



Study of Singapore as a Carbon Services Hub - Key Findings



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Acronyms and abbreviations

APAC	Asia Pacific
CAGR	Compound Annual Growth Rate
CCUS	Carbon Capture, Utilisation and Storage
CDM	Clean Development Mechanism
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
GVA	Gross Value Added
GHG	Greenhouse Gas
IMO	International Maritime Organization
JCM	Joint Crediting Mechanism
MNCs	Multinational Corporations
NDC	Nationally Determined Contribution
PMR	Partnership for Market Readiness
SEA	South East Asia
TCFD	Task Force on Climate-related Financial Disclosure
USD	United States Dollar

1 Introduction

Singapore has the opportunity to become a key carbon services hub for the Asia Pacific (APAC) region through strengthening regional markets and becoming a gateway hub for companies outside of APAC to engage with the region. This engagement is expected to initially be in the form of companies accessing carbon credits from voluntary and sectoral markets to address their own carbon footprints. Singapore also can support APAC countries in developing a regional carbon market, which is currently at a nascent stage.

Economic opportunities from carbon services could create a projected gross value added (GVA) of between USD 1.8 billion to USD 5.6 billion in Singapore by 2050. This range of economic opportunity that could be available to Singapore is wide, as carbon markets are still evolving and would depend on the market developments, such as the outcomes of Article 6 and efforts by voluntary carbon market initiatives. Jobs that could be created are mostly in services, such as the financing and trading of commodities supporting decarbonisation. New job types could also be introduced to Singapore related to governance services that ensure the integrity and tracking of decarbonisation.

This report discusses the role Singapore can play as a provider of carbon services to support the climate ambitions of corporates and governments in the APAC region. It presents the key findings of the study commissioned by Enterprise Singapore and the Economic Development Board of Singapore to assess the economic opportunities arising from global carbon market developments and provide considerations for Singapore to help it develop as a carbon services hub.

The findings of the report are based on an evidence-based approach that analyses the structure of the global carbon services value chain, the demand drivers for carbon services, the cities recognised as carbon services hubs and how they have developed as hubs, and complementary dynamics between hubs. The resulting report answers the following questions to support Singapore's policymakers in determining the value offered by developing a carbon services ecosystem in the city-state:

- 1) What is the global outlook for carbon markets?
- 2) What is the ecosystem of economic opportunities and jobs that could be realised in Singapore by 2050 as carbon services activities intensify?
- 3) Where in the carbon services value chain is Singapore well-positioned to participate?
- 4) What are the considerations for Singapore in growing as a carbon services hub?

2 Understanding the value chain of carbon services

Carbon services constitute a suite of specialised services to support the decarbonisation of sectors through the generation and trade of carbon commodities (i.e. carbon credits¹ or allowances²) and other non-commodified ways.

To fulfil this decarbonisation function, new carbon services go beyond simply serving carbon markets. While carbon services are typically associated with those enabling carbon markets, it should be noted that, for the purposes of supporting decarbonisation, a suite of non-commodified carbon services such as advisory and advocacy complements the generation and trade of carbon commodities. From the private sector's perspective, decarbonisation activities involve reducing emissions within a company's operations, along with investing in carbon crediting activities inside a company's value chain (referred to as **insetting**) or outside of it (referred to as **offsetting**). The scope of carbon services also includes the public sector, for instance, through public advisory for the design and implementation of climate and carbon pricing policies.

Based on a data collection exercise covering 580 carbon services providers globally, **the project identifies 36 unique carbon services, categorised into 11 broad service types** as summarised in Table 1.

Table 1: Taxonomy of key carbon services types

Service type	Service subtype
<p>1 Advocacy and research services</p> <p>These cover organisations that influence public opinion and political decision-making through evidence-based interventions with the ultimate goal of achieving environmental improvements and preventing environmental damage.</p>	<p>1.1 Climate-related advocacy and research services</p>
<p>2 Advisory services</p> <p>Carbon market advisors provide technical support to corporate and governmental clients to help them navigate the complexities of climate policy and carbon markets, and also develop climate action strategies.</p> <p>Advisory services are further subdivided into five sub-types: corporate strategy; accounting and reporting services; engineering services; governmental advisory services; and marketing communications services.</p>	<p>2.1 Corporate strategy, accounting, and reporting services</p> <p>2.2 Engineering services</p> <p>2.3 Governmental advisory services</p> <p>2.4 Marketing communications services</p>
<p>3 Data and market analysis services</p> <p>Data and market analysis services focus on tracking carbon market developments and predicting their direction. This category is further subdivided into four subtypes: data services and market analysis; news services; rating services; and indexing services.</p>	<p>3.1 Data services and market analysis</p> <p>3.2 News services</p> <p>3.3 Rating services</p> <p>3.4 Indexing services</p>

¹ A carbon credit represents the act of reducing or avoiding the equivalent of 1 tonne of carbon dioxide (tCO₂) or an equivalent of another greenhouse gas certified under an eligible standard.

² An allowance is a permit to emit one tCO₂ equivalent issued by a regulatory body for compliance under an ETS that is structured as a cap-and-trade scheme.

Service type	Service subtype
<p>4 Financial services</p> <p>Financial services channel financing towards supporting decarbonisation in the economy through their existing financial services (e.g. debt, equity and fund management), along with financing the development of carbon projects that can issue carbon credits.</p> <p>Financial services include the following subtypes: investment bank financial services; development bank financial services; venture capital financial services; private equity financial services; impact fund services; asset fund services; sovereign wealth funds services; and pension fund services.</p>	<p>4.1 Investment bank financial services</p> <p>4.2 Development bank financial services</p> <p>4.3 Venture capital financial services</p> <p>4.4 Private equity financial services</p> <p>4.5 Impact fund services</p> <p>4.6 Asset fund services</p> <p>4.7 Sovereign wealth fund services</p> <p>4.8 Pension fund services</p>
<p>5 Project development services</p> <p>This service entails the development of projects that result in emission reductions (carbon projects), which are then certified under a specific certification standard and can be sold to others as environmental attributes.</p>	<p>5.1 Carbon project development services</p>
<p>6 Insurance services</p> <p>Insurance services provide protection against losses during the carbon project development process, such as losses resulting from an under-issuance of carbon credits.</p>	<p>6.1 Insurance services</p>
<p>7 Legal services</p> <p>Legal services cover all legal aspects of environmental market structure and sustainable finance transactions; litigation services such as contracts enforcement; dispute resolution among project owners, project developers and buyers; and legal and regulatory advisory on understanding current and emerging climate and carbon pricing laws and regulations relevant to project development.</p>	<p>7.1 Legal services for supporting financial transactions</p> <p>7.2 Regulatory advisory services (governments or corporates)</p> <p>7.3 Litigation services</p>
<p>8 Financial intermediation services</p> <p>These include services provided by the intermediaries that sell and trade carbon commodities, i.e. brokers and traders to other financial intermediaries or to the final buyer, as well as those that provide the marketplace for transactions to be conducted transparently (exchanges and clearing houses).</p>	<p>8.1 Brokering services</p> <p>8.2 Trading services</p> <p>8.3 Exchanges (marketplaces)</p> <p>8.4 Clearing houses (marketplaces)</p>

