce states GHG emissions by 16% by 2020, emissions cap reduced 3% annually from 2015-2020. Fast from 2020-2030
USA	Low Carbon Fuel Standard	Requires petroleum providers to reduce the amount of CO2 in their products otherwise they are not allowed to be sold	Has contributed to the 16% in GHG reductions in California

Source:
<https://tinyurl.com/y2f95tqv>
<https://tinyurl.com/y4lpqy9v>

Current Singapore Policies

Type of Policy/ Incentive	Name- Governing Body	Description	Commentary - Impact to Singapore	Commentary - Country/Cities comparison
Policy	Energy Conservation Act- Singapore Government	Sets out Energy standards for Singapore Requires energy intensive users to have a manager monitor and report energy use and GHG- emission related info annually. Must also submit EE improvement plan annually	Helping SIN companies standardize sustainability related reports and enforce the implementation of EE technology in new expansions to set the stage for future developments	Denmark: NEEAP; outlines denmark's EE strategy across industry and policy initiatives to get there Sweden: 4th EE Action Plan; outlines EE strategy and policy initiatives
Policy	Carbon Tax- Singapore Government	Applied to any facility emitting more than 25,000 tCO ₂ e annually, covers all 6 GHGs \$5/ tCO ₂ e, then \$10, then \$15, will start in 2019- 2023, will be evaluated after	Not implemented yet	EU: Tax primarily applies to installations outside EU ETS. Energy and Carbon taxes are different per sector and emissions produced
EE incentive	EE Financing Pilot Program- EDB	Companies will receive 100% of financing for upfront capital investment for energy efficiency projects Savings shared between company and financier	*No Data	Denmark: will not fund capital investments, depending on project will subsidize after completion

Type of Policy/ Incentive	Name- Governing Body	Description	Commentary - Impact to Singapore	Commentary - Country/Cities comparison
EE incentive	Resource- Efficient Design Incentive- NEA	NEA will cofund 50% of design workshops to integrate resource and energy efficiency in design of new facilities capped at \$600,000 per project	*No Data	Denmark: Have created central website that contains EE information for buildings and new facilities
EE incentive	Energy Audit Incentive- NEA	NEA will cofund 50% of energy audits, which assess energy consumption and help develop energy efficiency plans Capped at \$200,000 per project	*No Data	Denmark: Large enterprises must carry out an energy audit every 4 years that contains the minimum requirements laid out in the EU EE directive Sweden: companies that use >500 MW/yr must complete energy audits
EE incentive	Retrofit Project Incentive- NEA	NEA will cofund 20% of investment costs of energy efficient equipment and technology	*No Data	Denmark: government created website offers list of providers that can help transition to EE equipment for a lower cost
EE incentive	Accelerated Appreciation Allowance Scheme- Singapore Government	Allows write off/ depreciation within one year of capital expenditure on EE or energy saving equipment to replace existing ones	*No Data	

Type of Policy/ Incentive	Name- Governing Body	Description	Commentary - Impact to Singapore	Commentary - Country/Cities comparison
EE incentive	Investment Allowance- EE Scheme- Singapore Government	All new buildings required to have green mark certification Existing Buildings require Green Mark when retrofitted Mandatory Audit of cooling systems for new/ existing buildings that have been retrofitted	Green mark buildings have shown to have lower EUI than non GM across all building types. Achieved >25% of green 80% of singapore buildings by 2030;	EU has created the Energy Performance for Buildings Directives that set binding codes for buildings; Denmark requires Energy performance certificate when renting/ selling buildings; Sweden: EE standards set by swedish board of national housing
EE incentive	Zero Capital Partnership Scheme - SGBC-BCA	Helps fund chiller plant and lighting retrofits for existing buildings	*No Data	Denmark: claim to have realized full economic potential of heating market and cogeneration transition
Transport Initiatives	Transport Initiatives- Singapore Government	Achieve 70- 30 modal split between public/ private transport Carbon Based Vehicle Emission Scheme: Cars >=135 CO ₂ / km can receive rebates from \$5,000-\$30,000 Cars <=186 CO ₂ / km shall receive surcharge between \$5,000- \$30,000	CO ₂ reductions but currently being updated to VES to include other forms of carbon emissions, NO _x especially	Denmark: enforce semi- annual rates based on fuel efficiency separated by petrol and diesel Sweden: Similar to singapore, tax bonuses and charges are based on level of carbon emissions; no tax on biofuels

