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RESEARCH ARTICLE



Positioning for net-zero: Singapore's extraterritorial agency in global production and financial networks

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ABSTRACT

The restructuring of global production networks (GPNs) towards decarbonisation is tightly coupled with a parallel transformation of global financial networks (GFNs), yet scholarship has given limited attention to their mutual dynamics. This paper addresses this gap by analysing how Singapore seeks to preserve its role as a regional trade and finance hub amid net-zero transitions. Building on the global production and financial networks (GPFNs) framework, the study shows that Singapore – led by its sovereign wealth fund (SWF) Temasek and associated state-owned enterprises (SOEs) and state-owned banks (SOBs) – leverages extraterritorial assets from neighbouring Southeast Asian countries to sustain its centrality in decarbonisation GPFNs. We identify three mechanisms of extraterritorial agency: mobilisation of capital and de-risking, targeted SOE investments, and occupying strategic positions in value creation. These mechanisms transform extraterritorial asset bases, generate self-reinforcing production–finance dynamics, and reproduce Singapore's sticky power. The paper contributes in three ways: (1) by responding to the call for greater attention to emerging renewable energy GPFNs, (2) by extending the GPFN framework to show how world governments exercise extraterritorial agency to align asset bases beyond their borders with their strategic objectives and (3) by deepening the understanding of the state-finance nexus in economic development strategies.

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1. Introduction

Singapore faces a critical economic and environmental crossroads as it pursues its goal of achieving net-zero carbon emissions by 2050 (NCCS, 2022), necessitating a profound transformation of its fossil fuel-dependent industries. However, Singapore's limited land area and low potential for domestic renewable energy production make it reliant on energy imports from neighbouring countries (EMA, 2024). Simultaneously, Singapore sees significant potential in positioning itself in new economic sectors (MOE et al., 2021). By leveraging its role as a financial hub, Singapore aims to support both its domestic transition and Asia's broader shift towards net-zero (MAS, n.d.-a). Maintaining its position as the region's trade and financial hub is therefore becoming increasingly intertwined with its net-zero agenda.

Historically, Singapore has successfully positioned itself as both an international financial centre (IFC) within global financial networks (GFNs) (Bastide, 2011; Chow & Pei, 2018; Lai, 2018; Thomsen et al., 2024) and a trading hub in oil and gas (O&G) global production networks (GPNs) (Breul & Revilla Diez, 2018; McGregor & Coe, 2023). The interconnections between the oil industry and finance sector have further strengthened Singapore's position within global production and financial networks (GPFNs) (Grote et al., 2024). Singapore's sovereign wealth fund (SWF), Temasek, and its associated state-owned enterprises (SOEs), have played a key role in these developments by supporting Singapore's embeddedness within O&G GPNs through extraterritorial strategies (McGregor & Coe, 2023). Temasek has been characterised as a strategic investment fund which invests in key sectors to advance Singapore's economic goals (Dixon, 2022; Haberly, 2011; Yeung, 2011). This reflects the broader role of state capitalism in Singapore's economic strategy.

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Given Singapore's state-led approach to economic development and the need to transition to a low-carbon economy, this study explores how Singapore seeks to maintain its central position in GPFNs amid net-zero transitions. In particular, it examines how Singapore leverages extraterritorial assets from neighbouring Southeast Asian countries – including renewable energy potential, green finance demand linked to regional energy transitions, and carbon credit creation – to advance its strategic goals. Vietnam represents a particularly relevant case, as it combines significant renewable energy potential and emerging carbon market opportunities rooted in its natural resource endowment with a strong demand for investments to realise these opportunities. Having become one of the key markets for Singapore's regional energy and carbon-related activities, Vietnam serves as a case study to analyse how Singapore, through Temasek-linked entities, leverages Southeast Asia's assets to advance its ambitions as a regional energy and finance hub. The paper addresses three questions:

- (1) What strategic goals is Singapore pursuing to realign its energy and finance sector with global and regional net-zero transitions?
- (2) How does Temasek promote the interplay between global and regional production and financial networks to advance its strategic goals?
- (3) How are Temasek-linked entities transforming extraterritorial assets to sustain Singapore's position as finance and trade hub in GPFNs?