Service type	Service subtype
<p>9 Governance and infrastructure services</p> <p>These include four broad service types. Reporting standards services set mandatory or voluntary rules, along with the corresponding tracking and control mechanisms, designed to guide organisations and ensure their carbon accountability and transparency. Certification standards services are provided by organisations that register carbon projects and issue carbon credits for the emission reductions or 9.1 removals achieved by the activities. Validation 9.2 and verification services are provided by 9.3 accredited third-party auditors who confirm that a 9.4 project fulfils all the requirements of the certification standard in question. Registry services track the transfer of ownership of these commodities between the original owners, financial intermediaries and final buyer (where credits are retired). Therefore, registry services act as a type of data infrastructure service that tracks the flow of credits from carbon project development to its use in the voluntary and compliance markets.</p>	<ul style="list-style-type: none"> Reporting standards services Certification standards services Validation and verification services Registry services
<p>10 Innovation ecosystems services</p> <p>These services help new organisations or ideas across the carbon services chain emerge (e.g. 10.1 through training, knowledge sharing or providing 10.2 managing support) and work as a catalyst for development in the carbon sector.</p>	<ul style="list-style-type: none"> Business incubation services Networking services
<p>11 Green services</p> <p>These are a range of services that support other carbon services and include: utilities services provided by utility organisations and that are consumed by the public as electricity from renewable sources or e-transport; big data and artificial intelligence services related to the development of intelligent machines and the use of big data for carbon-related purposes like 11.1 measuring climate risk (e.g. collecting satellite 11.2 data that can be used to measure greenhouse gas 11.3 (GHG) emissions in specific regions, verify the 11.5 physical impacts of climate and support carbon project verification); software development services such as applications for carbon infrastructure and crediting programme needs (e.g. development of registry software), carbon footprinting apps etc.; and specialised green recruitment services (including recruiters and recruitment platforms).</p>	<ul style="list-style-type: none"> 11.1 Utilities services 11.2 Big data and artificial intelligence services 11.3 Software development services 11.5 Recruitment services

(Source: South Pole, Vivid Economics and engeco, 2021)

The service types provide one or more of the following functions towards supporting the decarbonisation objective. These functions are:

- 1) **Function 1: Knowledge and advisory** shapes the market by influencing the strategies of organisations around climate change, thus enabling demand for carbon project development (function 2) and the trade of carbon commodities (function 3).
- 2) **Function 2: Carbon project development** covers services related to the development of mitigation projects and issuance of carbon credits.
- 3) **Function 3: Carbon commodity trading** refers specifically to services supporting the trading of carbon commodities in the primary and secondary markets.
- 4) **Function 4: Market acceleration** includes services that introduce innovative processes, services and products that boost transformational change.

The relationships between different service types and the interrelations between specific functions shape the **organisational structure of the carbon services value chain**, as shown in Figure 1 below.

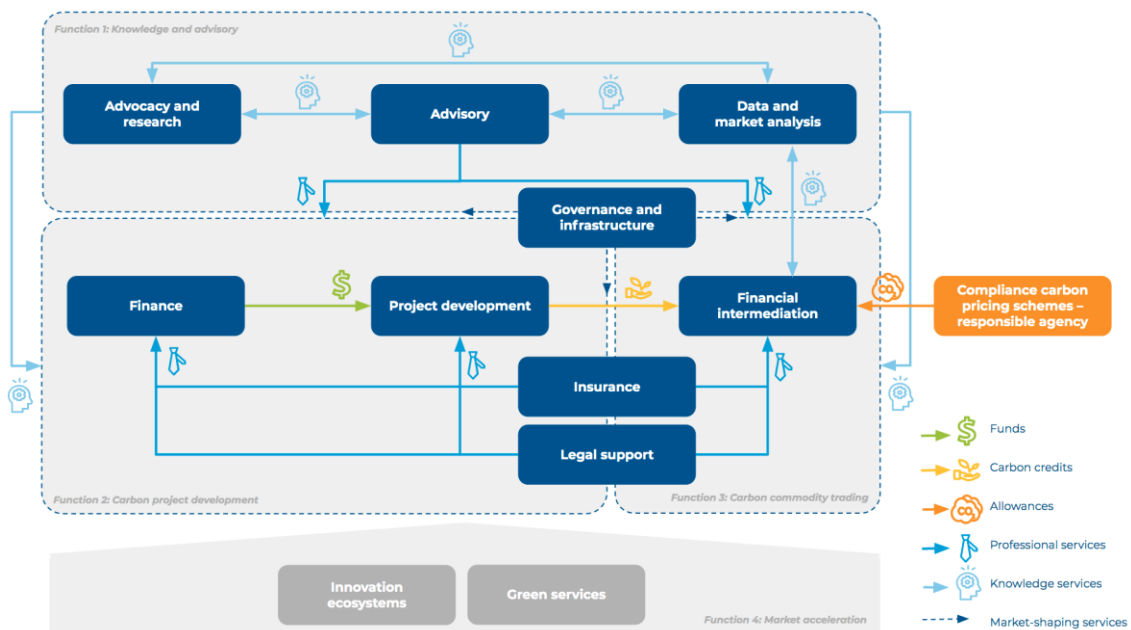


Figure 1: Organisational structure of the carbon services value chain

(Source: South Pole, Vivid Economics and engeco, 2021)

A carbon services hub is a city or region that clusters organisations and labour for either a broad range of carbon services or a specialised segment in the carbon services value chain, and has both inward and outward linkages with other hubs and regions. These linkages indicate the ability of the hub to attract external actors to tap into the resources present in the hub, as well as its ability to link with other hubs and regions to provide services, investments, and cooperation.