Type of Policy/ Incentive	Name- Governing Body	Description	Commentary - Impact to Singapore	Commentary - Country/Cities comparison
Transport Initiatives	Land Transport Authority Master Plan- LTA	2x railway system by 2028 Grow biking roads by 700m by 2030	Have created the most cost effective public transport system	Denmark: largest bike system in the world, growing every day to expand network, expansion into railway system undergoing

Benchmarking against Google for the adoption of RECs

- Google buys electricity directly from a renewable project developer in the form of a power purchase agreement, or PPA.
- Google then sells that power right back into the grid at the local, wholesale price. Today, because generic “grid” power is cheap and renewable power is relatively expensive, this may result in a slight net loss for Google.
- In the process of selling, Google strips renewable energy credits (RECs) and keep them so that no one else can claim credit for the green aspect of their purchase.
- Finally, Google apply those RECs to the energy used at their data centers. Their data centers get their power from the utility.
- Since the RECs were produced on the same grid, one REC represents one MWh of renewable power “used” at the data center, displacing one MWh of local conventional power.
- Once the REC is applied, the electricity consumed at the data center can now be treated as carbon-free.

ANNEX 3

CIRCULAR ECONOMY AND GREEN PROCUREMENT

Resource Overview:

ENERGY

Energy plays an indispensable role in Singapore's economy, and will remain critical to its economic growth and development.

- 1 The global energy landscape has changed significantly in recent years. First, the economic growth in SE Asia has now reached point where domestic energy resources are no longer primarily considered as an export commodity but increasingly as a means of providing domestic security.
- 2 Oil prices have become more volatile and less predictable as global markets become more diversified. This trend is likely to continue as expanding world population and strong economic growth, especially in large emerging economies like China and India continue to fuel energy demand.
- 3 On the supply side, there are sufficient reserves of oil, natural gas and coal to meet global energy needs for the next few decades. However, whether new supplies will come on-stream depends on producer countries making timely and sufficient investments to increase output. Geopolitical tensions and natural disasters could also disrupt supplies, driving prices higher and increasing price volatility. Given that the Middle East holds the bulk of the world's proven oil and gas reserves, the world's dependency on this region for energy will also increase.
- 4 Significant uncertainties exist both in terms global economic growth and climate risks that could change the energy landscape

FOOD

Singapore currently grows about 10% of its own food but has ambitions to increase this 30% by 2030 mainly driven by investing heavily in new agri-tech solutions.

WATER

Singapore has been lauded for its commitment to optimise water recovery and recycling, however it remains dependent on imports for almost 50% of its needs. Whilst its contract with neighboring Malaysia only expire in 2061, fears of prolonged drought and increasing pollution caused by climate change and rapid economic development have increased supply risks and focused government thinking towards becoming more self-sufficient. PUB has established a target of becoming capable of achieving 85% self-sufficiency by 2060 utilising advanced desalination and improved water processing and recycling technologies.

WASTE

According to the Singapore NEA, Singapore generated 7.7 million tons of waste in 2017, a seven-fold increase from 40 years ago and is running out of space for waste and needs to look at all options to become more resource efficient and reduce and reuse waste. In terms of types of waste generated, 5 types of waste stand out as being the ones that require closest attention:

1	Paper / Cardboard
2	Ferrous metals
3	Construction Debris
4	Plastics
5	Food Waste

The good news is that massive progress has been made in terms of recycling Ferrous Metals (now virtually 100% recycled) and Construction Debris (now virtually 100% recycled for use in construction and land reclamation activity) over the past decade, but whilst some progress has been made with the other 3 types, recycling rates remain stubbornly.

There is therefore a need to either invest in newer recycling technologies or very clearly switch the focus to less resource intensive use. Paper / Cardboard (approx. 50% recycled) with Plastics and Food Waste trailing (less than 20% recycled).

2019 was named the year towards zero waste, and authorities are focused at looking at how Singapore can develop a more circular economy. In recent months, Singapore has declared electronics waste to be a new area for waste management with the intent of ensuring that as much recyclable material is restored to the value chain as possible.

Solid waste management in Singapore begins at homes and businesses. Prior to the collection of solid waste, recyclables are sorted and retrieved for processing to prolong the lifespans of recyclable materials. The solid waste that remains is then collected and sent to the various waste-to-energy plants for incineration.

Incineration reduces the volume of solid waste by about 90% and produces steam that runs turbine-generators to generate electricity.

The Circular Economy

Resource use is essential for a decent quality of life and to ensure our basic human needs are met. However, continuous growth in resource extraction and current unsustainable consumption and production patterns are now generating excessive negative environmental pressure on our planet.