This research responds to Grote et al.'s (2024) call for greater attention to emerging GPFNs of renewable energy, and extends this framework by showing how world governments – states with extraterritorial influence – can exercise agency to transform and mobilise extraterritorial assets where domestic assets are lacking. In doing so, the paper also contributes to emerging literature on extraterritorial state agency by showing that, beyond extraterritorial institutions (Kavelage & Walker, 2024), states themselves can reshape global economic networks in line with its strategic interests through SWFs and SOEs. Finally, the study advances a more systematic understanding of the state-finance nexus in economic development strategies (Lai, 2018; Lai, 2023), highlighting how states can directly influence private sector behaviour and market structures not only as facilitators, but as investors and owners.

The paper is structured as follows. First, we explore the role of the state in emerging GPFNs of decarbonisation and Singapore's prior position in O&G GPFNs. Next, we outline the study's methodological approach. Then, we explore the strategic goals Singapore is pursuing to align its energy and finance sector with net-zero transitions and how Temasek promotes the interplay between global and regional production and financial networks in line with its strategic goals. The discussion reflects on how Singapore's mechanisms of extraterritorial agency both reinforce long-standing features of its state-capitalist development model and adapt them to the emerging context of net-zero GPFNs, before the paper concludes.

2. Conceptual framework

2.1. *The role of the state in global production networks and global financial networks of decarbonisation*

Debates about the role of the state as an owner and investor in the global economy through actors such as SWFs, SOEs and state-owned banks (SOBs), have gained renewed attention (Alami & Dixon, 2023; Haberly & Wójcik, 2017; Lim, 2018; McGregor & Coe, 2023; Su & Lim, 2023). Scholars have identified two key features of the latest wave of state capitalism, distinguishing it as 'new' state capitalism (Alami & Dixon, 2024; Babic et al., 2020; McGregor & Coe, 2023). Firstly, SOEs increasingly act as hybrid entities, operating according to both private and public logics, unlike purely private firms (McGregor & Coe, 2023). While the degree of state ownership in SOEs can vary from minority to majority stakes, they often serve as instruments of state power to achieve political objectives, despite being market-oriented (De Graaff, 2012; McGregor & Coe, 2023). Secondly, 'new' state capitalism reached an extraterritorial dimension, as SOEs and SWFs expand internationally and become deeply involved in global financial, production, trade and infrastructure networks (Alami & Dixon, 2024; Lim, 2018). However, Babic et al. (2020) show that these state-led outward

investment strategies can vary in their objectives, ranging from financial approaches, predominantly used by liberal economies such as Norway, to control-focused strategies characteristic of more statist economies such as China. While the influence of the state was previously largely confined to national boundaries, it now extends beyond territorial borders in global economic networks (McGregor & Coe, 2023).

While GPNs are constantly subject to some degree of state influence (Coe & Yeung, 2015), this is especially pronounced in industries of strategic importance, such as energy (Horner, 2017). The strategic significance of the energy sector is tied to concerns over national energy security (De Graaff, 2012; Horner, 2017) and its central role in the economic development goals of states (Breul et al., 2019; McGregor & Coe, 2023). The O&G sector, as a cornerstone of the energy industry, has therefore been extensively analysed for state involvement in GPNs at both global and regional levels (Breul et al., 2019; De Graaff, 2012; Grote et al., 2024; Lim, 2018; McGregor & Coe, 2023). Lim (2018), for instance, demonstrates how SOEs engage in extraterritorial activities to both enhance energy security and sustain its economic growth domestically. In recent years, crises and geopolitical tensions have further highlighted the interventionist role of states in GPNs (Blažek & Lypianin, 2024; Gong et al., 2022; Pavlínek, 2024), especially in the energy sector (Kalvelage & Tups, 2024; Kalvelage & Walker, 2024). Climate change adds an additional dimension of urgency, as net-zero commitments compel states to accelerate energy transitions and decarbonise carbon-intensive industries, making access to clean energy sources a strategic priority for states (Kalvelage & Tups, 2024; Kalvelage & Walker, 2024). Particularly for countries unable to produce sufficient renewable energy domestically at competitive costs, securing renewable energy from abroad becomes strategically vital to remain integrated in GPNs. Through a case study of Germany's involvement in Namibia's green hydrogen industry, Kalvelage and Walker (2024), illustrate how states lacking sufficient renewable energy can exercise extraterritorial agency to transform regional assets beyond their own borders in pursuit of domestic objectives. Accordingly, decarbonisation trends render regional assets such as the access to renewable energy central to states' strategic development goals, prompting active state intervention in relevant GPNs.