3 Global carbon market outlook and Singapore's economic opportunities

3.1 Three different scenarios modelled to assess the magnitude of global values

Three scenarios were used in the modelling of carbon services, based on the potential evolution of carbon markets. Each scenario used distinctive assumptions to represent three possible scenarios for carbon markets:

- 1) A **global scenario** in which all countries of the world adopt a compliance scheme by 2050. Here, the demand for carbon services primarily comes from the expansion of compliance markets. It is assumed that 100% of country emissions are covered by a scheme, in the form of an ETS or carbon tax, by 2050. Those jurisdictions with an existing or announced scheme would be maintained, whereas the rest of the countries would eventually adopt one, with the latest scheme starting by 2040.

Here, the participation of voluntary markets would be by supplying offsets to compliance schemes, up to a certain limit. Sectoral schemes such as CORSIA and IMO would also be in place, with CORSIA having begun in 2020 and IMO expected to begin in 2030. Carbon prices will eventually converge in 2050 for jurisdictions with existing schemes.

Assumptions on what the price might be in 2050 come from different studies conducted by Vivid Economics, the European Commission, IETA and the OECD published in recent years. For regions with existing schemes, the price by 2050 reaches almost USD 250 per tCO_{2e}. Whereas, for regions with no schemes in place and without previous work on carbon pricing, the prices are one third of that, although these exhibit higher growth rates on an annual basis, from a very low price (e.g. USD 3) to around USD 82. In the ASEAN region, the price is modelled at almost USD 150 per tCO_{2e} in 2050.

- 2) A **fragmented scenario**, which represents an extension into the future of what exists today. Here, compliance schemes will exist not only for those that are in place already, but gradually more countries adopting one until all countries who are part of the World Bank's PMR have one scheme, for a total of 70 jurisdictions adopting a compliance scheme. It is assumed that 100% of emissions for those jurisdictions with a compliance scheme will be covered by 2050.

As in the global scenario, a limited number of carbon credits from voluntary markets are supplied as offsets to compliance schemes. Corporations also adopt mitigation targets, as not all countries respond to the need to achieve the goals of the Paris Agreement. The necessary emission reductions beyond what can be achieved by corporations are compensated by credits from voluntary markets. Sectoral schemes also participate, with CORSIA and IMO starting in 2020 and 2030 respectively. These schemes rely on the supply of carbon credits from voluntary standards.

- 3) A **voluntary scenario**, that represents a world with the lowest mitigation ambition. In this scenario, only the existing compliance schemes continue to be in place, without any new schemes being adopted. The compliance schemes still receive carbon credits from voluntary markets as offsets, up to a certain limit. The rest of the market growth will come from corporate claims and sectoral schemes that constitute the main source of demand for offsets.

In this scenario, around 45 countries have a compliance scheme in place with a coverage of around 80 to 100% of national emissions. The corporate claims are represented by improvements in emissions intensities on a sector-by-sector basis in the most emissions-intensive sectors (e.g. cement, steel, oil and gas, and aluminium). Given the lack of stronger demand for reductions, it is assumed that the price evolves but is kept low compared to prices in the other scenarios and reaches USD 20 per tCO_{2e} by 2050.

Table 2: Summary table of the scale of global carbon services growth

		Global	Fragmented	Voluntary
Scenario description		Compliance schemes covering all emissions by 2050 (with sectoral systems in place), limited reach from voluntary services	Compliance schemes covering emissions of ~70 countries by 2050, voluntary carbon market significant	Compliance schemes covering 45 countries by 2050, carbon markets mainly driven by sectoral and voluntary offsets
Country coverage (Compliance schemes)		All countries in the world by 2050	~70 countries by 2050	~45 countries by 2050
Coverage of compliance schemes		100% coverage per country	80% coverage per country	80% coverage per country
Carbon price		Converging high price	Differentiated price per region	Overall low price
2050 projections World	Emissions coverage ³	10,537 MtCO ₂ e	25,185 MtCO ₂ e	14,332 MtCO ₂ e
	Value	USD 1,389 billion	USD 2,453 billion	USD 589 billion

(Source: South Pole, Vivid Economics and engeco, 2021)

3.2 Why does the fragmented scenario have the highest value for carbon services in 2050?

As Table 2 above demonstrates, the difference in the global value for carbon services among the scenarios is explained by how fast decarbonisation will occur, due to the strength of the carbon price signal under each scenario, and therefore, the reliance on carbon commodities as a flexible, cost containment measure that is needed to meet these targets. As a rule of thumb, the higher the reliance on carbon commodities to act as cost containment measures for high carbon prices, the greater the demand for, scope of, and value of carbon services. The scope of high-value carbon services needed is most likely to involve project financing, trading, and the support system of services (that is, governance, legal and insurance) to enable market transactions. Furthermore, knowledge and innovations systems services are needed to ensure the integrity of the market and enable decarbonisation. This explains why the fragmented scenario has the most value in comparison to the global scenario and voluntary scenario.

Under the global scenario, the assumption is that all countries are ambitious and commit themselves to collectively achieving the goals of the Paris Agreement through setting a very strong carbon price signal that leads to a steep decarbonisation curve. While the global scenario will rely on high-value carbon services in the short to medium term, by 2050, the global economy is expected to have decarbonised and transitioned to being a low-carbon economy. This explains why the emissions coverage under the global scenario is the lowest of all three scenarios. However, the global scenario still has a higher market value for carbon services than the voluntary scenario as it still assumes that the remaining emissions, which represent the most difficult emissions to abate, will require the most valuable high carbon services (e.g. the most expensive carbon credits or abatement technologies).

³ Refers to the proportion of emissions that will require carbon services.

On the other end of the spectrum is the voluntary scenario, which assumes the level of ambition does not increase beyond the current level. As such, the scope (in terms of countries and sectors) and strength of the carbon price signal is rather weak to instigate deep decarbonisation. Therefore, there is not as much compliance demand for services to support the decarbonisation of existing sectors. It is assumed that there will be greater reliance on voluntary efforts of proactive companies, most likely those headquartered in economies that have a carbon price signal, to have demand for carbon services. Given that these are voluntary efforts, it is unlikely that all voluntary efforts will lead to a carbon price signal that would need to rely on carbon commodities to flexibly meet ambitious targets. As such, there would be less reliance on project financing for carbon credits or arbitrage opportunities between carbon commodities. This explains why the emissions coverage of the voluntary scenario is the second highest between the three scenarios but has the lowest value of all three scenarios. Under this scenario, the scope for demand and value of these carbon services would be low.