Over the last decade, we have witnessed a slow by steady shift of policy and associated regulatory frameworks towards improving sustainability and resilience without compromising economic growth, wealth and well-being.

Globally, there is increasing recognition that our limitless appetite for resources, to a large part driven by the increasing pace of technological advancement, must be significantly modified. Such change can only be driven by fundamental changes in infrastructure, logistics, and spatial organisation social and behavioural patterns that can only take place with a fundamental re-structuring of today's business models.

The principles of the "Circular Economy" (CE) and embedding them within future policy directives have gathered support as a means of creating an optimal pathway. A good example is Europe.

Since 2015, when the European Commission launched its ambitious CE Action Plan, Europe has increasingly adopted CE principles in its policy guidelines and in 2018 took a large step towards embedding some of them into law. However, actions to date have largely placed the emphasis on industrial processes as opposed to creating change in consumer behaviour towards making sustainable purchasing / procurement choices.

Up until now, the only major attempt to modify consumer behaviour has been a focused-on waste and waste recycling. In March 2019, the European Commission adopted a comprehensive report presenting the main achievements under the CE Action Plan and sketching out future challenges on the way to reaching a carbon-neutral economy.

The following is a summary of the **European Press Release published on 4th March 2019**.

- All 54 actions under the plan launched in 2015 have now been delivered or are being implemented. This will contribute to boost Europe's competitiveness, modernise its economy and industry to create jobs, protect the environment and generate sustainable growth.

- **Moving from a linear to a circular economy**

Three years after adoption, the Circular Economy Action Plan can be considered fully completed. Its 54 actions have now been delivered or are being implemented. According to the findings of the report, implementing the Circular Economy Action Plan has accelerated the transition towards a circular economy in Europe, which in turn has helped putting the EU back on a path of job creation.

In 2016, sectors relevant to the circular economy employed more than four million workers, a 6% increase compared to 2012. Circularity has also opened up new business opportunities, given rise to new business models and developed new markets, domestically and outside the EU. In 2016, circular activities such as repair, reuse or recycling generated almost €147 billion in value added while accounting for around €17.5 billion worth of investments.

- **EU Strategy for Plastics**

The EU Strategy for Plastics in a Circular Economy is the first EU-wide policy framework adopting a material-specific lifecycle approach to integrate circular design, use, reuse and recycling activities into plastics value chains. The strategy sets out a clear vision with quantified objectives at EU level, so that inter alia by 2030 all plastic packaging placed on the EU market is reusable or recyclable.

To boost the market for recycled plastics, the Commission launched a voluntary pledging campaign on recycled plastics. 70 companies have already made pledges, which will increase the market for recycled plastics by at least 60% by 2025. However, there is still a gap between supply and demand for recycled plastics. To close this gap, the Commission launched the Circular Plastics Alliance of key industry stakeholders supplying and using recycled plastics.

The rules on Single-Use Plastics items and fishing gear, addressing the ten most found items on EU beaches place the EU at the forefront of the global fight against marine litter. The measures include a ban of certain single-use products made of plastic (such as straws and cutlery) when alternatives are available and of oxy-degradable plastic and propose actions for others such as consumption reduction targets, product design requirements and Extended Producers Responsibility schemes.

- **Innovation and Investments**

To accelerate the transition to a circular economy, it is essential to invest in innovation and to provide support for adapting Europe's industrial base. Over the period 2016-2020, the Commission has stepped up efforts in both directions totaling more than €10 billion in public funding to the transition. To stimulate further investments, the Circular Economy Finance Support Platform has produced recommendations to improve the bankability of circular economy projects, coordinate funding activities and share good practices. The platform will work with the European Investment Bank on providing financial assistance and exploiting synergies with the action plan on financing sustainable growth.

- **Turning Waste into Resources**

Sound and efficient waste management systems are an essential building block of a circular economy. To modernise waste management systems in the Union a revised waste legislative framework entered into force in July 2018. This includes, among others, new ambitious recycling rates, clarified legal status of recycled materials, strengthened waste prevention and waste management measures, including for marine litter, food waste, and products containing critical raw materials.

- **Circular Design and Production Processes**

Smart design at the beginning of a product's lifecycle is essential for ensuring circularity. With the implementation of the Ecodesign Working Plan 2016-2019, the Commission has further promoted the circular design of products, together with energy efficiency objectives. Ecodesign and Energy Labelling measures for several products now include rules on material efficiency requirements such as availability of spare parts, ease of repair, and facilitating end-of-life treatment. The Commission has also analysed, in a dedicated Staff Working Document, its policies for products, with the intention to support circular, sustainable products.