The restructuring of GPNs towards decarbonisation is closely intertwined with a parallel transformation of GFNs. Clean energy technologies require substantial investment, while new subsectors like carbon services and trading are expanding rapidly. Financial and business services (FABS) firms, in particular, are increasingly moving away from fossil fuels and are seeking to direct capital towards green sectors, such as the production of renewable energy (Grote et al., 2024). At the same time, as more companies seek to reduce their greenhouse gas emissions, the demand for carbon credits – generated through carbon avoidance, reduction or removal projects – is expected to increase more than 15-fold by 2030, with the carbon market potentially exceeding USD 50 billion (TSVCM, 2021). These dynamics open up new opportunities for FABS firms, whether in financing low-carbon technologies or in financing and trading carbon credits. This positions the financial sector itself as a growth sector within the context of decarbonisation. In line with this, Lai (2018) points out that beyond manufacturing and high-tech sectors, the financial sector also plays a central role in economic strategies of developmental states. Accordingly, in addition to GPN-related regional assets, those assets that align with the strategic needs of GFN actors – such as investment opportunities in low-carbon projects – are becoming increasingly important for states pursuing development goals in the context of decarbonisation. Yet, states' growing direct engagement in GFNs, for instance through SWFs and SOBs, the mechanisms through which they shape financial networks in pursuit of strategic goals remain insufficiently examined. This again highlights the need for a more systematic analysis of the state-finance nexus (Lai, 2023). Moreover, although the interrelationship between finance and production has begun to attract greater scholarly attention (e.g., Coe et al., 2014; Grote et al., 2024; Migozzi et al., 2023), its implications on the strategies of states seeking to integrate into these networks remain underexplored.

2.2. World governments and the shaping of global production and financial networks of decarbonisation

The above-described shifts in GPNs and GFNs demonstrate how deeply intertwined these economic networks are and how contingent their development is upon one another. Green GFNs mobilise the capital required to decarbonise GPNs, while viable low-carbon technology projects in turn enable the growth of green and carbon market GFNs. Grote et al. (2024) highlight the interconnection between GPNs and

GFNs through their analysis of the oil industry and financial markets, showing how production and finance have continuously influenced and reinforced each other over time. To capture these dynamics, the authors introduced the concept of global production and financial networks (GPFNs), allowing for the identification of key actors and geographies shaping both production and financial flows. In doing so, Grote et al. (2024) show how certain geographies and actors have assumed enduringly central positions in oil GPFNs. Accordingly, for regions seeking to stay integrated into GPFNs shifting towards decarbonisation, the key challenge lies in sustaining such integration. As illustrated above, access to regional assets that align with the strategic needs of GPN and GFN actors becomes crucial in this context. Only where such assets are available can regions profit from the self-reinforcing development effects of production-finance intertwining, enabling them to remain central nodes in both networks. For states lacking these regional assets, integration into GPFNs requires alternative strategies. One such mechanism is the transformation of extraterritorial assets in pursuit of domestic objectives (Kavelage & Walker, 2024) – a strategy that has so far received little attention.