The fragmented scenario has the most value because it does send a strong enough carbon price signal to have more ambitious targets but assumes that deep decarbonisation to a Paris pathway would not have been achieved. As such, compliance actors will still need to rely on carbon commodities as flexible, cost containment measures to avoid negative economic consequences of strong carbon price signals that are set to meet ambitious targets in 2050⁴. The fragmented scenario thus covers the most emissions and relies on the parts of the value chain that provide the greatest value to the economy.

Based on current assessments of policy ambition and voluntary sector momentum, the Consulting team agrees that the fragmented scenario is the most plausible. Though the optimal situation would be for the global scenario to be realised to avert disastrous climate change, current policy efforts suggest it is less probable that policymakers will be willing to implement a strong enough policy signal to instigate deep decarbonisation efforts at the pace and level needed to meet the Paris targets. Conversely, given the increasing pressure for Parties under the Paris Agreement to increase their ambition to decarbonise, along with increased pressure on the private sector to address their climate risk by setting and meeting science-based targets, it is unlikely that the voluntary scenario will occur. It should be noted that if the global scenario does occur, those economies that played a significant role in providing carbon services will still have a first-mover advantage in a low-carbon economy. Their efforts to decarbonise the economy provide them with the foresight to change the nature of their services to operate in a low-carbon economy.

As the fragmented scenario is the most likely to occur, the following section provides the quantitative results of the fragmented scenario to estimate the potential economic opportunity for Singapore.

3.3 Opportunities for Singapore

In the modelling, we estimated the value created in Singapore by providing services to the decarbonisation of each country around the world, where such decarbonisation may happen through voluntary demand (corporate targets that require carbon offsets), aviation and shipping demand (sectoral decarbonisation via carbon offsets) and by compliance instruments (an ETS or carbon tax) where a percentage is via carbon offsets and the remaining is via carbon credits (that would be equivalent to allowances in an ETS).

⁴These negative economic consequences include loss of economic competitiveness and jobs when foreign jurisdictions do not adopt as strong a carbon price as the domestic carbon market, and there is a lack of low-carbon technologies and processes that can allow domestic actors to reduce their compliance costs. Carbon markets that trade carbon commodities (both allowances and/or carbon credits) can be designed to set a strong carbon price signal that aligns to the GHG reduction target, but also be designed to include cost containment measures *if* the carbon price exceeds thresholds that would undermine the competitiveness of the domestic compliance actors. These cost containment measures include increasing the supply of allowance that were held in a reserve by the government (similar to the European Union's Market Stability Reserve mechanism for its emissions trading scheme), or increasing the amount of carbon credits compliance actors can surrender in lieu of paying the carbon price for its emissions.

In every case, for every market in every country, every US dollar of value created comes from employee compensation, fixed capital creation, income surplus, subsidies, and taxes. The value is created from delivering carbon services for voluntary, sectoral and compliance markets in each country. The value creation calculation does not imply that Singapore must have an ETS in place, but rather, that Singapore may serve systems and demand in the region. Countries in the APAC region, including SEA, feature more prominently in the projections due to their geographical proximity and the higher intensity of cross-border commercial interactions.

3.3.1 Singapore’s economic opportunities set to grow

As seen in Figure 2 below, the GVA for Singapore from the provision of carbon services is set to grow to approximately between USD1.8 billion to USD5.6 billion in 2050. The addressable markets are services needed to support compliance markets, and the demand for services from the voluntary market and sectoral markets (from CORSIA and IMO).

Considering Singapore’s strengths as a regional hub for finance, trading and legal services, the largest source of opportunity for Singapore comes from financial, financial intermediation, and legal services to compliance schemes. However, this is contingent on the setting up and launching of the compliance schemes in SEA. The relative opportunity is lower for sectoral schemes as they only represent a subset of economic activity, and for voluntary markets, where the need for carbon services would only come from corporations adopting targets.

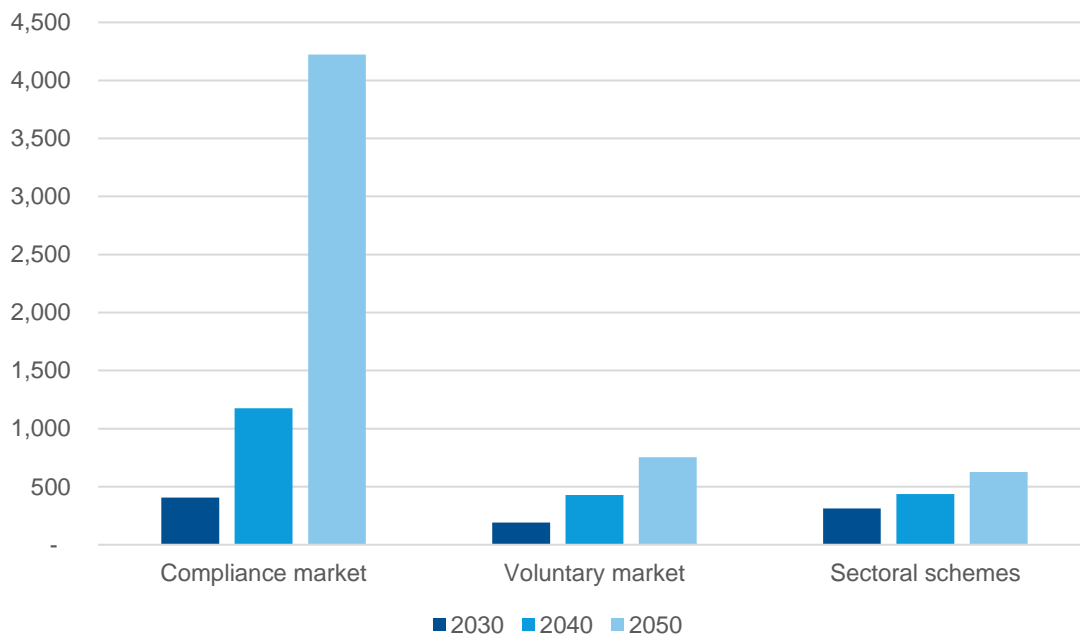


Figure 2: GVA (USD millions) to 2050 under the fragmented scenario

(Source: South Pole, Vivid Economics and engeco, 2021)

3.3.2 Supporting regional growth

Some countries in SEA are in the process of designing and implementing compliance schemes. However, there is uncertainty on when this will happen, as a compliance scheme may take several years (from 5 to 10 years) to design and set up before it is ready for full implementation. Such lag time is also associated with the required capacity building across the value chain in the country for it to be ready to adopt such a scheme. Therefore, in the short term, Singapore can play a role in supporting capacity building in these countries, particularly on carbon accounting, MRV (monitoring, reporting and verification) and governance for carbon crediting.