- **Empowering Consumers**

The transition towards a more circular economy requires an active engagement of citizens in changing consumption patterns. The Product Environmental Footprint (PEF) and Organisation Environmental Footprint (OEF) methods developed by the Commission can enable companies to make environmental claims that are trustworthy and comparable and consumers to make informed choices.

- **Strong Stakeholder Engagement**

Stakeholder engagement is vital for the transition. The systemic approach of the action plan has given public authorities, economic and social players and civil society a framework to replicate in order to foster partnerships across sectors and along value chains.

The role of the Commission in speeding up the transition and leading international efforts for circularity was also recognised at the World Economic Forum 2019 where the Commission received the Circulars Award in the Public Sector Category.

- **Open Challenges**

The circular economy is now an irreversible, global trend. Yet, much is still needed to scale up action at EU level and globally, fully close the loop and secure the competitive advantage it brings to EU businesses. Increased efforts will be needed to implement the revised waste legislation and develop markets for secondary raw materials.

Also, the work started at EU level on some issues (like chemicals, the non-toxic environment, eco-labelling and eco-innovation, critical raw materials and fertilisers) needs to be accelerated if Europe wants to reap the full benefit of a transition to a circular economy. Interaction with stakeholders suggests that some areas not yet covered by the action plan could be investigated to complete the circular agenda.

Building on the example of the European Strategy for Plastics in a Circular Economy, many other sectors with high environmental impact and potential for circularity such as IT, electronics, mobility, the built environment, mining and energy resources, furniture, food & drink and textiles could benefit from a similar holistic approach to become more circular.

How to achieve greater focus on green procurement

1 FOCUS ON CITIES / MAJOR ENERGY MARKETS

Half of the world's population – some 3.5 billion people – currently live in cities and the number is expected to rise further, reaching five billion by 2030. Although cities cover only approximately three per cent of the world's land area, they consume 60–80 per cent of the world's energy and produce 75 per cent of global CO₂ emissions, and around 67 per cent of the world's greenhouse gas emissions are related to the consumption of materials.

2 FOCUS ON THOSE RESPONSIBLE FOR PROCUREMENT WITHIN ORGANISATIONS

Balancing green procurement with business goals is not always easy work. Organisations need to be encouraged to commit to dedicated effort for such activity including adopting digital procurement to analyse complex compilation of data and analysis of options from an asset life-cycle perspective.

Perhaps the most fundamental point that needs to be borne in mind when discussing green procurement in organisations is that responsibility for this activity cannot be placed on procurement specialists alone but must consist of a multi-functional team responsible for all stages of a product's development



Source: Peter Godfrey - Energy Institute

Organisations must also allow space for innovation of new circular products and solutions. To achieve this, procurement teams must have the ability to effectively align procurement goals with an organisation's sustainability policies and strategies.

This requires organisations to adopt clear green procurement strategy directives within their overall corporate strategy and to manage and regularly audit against stated objectives from the perspective of achievement, risk and reward.

In most cases, procurement practices are to a large part based on those of an organisation's suppliers and it is therefore of fundamental importance that suppliers, business partners and contractors are also incorporated into an organisation's green procurement strategy ensuring that they too have clear accountability to perform against strategy.

Within this context ISO 20400 provides a useful basis on which to build a green procurement model. The diagram below summarises the framework of this standard.



Source: ISO 20400 Summary by Peter Godfrey Energy Institute

ANNEX 4

ARTICLE 6 OF THE PARIS AGREEMENT

One of the most important and debated provision of the Paris Agreement (PA) is Article 6 which seeks to establish a market mechanism for trading of carbon credits, to allow countries to achieve their NDC's. Article 6 is the driving force behind an international regime for the functioning of an efficient and a well-connected and efficient carbon market.

In brief, the scope of the Article 6 can be broken down into the following subparagraphs: Article 6.1 of the Paris Agreement illustrates the concept that parties may choose on a voluntary basis to cooperate in the implementation of their NDC.

Article 6.2 and 6.3 describe the use of cooperative approaches that allow application of internationally transferred mitigation outcomes towards NDCs, sustainability and environmental integrity and to ensure that the use of such mitigation outcomes does not lead to double counting.

Article 6.4 to 6.7 establishes the mechanism to produce mitigation outcomes and support sustainable development.

Article 6.8 and 6.9 recognise the importance of an integrated, holistic and balanced non market approach to assist the parties in achieving their NDCs.

An analysis of this Article has concluded that countries may participate in the carbon market either through a more centralized system under Article 6.4 which directs the Conference of Parties to provide for the required authority and guidance to establish a mechanism for mitigation of GHG emission; or under Article 6.2 where countries themselves define the approach or mechanism.

Thus 6.2 is similar to the Joint Implementation and International Emission Trading that existed under the Kyoto Protocol whereas 6.4 is believed to be the successor of Clean Development Mechanism. Whilst the Kyoto Protocol provided the basis for a start to the carbon markets, the PA goes further in ensuring that entire world works collaboratively and holistically in achieving their respective targets to reduce emissions jointly under Article 6 of the PA.

CARBON MARKETS

In March 2016, the World Bank announced the Networked Carbon Market Initiative (NCMI) in which cooperative approaches that involve the use of Internationally Transferred Mitigation Outcomes (ITMO) towards Nationally Determined Contributions (NDCs), a centralized approach that involves the use of a Sustainable Development Mechanism (SDM) and also a framework for non-market approaches to meet the overall goals of the PA will be undertaken. Refinements are currently underway to ensure that all approaches are carefully thought through.

Global Scenario

Sr no.	Country/Organization	Prevailing regulation/scheme for regulating carbon
1	Europe	The European Market is governed by the EU Emission Trading Scheme (EU-ETS). On April 11, 2019 the carbon price on the EU-ETS peaked at a 10 year high ever to reach Euro 26.89 and were the best performing commodities in 2018.
2	United States of America	- The Regional Greenhouse Gas Initiative (RGGI) was the first mandatory cap and trade programme in the United States to limit carbon dioxide from the power sector. There are 10 States that are currently participating in this scheme who have set a goal to reduce emission an additional 30% by 2030. - The Western Climate Initiative is market-based programme to administer the emission trading market between California and Quebec (Canada). - Apart from these schemes, many regions are looking to price carbon or increase carbon targets in the absence of a federal legislation. By 2019, more than 200 businesses are expected to reflect carbon pricing investment decision and nearly 11 US States will impose some form of carbon price
3	Japan	- Japan was the very first Annex I country under the Kyoto Protocol compliance rules to reduce its emissions, and no other Asian or ASEAN country has been required to do so under the KP regime. - Japan established the Tokyo ETS-cap and trade programme as a mandatory ETS which is also linked to the Saitama ETS. This ETS is currently in its second phase and is expected to reduce emissions by 15-17% from large offices and factories.
4	South Korea	- In 2016, the Korean government formulated plans to reduce 25% emission through domestic reductions and 11.3% through the international carbon markets. - In fact, South Korea is the first mover to already operationalize an ETS @US\$21 per ton since 2015. - The Koreans are currently seeking a considerable supply of carbon credits through the CDM from South East Asia in hope of raising its supply as soon as possible.

Sr no.	Country/Organization	Prevailing regulation/scheme for regulating carbon
5	China	- China launched its national ETS programme in 2017, through which it targets to lower its emission per unit of GDP by 60-65% by 2030. - This ETS programme will eventually include compliance from 8 sectors, starting with the power generation sectors.
6	Thailand	Thailand has also announced the creation of voluntary ETS although this is not yet operationalized.
7	Singapore	- In February, 2017 Republic of Singapore announced a potential start to a carbon pricing plan through the enforcement of a carbon tax for Emissions Intensive Trade Exposed (EITE) sectors. - In early March 2018 Singapore's Finance Minister, during the Budget Parliament's congregation announced that the carbon tax would start firmly at S\$5 per ton from Jan 1 2019 for the EITE sectors and the companies firmly affected by the tax would need to buy Singaporean "carbon credits" or allowances from the enforcing agency, National Environment Agency (NEA) once monitoring protocols have been established and then verified in the 1st year of compliance. - Singapore is the first South East Asian country to employ a carbon tax without allowing a potential decrease to its current and/or forecasted economic growth potential
8	International Civil Aviation Organisation (ICAO)	ICAO has developed a Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) as a mitigation approach for the global airline industry. This scheme will be implemented in three phases, beginning 2021.

ANNEX 5 - Definitions

BLENDLED FINANCE

An innovative finance solution that could boost funding for renewable energy projects is “blended finance”. Blended finance is a form of Public-Private-Partnership that combines public official development assistance with commercial loans. Through the deployment of concessional finance, the approach significantly reduces the risk involved for investors to come on board and can, therefore, mobilise additional commercial funding. This is becoming an increasingly popular structure for those nations providing development assistance as it promises to provide some form of auditable return on investment in the longer term.