In the medium term, Singapore could leverage its strengths to finance mitigation actions and carbon crediting projects in different sectors, as well as the trading of carbon commodities. In the long term, and subject to wider adoption of compliance schemes in SEA, Singapore might consider facilitating financial intermediation and trade and the further development or adoption of reporting standards for carbon disclosure.

3.3.3 Supporting aviation and shipping decarbonisation

Singapore is an important transport and bunkering hub for international aviation and shipping activities, and holds a strong position for serving these sectors. In that regard, Singapore already hosts verification bodies that verify aircraft operators' annual operations, and the country itself is a CORSIA participant.

In the case of IMO, the plans for adopting a carbon compensation scheme similar to CORSIA are less evident, and the IMO may follow a different route to decarbonise international shipping operations, as the attention is on energy efficiency. However, the IMO has not ruled out the use of a flexibility mechanism to meet sectoral targets.

In the short term, Singapore may facilitate the procurement of eligible carbon credits for domestic aircraft operators or finance projects that result in the issuance of CORSIA-eligible carbon credits. Similarly, the government may aim to foster advisory services relating to emissions reductions. Governments around the world have financed Article 6 pilots and studies in that direction, a step that has helped in building capacity across government agencies in the country and neighbouring countries (or in those in which some degree of cooperation or collaboration exists).

In the medium term, the government of Singapore may play an important role in the definition of IMO's steer on climate policies or sectoral decarbonisation.

If IMO does not adopt a scheme similar to CORSIA, the opportunities from sectoral schemes will be contingent on the recovery of the aviation industry and the recuperation of international flights after COVID-19. Similarly, a key challenge may come from outcomes of international negotiations that affect the implementation of the Paris Agreement and the level of ambition, including those influencing the willingness of other countries to undertake corresponding adjustments or enhance mitigation ambition in the coming years.

3.3.4 Supporting voluntary action

Singapore could also play a role to support the voluntary adoption of mitigation targets by corporations in the region and around the world. Voluntary action is expected to have a greater influence on sectors and corporations that are either significantly exposed to public pressure, including from their consumers or clients, or whose Board is influenced by the disclosure and decarbonisation trends observed around the world.

This pressure is particularly seen for companies headquartered in Europe and North America. Governments and investors are putting greater pressure on companies to mandatorily disclose their carbon footprint as a way of assessing systemic climate risk under the Task Force on Climate-related Financial Disclosure (TCFD). As many of the large companies are multi-national, they are required to disclose their global carbon footprint, including emissions from operations and supply chains in the APAC region. Singapore is a regional host for a number of European and North American companies that have adopted targets towards carbon neutrality or net-zero emissions profiles. Therefore, Singapore is well-positioned to provide carbon services in terms of advisory services, insetting or offsetting emissions for the regional operations for European and North American companies.

More broadly, the Singapore Government could also support companies to voluntarily undertake similar ambitious climate action, particularly through awareness raising of climate risk.

In the context of voluntary markets, Singapore may consider supporting companies through awareness raising, disclosure of climate risk, financing of activities leading to direct mitigation or

the creation and verification of carbon credits that would facilitate companies' decarbonisation and advisory services related to decarbonisation strategies.

3.3.5 Existing and new professions in Singapore

To meet the demand for carbon services around the world, we expect the number of professionals geared towards providing carbon services to grow, largely in existing services that Singapore already provides, and also new services such as those related to governance and infrastructure (e.g. registries, IT, etc.) of carbon markets.

Most of the jobs are created in financial and financial intermediation (e.g. carbon trading) services. A large part of jobs growth in this sector by 2050 is contingent on the adoption of new compliance schemes in SEA. The modelled entrance of new systems in different countries is reflected by an important increase in jobs creation between 2040 and 2050.

The jobs created are in economic activities already established in Singapore, such as financial services. This suggests that more professionals in existing sectors will need to use existing skills to support clients in their decarbonisation needs, leading to an increase in the number of jobs in existing sectors. However, given that Singapore could also be the hub for the certification and verification services of projects in the region, there would also be an increased demand for these new types of jobs.

4 Singapore's performance in the APAC region

Today, Singapore is a leading location in the APAC region for carbon services. Considering factors such as climate policy, economic opportunity, sustainability and innovation culture and geographic attributes, which are important factors to be a carbon services hub, Singapore performs well across these categories given its geographical attributes and existing climate policy frameworks. A potential area of improvement, however, is to push for the creation of economic opportunities for carbon services, particularly by exploring all possible economic opportunities from domestic decarbonisation activities, improving the current ecosystem of carbon services, and upgrading current skills and experience in carbon trading.

Other leading locations in APAC are Seoul, Sydney, and Shanghai. A key reason for Seoul, Sydney and Shanghai's success is their relatively strong climate policies which helped to create demand for carbon services domestically. Considering the learn-by-doing nature of carbon pricing, the presence of existing carbon pricing policies in some form is a major experiential advantage to these cities, including Singapore.

Singapore has the opportunity to develop a carbon services hub that is outward-looking in orientation.

The carbon services industries in other leading locations like Seoul and Shanghai are expected to primarily serve their large domestic markets. Tokyo, as well as Japan more broadly, has seen significant recent activity from companies making commitments to support the Government's intentions to reach net-zero emissions by 2050. These efforts are expected to be focused primarily on domestic emissions within Japan, although Japan has been working for many years in the area of carbon markets to source international carbon credits via the Joint Crediting Mechanism (JCM) – and the Japanese Government intends to use these credits to meet its Nationally Determined Contribution (NDC) target. Locations like Sydney have a long-established carbon services industry that serves both domestic and international markets. The Australian carbon services industry supports both the compliance market that exists under the Safeguard Mechanism and Climate Active, the Government-supported carbon neutrality certification scheme. There are already instances of skills and experience being imported into Singapore from Australia to support growing carbon services, such as verification and assurance activities.