Blended finance could facilitate the deployment of large-scale solar and wind farms, and, particularly in the ASEAN region, where a lack of energy access is still prevalent, it could also catalyse investment in smaller scale decentralised energy solutions in partnership with local government authorities.

GREEN FINANCING

Source:

Climate Mundial

Definition:

Green finance refers to any financial instrument or investment – including equity, debt, grant, purchase & sale or risk management tool (for example: investment guarantee, insurance product or commodity, credit or interest rate derivative, etc.) – issued under contract to a firm, facility, person, project or agency, public or private, in exchange for the delivery of positive environmental externalities that are real, verified and additional to business as usual, whereby such positive externalities result in the creation of transferrable property rights recognised within international, regional, national and sub-national legal frameworks.

Climate Finance:

Climate Finance is an emerging form of green finance available for projects in developing countries that help reduce emissions or adapt to climate change. This is achieved either via increasing the revenues available to public and private development projects, such as tariff support or carbon finance, or by improving project capital structure, for example by reducing the costs of debt and equity.

Climate finance is a growing sector in international development and environmental finance. Governments of the world are continually making more resources available for climate finance, and have committed to raising \$100 billion per year by 2020 – from public and private sources – under the Paris Agreement on climate change.

Source:

Whitepaper on Green Financing by Bloomberg BNA

The Paris Agreement introduces a new idea that a certain amount of new finance should be allocated— not just by governments, but also by entities—to activities that can reduce emissions or help mitigate the effects of climate change. This activity is known under the Paris Agreement as climate finance. In the broader financial markets, financing for climate is taken to be a subset of a broader pursuit called green finance. For the purpose of this paper, let us call this green finance for climate change. There is no common understanding among governments and entities, let alone members of the general public, however, as to what green finance actually is or what it should deliver.

Finance—or financial instruments—can include a variety of products. Some examples include equity, debt, grant, or purchase and sale contracts. Others include risk management tools such as investment guarantee, insurance product or commodity, credit, or interest-rate derivatives. What is important for green finance for climate change is not the type of finance or financial instrument, but whether it creates a measurable positive externality and that it is claimed or counted by only one firm or party at a time.

Source: Business Times

While a lot of the focus has been on green bonds and green loans - interest in a newer type of loan, sustainability-linked (SL) loans, is starting to take form. Although the green focus for all these loan types is similar - the ways of getting there are quite different. SL loans, unlike green loans and bonds, are focused on a borrower's environmental, social and governance (ESG) performance. Interest rates for these loans may then be reduced, based on how well the company performs against said ESG metrics. Uses of these proceeds are also not restricted and can be used for general corporate purposes. Green loans and bonds meanwhile, focus on the use of proceeds which provide clear environmental benefits to be assessed and where "feasibly quantified, measured and reported by the borrower"

WHITE CERTIFICATES

Source:

KYOS

A white certificate is a tradable asset which proofs that a certain percentage of energy savings has been achieved relative to a baseline. It is also referred to as Energy Savings Certificate (ESC) or Energy Efficiency Credit (EEC).

The white certificate schemes encourage companies and their clients to save energy through various investments in energy efficiency which are rewarded by certificates credited by registered agencies. The savings are calculated as the cumulative savings over the lifetime of the product or the investment. White certificates are traded in Poland, France and Italy. In France, the name for the white certificates is Certificat d'Economies d'Energie (CEE) and the tradable unit is 'MWh cumac'. In Poland and Italy, the white certificates are called EFX and TEE respectively, and traded in tonne of oil equivalent (toe). Other countries are considering to introduce the mechanism of white certificates too, because it is generally considered to be an efficient and cost effective way to achieve energy savings, attractive to policy makers, companies and households.

A white certificate cannot be transferred between the European markets, as opposed to emission certificates, so the total market size is often small and trading rather illiquid. Most trading activity is via brokers, such as STX, Cleanworld, Evolution Markets and Amsterdam Capital Trading.

RENEWABLE ENERGY CERTIFICATES

Source:

Investopedia and Wikipedia

A Renewable Energy Certificate (REC) is a market-based instrument that certifies the buyer/bearer owns one megawatt-hour (MWh) of electricity generated from a renewable energy resource. This can be used to offset the buyer's actual consumption of electricity generated by non-renewable sources and they can claim that they are consuming clean and renewable energy.

Once the renewable power generator has fed the energy into the grid, the REC they receive can then be sold on the open market as a commodity.

RECs are also known as **Green tags, Renewable Energy Credits, Renewable Electricity Certificates, or Tradable Renewable Certificates (TRCs).**

Solar renewable energy certificates (SRECs) are RECs that are specifically generated by solar energy.[1] Renewable Energy Certificates provide a mechanism for the purchase of renewable energy that is added to and pulled from the electrical grid. The updated Greenhouse Gas Protocol Scope 2 Guidance[2] guarantees of origin, RECs and I-RECs as mainstream instruments for documenting and tracking electricity consumed from renewable sources.

Will the renewable energy be delivered directly to my home or business?

When you purchase RECs it is guaranteed that renewable energy has been generated on your behalf and sent to the electrical grid, which is the network that delivers electricity from suppliers to consumers. However, once it enters the grid, it is impossible to distinguish where or how that electricity is being delivered. As more and more people purchase RECs, we become closer to true energy independence. REC arbitrage is also called a REC swap. These trades involve the near-simultaneous buying and selling of RECs with differing prices. Traders attempt to profit from the disparity between the buy and sell price.

RENEWABLE ENERGY CERTIFICATES

Source:

How Stuff Works

Carbon offsets are a form of trade used to fund projects that reduce greenhouse gas (GHG) emissions. The projects might restore forests, update power plants and factories or increase the energy efficiency of buildings and transportation. Carbon offsets let you pay to reduce the global GHG total instead of making radical or impossible reductions of your own.

The money funds programs that offset an equal amount of emissions. Some offset companies allow customers to choose their projects; others do not.

Several standards for rating offset companies and projects have recently emerged: the Voluntary Carbon Standard (VCS), the Gold Standard and the Climate, Community and Biodiversity Standard.

A good quality offset fulfils these criteria: it is one that funds projects with **additionality**; it has an accurate **baseline**, or estimate, of how much GHG a particular project sequesters or avoids; the GHG reductions should be accurately quantified, and the projects should have **permanence** - a low potential of releasing CO₂ back into the atmosphere in the near future; and offset companies that warn consumers of the risks associated with projects and up-front about the projects' permanence are acting with **transparency**.

Offsets also need clear, registered ownership so the same offset cannot be resold again and again.

Carbon offsets encourage individuals and businesses to take responsibility for their part in global climate change, but they shouldn't be used solely as an excuse not to reduce actual GHG emissions through physical interventions and improvements.

Perhaps more importantly, the popularity of voluntary offsets could help promote a carbon market or a carbon tax backed by public policy.

REC Versus CARBON OFFSETS

REC and carbon offsets, while both are financial instruments, are effectively different.

REC is proof that there is the physical and actual generation of electricity from renewable source (solar, wind, hydro etc) fed into the grid.

While carbon is actually reduced (or eliminated) in the process of say, solar power generation, REC does not take that carbon reduction or elimination into account.

Carbon offsets, on the other hand, do not reduce the actual GHG emissions as a result of human activities. They create projects that would not have happened otherwise to reduce GHG emissions. These reductions thus offset the emissions that had already been released to the atmosphere in another part of the world.

Both instruments do share similar challenges, especially in the standards and the originality. How do we avoid a REC generated from one particular project not to be repeatedly traded in other markets when there is no one single system to verify, issue, track and retire RECs on a global basis? This same challenge is also staring in the face of carbon offsets.

ANNEX 6 - Contributors



Dr Sanjay C Kuttan

Dr Sanjay C Kuttan is Chairman of the Singapore Decarbonization White Paper committee and a council member of the Sustainable Energy Association of Singapore where he chairs the Sustainable Infrastructure Committee.

Currently Executive Director of the Singapore Maritime Institute, Dr Kuttan previously served as Programme Director at the Energy Research Institute at the Nanyang Technology University managing the Energy System Project.

Prior to that, his experience ranged from line management (AP Technology Response Manager at ExxonMobil Asia Pacific); to business development at Mobil Oil Australia; to policy and program management with the Energy Market Authority during which he was part of two award-winning teams; to management consulting in the area of Petroleum Practice at McKinsey & Company; and to business leadership as Managing Director of the Clean Technology Center and Country Manager, DNGVL - Energy.