Given our export-oriented economy, there is an opportunity for Singapore to complement the hubs in Seoul, Shanghai, and Sydney to serve international markets.

Singapore can also learn from other global carbon services hubs. London's emergence as a global carbon services hub, for instance, underpins the importance of being an early mover in setting the right policy signals in the region that can be its source of demand and amassing talent and skills. The UK piloted its ETS four years ahead of the EU ETS, influencing future rules. London's carbon services industry is already more than two decades old and its breadth and depth of carbon services knowledge – which is crucial given the sector's highly technical nature – spans GHG emissions calculations, financial services, decarbonisation pathways and policy. London is also a centre for thought leadership with globally focused think tanks and advocacy groups making it their base.

The carbon service hubs of London and Amsterdam are much more outward looking with regard to providing carbon services to other cities and regions. Both London and Amsterdam demonstrate the importance of domestic ecosystems engaging early in developing carbon markets to nurture the technical and experiential expertise needed to make these markets grow and uphold their integrity. This provides domestic services with a first-mover advantage in providing carbon services in other regions that are setting up their own markets. As the technical requirements for these markets continue to develop to address evolving challenges, particularly as markets integrate across geographies and sectors, their first-mover advantage is sustained by being at the forefront of understanding how to develop effective solutions. It is difficult for services in other hubs to scale the learning curve as quickly, particularly as the 'frontier' of these markets continues to advance.

5 Singapore's value proposition as a carbon services hub

Singapore has an attractive value proposition to grow as a carbon services hub. It performs well on several key drivers deemed necessary for making a location attractive for clustering carbon service providers and forging inward and outward linkages.

These drivers were identified through detailed case studies on the following successful carbon services hubs: London (recognised as a carbon services hub that provides a breadth of carbon services globally), Amsterdam (a carbon services hub that specialises in financing and trading carbon commodities globally) and Shanghai (a hub that provides a breadth of carbon services to the domestic market). Interviews with relevant experts also supported the data collection process and findings.

Singapore has several pre-existing advantages that can be capitalised to develop a thriving carbon services industry. Singapore already has a small but growing carbon services industry, with 14 companies involved in carbon services headquartered in the country and 73 MNCs (mainly from Europe and North America) with regional offices in the city-state, as per our data collection. The companies working in carbon services cover most of the carbon services value chain, although financial, financial intermediation and legal services are the key services offered in Singapore.

Singapore is a regional hub for commodity trading and, is therefore a favourable location for companies to set up their commercial base for providing carbon services across the region. This may involve providing a local hub for these MNCs to procure carbon credits from the region and/or develop insetting projects within SEA-based supply chains for these MNCs. Moreover, being an international aviation and shipping hub makes Singapore an attractive carbon credits trading destination for international sectoral schemes such as CORSIA.

Singapore has a robust climate policy framework and has already set short, medium and long-term targets for decarbonisation. These targets are supported by the central policy lever of Singapore's 2030 GHG reduction target under its NDC of the Paris Agreement and its 2050 Long-term Low Emissions Development Strategy. Furthermore, Singapore's carbon tax provides a clear price signal for domestic reductions and additional climate policies exist under frameworks like the Singapore Green Plan. Acting to Singapore's advantage is the **strong policy alignment at the government and institutional levels, as well as evidence of a collaborative, multi-ministry approach to climate action planning.** Strong public governance structures for climate change extend into the Government's support for sustainability and innovation more broadly, with it playing an important role as an active player in this area.

Last but not the least, geographical attributes such as an English-fluent population, a high standard of living, a stable economy with a good governance track record, and an international transport hub make Singapore an attractive destination for foreign talent and companies. These geographical attributes already work in Singapore's favour and partly explain why Singapore is the regional headquarters of commodity trading companies and MNCs, particularly those headquartered in Europe and North America. Singapore is well-trusted internationally and can build on this reputation. As Singapore's legal system is modelled after the English Common Law system, it can also benefit from legal expertise in London that can support carbon trading and transactions.

With the foundational attributes needed for building a services hub in place, our key recommendation to Singapore is to grow the industry where its strengths lie in terms of service types and its strategic geographical positioning in Asia. These are summarised next.

5.1 Where in the carbon services value chain is Singapore well-positioned to participate?

Examining the different streams of evidence collected in this study, we conclude that **Singapore is well-placed to play a key role in the development of carbon services for SEA and, ultimately, across APAC.**

As discussed earlier, Singapore already has clear advantages both in terms of its existing ecosystem of carbon services types as well as favourable policy and geographical attributes. It can build upon these to **finance, originate and trade carbon offsets, which can support neighbouring APAC countries to unlock the potential of offsets, and enable domestic and foreign companies to access the supply of carbon commodities to complement decarbonisation measures.** The services could focus on servicing the increasing demand for carbon credits in the coming decades under international sectoral schemes such as CORSIA, voluntary demand arising from corporate commitments towards decarbonisation, and Singapore and the region's future compliance demand.

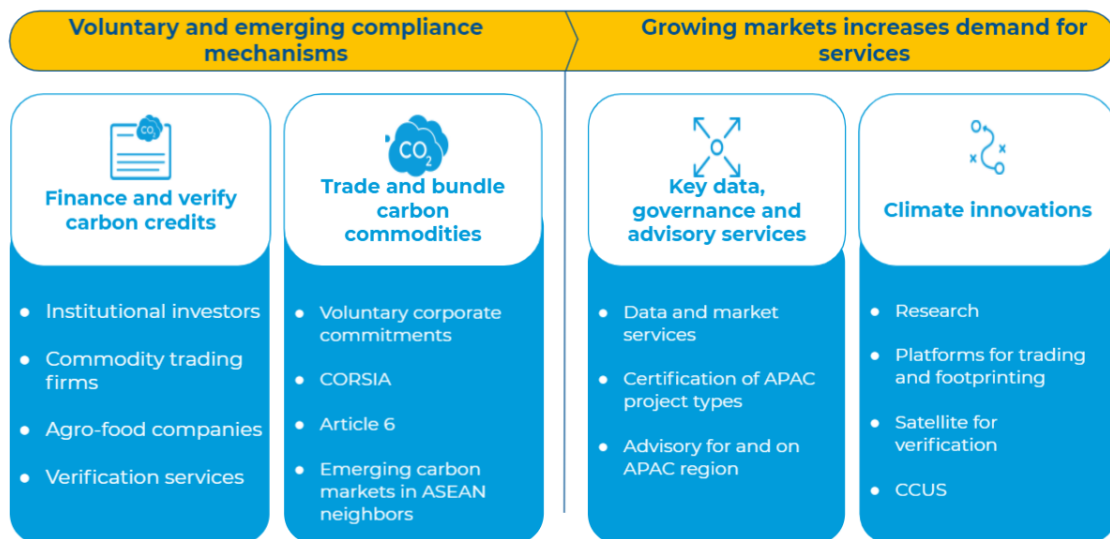


Figure 3: Illustrative summary of the key segments along the carbon services value chain that Singapore is well-positioned to offer

(Source: South Pole, Vivid Economics and engeco, 2021)

The extent to which Singapore becomes a carbon services hub will depend critically on the evolution of international and sectoral carbon markets – both voluntary and compliance. Key drivers include policy and technology advancement in decarbonisation, the integration of carbon markets and opportunities for arbitrage for carbon commodities.

Singapore's clearest near-term opportunity is in the financing and trading of carbon credits originating in SEA. SEA is a globally significant region for the development of high-value and cost-effective carbon projects such as nature-based solutions and industrial abatement projects. Regionally, 16 Asian countries have indicated a desire to utilise carbon markets as part of their NDCs, aiming to supply credits to a global market. Singapore is well-positioned to support and complement growth in these regional locations, due to its proximity and the breadth of Singapore-based companies that could support investment in and the use of these credits. This, in turn, also supports additional carbon services such as insurance and legal services. In addition, **verification services could be supplied from Singapore as a base through the region,** building on the existing services provided by emissions inventory assurance providers in Singapore.

In the near term, carbon services in Singapore can support the voluntary market and the emerging compliance markets throughout the region and potentially globally. These markets are likely to be driven from specific sectors (e.g. the CORSIA scheme) and/or demand from large MNCs to support their decarbonisation efforts. With increased scrutiny on the value chain emissions for large companies and increasing calls for them to take responsibility for their Scope 3 emissions, the voluntary market is likely to see growth from this area. European and North American MNCs, along with Australian resource companies, are increasingly under pressure from stakeholders and investors. Energy and mineral resource companies, which are already trading these commodities in Singapore, are exploring the potential of bundling these commodities with carbon credits to compensate for the carbon footprint of these commodities.

As the market grows on the voluntary side and compliance markets emerge, **the scope of services supplied by Singapore will likely grow to encompass the governance and infrastructure of carbon credits and data/market analysis across the region.** Advisory companies, providing advice to companies and governments in SEA, can operate out of Singapore, building on the city-state's first-mover advantage developed by servicing the local market in the near term. The growth in the market for carbon services in these years will also support the development of innovations and research-related services, also building on the country's strong innovation and research culture.

5.2 Which regions could Singapore complement in providing carbon services in the APAC region?

Singapore can realise complementary dynamics with other hubs involving the supply and trade of carbon credits. Complementary areas such as the financing of regional carbon reduction projects and trading the generated credits to serve offsetting demand of MNCs have already been discussed – as has the presence of regional offices and headquarters for both MNCs and carbon services providers from Europe, North America and Australia.

Singapore can also build partnerships with leading carbon services hubs in Europe and North America that are shaping international carbon markets, particularly around the Paris Agreement rules, to more effectively develop the governance and infrastructure systems necessary for SEA. Such engagement is necessary to ensure that carbon credits from SEA can be used in a greater number of international and sectoral schemes. In a similar vein, although Singapore is not servicing key markets in the region which have a more domestic focus (e.g. Chinese ETS, Australia, New Zealand), it can help enable markets in Southeast Asia by actively participating in and influencing multilateral (World Bank, UN ESCAP) and bilateral (ADB) channels facilitating markets in the region.

Furthermore, **complementarity can be explored with hubs in the APAC region that specialise in the type of carbon services Singapore may want to build its own capacities on. A primary candidate is Australia,** which has a mature project development, verification, and assurance services industry. Singaporean companies could, for instance, learn from the project development experience of Australian companies and project developers by collaborating with them to develop methodologies for novel project types and share technical competencies on sourcing and certifying carbon projects in the APAC region. An example of this may be in CCUS, where Australia is currently developing methodologies to generate Australian Carbon Credit Units from CCUS activities.

5.3 Considerations in growing Singapore as a hub

While several factors are working in Singapore's favour for the continued development of carbon services in the country, **certain challenges can be foreseen and will need to be addressed to effectively develop the industry.** These have been identified through the various evidence streams examined for the study and summarised below.

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- **The overall small size of the domestic carbon market and limited domestic demand:** Singapore has relatively low absolute emissions, meaning an insular market for carbon services (i.e. one that only services domestic demand) would be limited by size and domestic offsetting options. Experts draw parallels between Singapore and South Korea in this regard. However, a key reason for momentum in the South Korean carbon services industry is the integration of carbon credits in the compliance instrument whose ambition and scope is expected to increase in the future – a finding that resonates with our own experience in countries with new carbon pricing schemes such as South Africa and Colombia. Singapore’s carbon tax (under the Carbon Pricing Act of 2018) is robust with relatively wide coverage in terms of both taxable and reportable facilities. However, it does not provide the flexibility for carbon credits to be surrendered in lieu of carbon tax for compliance, hence creating limited opportunities locally for businesses with carbon services offerings to grow.
 - **Potential to grow a larger base of professionals to serve the carbon market:** Many high-value service types in the carbon services value chain are driven by experiential talent, i.e. skilled and entrepreneurial professionals from varied fields of study with inimitable skill sets that wish to tap into the opportunities in an emerging carbon services hub. Given that the carbon market is relatively nascent in Singapore when compared to established markets like London or Amsterdam, there is potential for the country to grow its global talent pool of carbon services professionals and groom locals with the requisite skillsets to take on roles in carbon services and trading

Specifically, **skills in carbon footprinting, including emissions inventory development, climate risk analysis and decarbonisation strategy development, carbon project origination and carbon trading have been recognised by experts as being in high demand.**

Interviewees have also highlighted the importance of a thorough understanding of the emerging areas in the sustainability/climate reporting space, such as the role of decarbonisation pathways, use of carbon commodities, market disclosure of climate risk exposure, amongst other areas.