He was recently appointed for two year to the Pro-Enterprise Panel under the Ministry of Trade and Industry. He is currently also an advisory committee member to the School of Electrical Engineering at the Ngee Ann Polytechnic and Stamford Primary School in Singapore. The Ministry of Education Singapore awarded the Service to Education Award for his service to Stamford Primary School in 2012 and 2017. Dr Kuttan was also a council member on the Singapore Chapter for the World Business Council for Sustainable Development up till 2015.

Dr Kuttan graduated from the National University of Singapore with a doctorate in Pharmacology in 1993, after receiving his honours degree in Biochemistry from the same university in 1988. He was a research fellow at the Institute of Molecular and Cell Biology before joining the private sector in 1994.



Kavita Gandhi

Kavita is a member of the Singapore Decarbonization White Paper committee and she is the Executive Director of the Sustainable Energy Association of Singapore (SEAS).

Kavita is a key figure and pioneer in environmental management in Singapore. She set up the pilot Centre for Clean Technology & Environmental Management in Singapore as part of the United States-Asia Environmental Partnerships (US-AEP) project to educate manufacturers on pollution prevention and source reduction.

Subsequently, she was Manager of the Singapore Association for Environmental Companies (SAFEEO) where like-minded companies could meet and network and transform Singapore into a hub for environmental technology and service. In 2006,

Kavita accepted her current appointment with SEAS and leads efforts to develop the sustainable energy capacity of Singapore.

Kavita has an MSc in Environmental Management from Wye College, University of London.



Laurence Kwan

Laurence is a member of the Singapore Decarbonization White Paper committee.

Laurence has diverse experience spanning more than 20 years in the public and private sectors. Currently Director, Energy of Singapore's largest clean energy provider Sunseap Group, Laurence is the organization's subject matter expert in the areas of electricity and electricity transactions in Singapore and Asia-Pacific.

After a long service in the Republic of Singapore Navy as a Military Officer, Laurence moved on to Hyflux in the private sector, where he was Acting Plant Manager in Algeria. He continued building experience and his network across the industry with various companies before joining the Diamond Energy Corporation as Business Development Manager.

By the time he left three years later to accept an appointment with his current organization, he was General Manager.

Laurence graduated with an Advanced Diploma in Telecommunications at the Singapore Polytechnic in 1998.



Vinod Kesava

Vinod is a member of the Singapore Decarbonization White Paper committee.

Vinod is the CEO & principal founder of Climate Resources Exchange (CRX) and the CRX CarbonBank™, a web-based platform for transactions of instruments related to the environmental markets.

A pioneer in the carbon markets since 2003, Vinod was Executive Director and Chief Operating Officer of The GreenAsia Group, where he ensured establishments and developments achieve maximum sustainability through an integrative design approach (IDP).

Prior to that, he was in a similar capacity with the Asia Carbon Group, inventing, developing and implementing the world's first CDM-focused emission exchange. He was also the principle architect of the Asia Carbon Exchange's unique auction system which was recognized by market leaders as the primary instrument responsible for transparency and price discovery.

He is currently Chairman of the Circular Economy Committee of the Singapore International Chamber of Commerce.



Peter Godfrey

Peter is the chief regional representative of the UK Energy Institute based here in Singapore. In addition to his work with the EI, Peter provides customised executive advisory services through his own company Merlenergy Pte Ltd and as an Associate Director of Tembusu Asia Consulting, Asia's leading consultants in sustainability.

Peter has gained an international reputation as a leading independent energy strategy and business development consultant with an executive-level international client-base that has included the world's leading national and international energy and mineral resource companies as well as a number of governments and regulatory agencies.

Most of Peter's career has been spent in the Oil and Gas industry, mainly with BP. Here in Singapore, Peter was Head of Oil & Gas in Standard Chartered Bank's principal finance team and prior to that, he was a member of Arrow Energy's executive leadership team.

His interests have now extended into renewable and alternative energy development and addressing issues related to industry transition towards a lower carbon, greener and cleaner energy future.

Within this context, Peter has majored on promoting the relevance of "The Circular Economy" as a framework for the future development of energy systems worldwide.



Sanjana Somani

Sanjana is a member of the Decarbonisation White Paper Committee.

Sanjana works at Climate Resources Exchange International Pte Ltd. as a Contracts Executive. She is involved in the area of Climate Financing, Carbon Trading, Carbon Offsetting and Carbon profiling for various companies.

Previously, she has worked on different projects towards achieving Sustainable Development Goals such as Quality Education, Reduced Inequality, Responsible Consumption and Production and Climate Action.

She has done her Master-in-Laws from National University of Singapore, Singapore. She is a member of the Maharashtra and Goa Bar, India.