6 Concluding Comments

This report has demonstrated that Singapore is well-positioned to become a carbon services hub to support the climate goals of corporates and governments in the region. Singapore has key attributes that make it predisposed to do so. It can leverage its strong positioning as a regional HQ to commodity trading services and MNCs, and geographic proximity to SEA to support the growth of regional markets. It also has a relatively strong policy intent with regard to climate change that acts as a catalytic factor in building a larger breadth and depth of the carbon services ecosystem needed to support the carbon services needs beyond its domestic market. There are various efforts that it can undertake in creating a conducive environment to attract and grow the current ecosystem. These recommendations fall into the category of catalysing innovation and building market expertise. Given that the Paris Agreement requires the entire global economy to decarbonise, Singapore can complement existing carbon services' hubs by playing a role to help corporates and nations in APAC achieve their climate goals and advance the global climate agenda.

7 Annex

7.1 Methodology

The future growth of carbon services and their value was modelled in a sequence of five steps.

7.1.1 Step 1: Compliance and sectoral markets forecast

The size of compliance markets is projected based on the number of carbon pricing and international sectoral schemes that are expected to be in place, as well as on their expected level of ambition. The starting point for forecasting compliance markets is the current and future coverage of the carbon pricing schemes that are in place. The three scenarios are:

- **under the global scenario**, all countries will have a compliance system in place (either an emissions trading system [ETS] or carbon tax), covering 100% of worldwide emissions;
- **under the fragmented scenario**, 70 countries will have a compliance system in place by 2050 – these include all countries with a compliance system either implemented or scheduled and countries that are currently part of the World Bank’s Partnership for Market Readiness (PMR) programme; and
- **under the voluntary scenario**, only countries with an existing or scheduled compliance system (i.e. 45 countries globally) will have a compliance system by 2050.

In terms of sectoral schemes, Carbon Offsetting and Reduction Scheme for International Aviation (CORSA) is assumed to develop as planned, with the pilot phase having begun in 2021 and entering its first phase in 2024. A system for international maritime activities governed by the International Maritime Organization (IMO) is expected to be launched in 2030.

7.1.2 Step 2: Voluntary markets forecast

The demand for carbon credits in the voluntary market is projected based on expected corporate claims towards carbon neutrality and on the scope of compliance markets, where it is assumed that corporates will maximise the use of carbon credits under compliance systems. Corporate claims are represented by increases in emissions intensities on a sector-by-sector basis for emissions-intensive and trade-exposed industries. The impact of compliance markets was defined based on the current number of carbon pricing schemes allowing carbon credits and on the proportion in which they are allowed.

7.1.3 Step 3: Carbon services sizing

The cost structure of compliance regimes and carbon projects were assessed to quantify the different services of the value chain. In the case of compliance markets, the cost structure was associated with the cost of participating under a compliance scheme, such as the cost of estimating emissions, their monitoring and verification, and the advisory required by markets participants to ensure compliance (e.g. through a carbon management strategy). The detailed services involved in both compliance and voluntary markets were mapped to the main components of the value chain as discussed in the previous section.

7.1.4 Step 4: Value creation of carbon services

Applying the methodology in step 3 produces estimates of the demand for the various carbon services resulting from the size of carbon markets in each country. To translate this into potential jobs, GVA and investment requires assumptions about the components of turnover which include intermediate inputs, employees’ compensation (payments to labour), fixed capital creation, subsidies, taxes and imports. This information is provided by input-output tables that are available

for a wide range of countries, including Singapore, from the Eora Global Supply Chain Database.^[2] To use this information, it is necessary to map the services outlined in step 3 to the sectors included in the input-output tables. This is simple for large sectors, such as legal services and insurance, but more complicated for niche services such as carbon credit verification. To obtain specific estimates for these niche services, information was taken from the more sectorally detailed input-output table for the US, adjusted to account for differences between US and Singaporean economies (such as import intensities).

7.1.5 Step 5: Location of carbon services

The result from step 4 is the potential GVA, employment and investment for each country that could be captured by Singapore through exporting carbon services. Economic analysis of trade flows in any sector is typically conducted using ‘gravity models’, so named because of the analogy to Newton’s gravity equation. The key insight of this approach is that trade between any two countries is positively related to the size of each economy and negatively related to the distance between them. Historical data was used to predict trade patterns within the ‘carbon services sector’. This involved incorporating the estimates of turnover from carbon services produced through step 3 as the ‘weights’ for each country. In addition, Singapore’s weight was increased for the estimation of exports to countries in the SEA, reflecting its potential to become a hub for carbon services in the region.

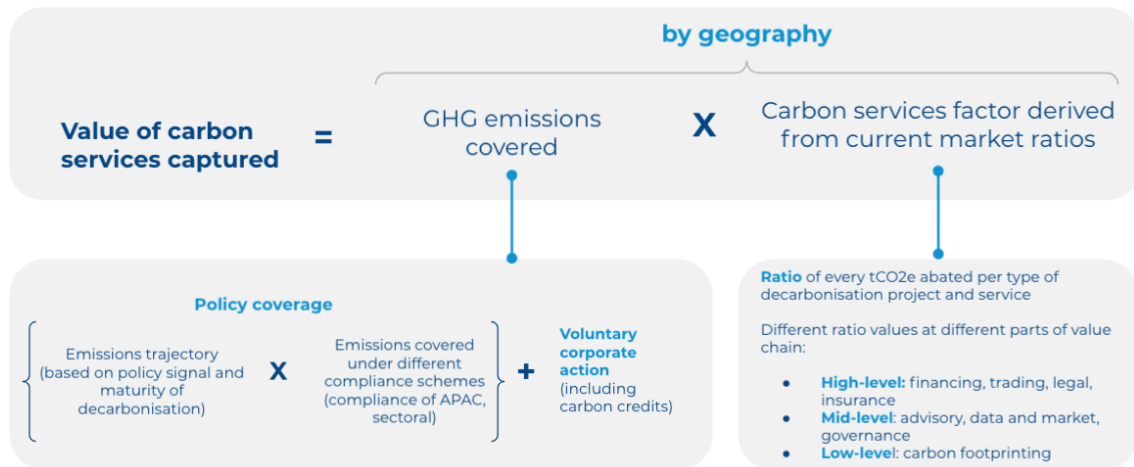


Figure 4: Methodological assumptions to calculate GVA and jobs for Singapore

(Source: South Pole, Vivid Economics and engeco, 2021)