Building on the GPFN framework, we shed light on the role of world governments as key actors in both, production and financial networks and their ability to influence the development of decarbonisation GPFNs by exercising extraterritorial agency (Figure 1). World governments are governments or inter-governmental organisations with extraterritorial influence, allowing them to shape the geography and structure of GPFNs to their advantage – for example by leveraging their own capital and influence through SWFs, SOEs or SOBs (Grote et al., 2024). With regard to decarbonisation GPFNs, these governments therefore possess the means and power to secure the access to those extraterritorial assets required to attract GPFN actors and transform them according to their needs, if necessary. As ‘sources of patient capital’ (Alami & Dixon, 2024, p. 34), SWFs can, for instance, provide the capital needed for long-term infrastructure projects such as renewable energy, thereby facilitating the access to clean energy for GPN actors seeking to decarbonise. Moreover, de-risking measures with public funds – often through public-private partnerships and ‘blended finance’ mechanisms – allow states to reduce the financial, operational or political risks associated with investing in projects, improving improve their risk-return profiles and making them more attractive for GFN actors (Alami & Dixon, 2024; Kavelage & Walker, 2024). Moreover, SOEs can be leveraged to direct capital into strategic projects or sectors (McGregor & Coe, 2023) or to take up strategic positions in the value creation of necessary extraterritorial assets. Through such instruments, world governments become not merely facilitators but direct participants in GPFNs by acting as investors and market players through their SWFs, SOBs and SOEs.

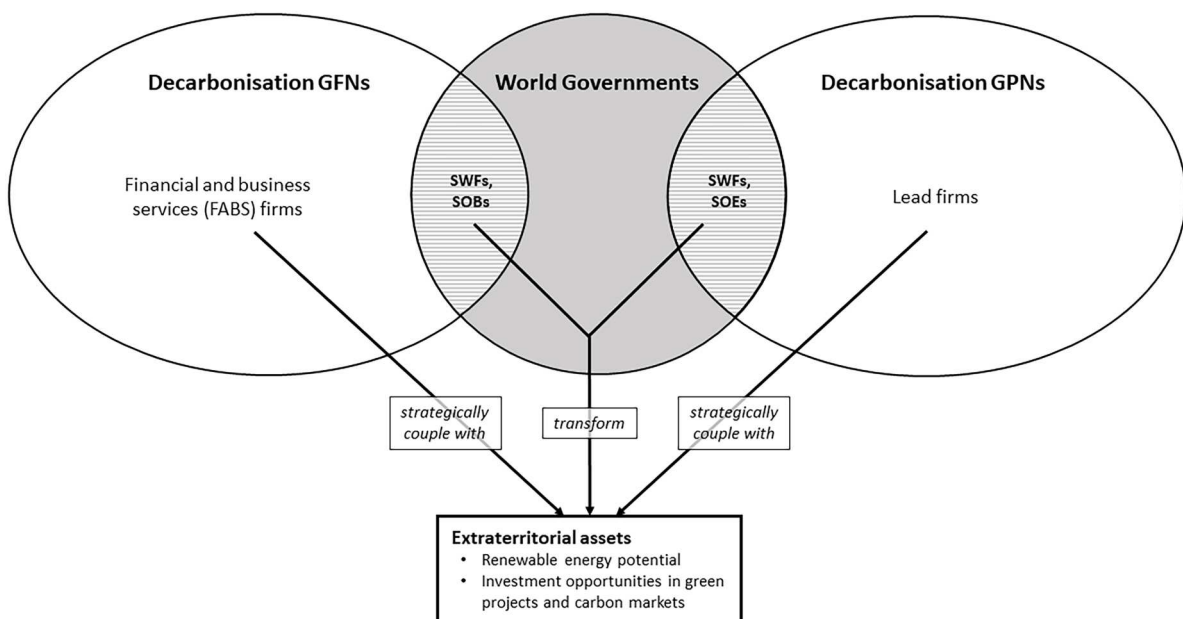


Figure 1. World governments shaping global production and financial networks of decarbonisation through extraterritorial agency.

Source: Author's own design.

In doing so, they secure and reinforce their central position in both production and financial networks, a position further strengthened by the self-reinforcing dynamics of decarbonisation-led development.

2.3. Singapore's position in global production and financial networks

Since gaining independence from Malaysia in 1965, Singapore has strategically positioned itself as a key node in the global economy (Bastide, 2011). The state has played a central role in this process, actively shaping the city-state's integration into GPFNs. A number of studies have examined the pivotal role of the state's role as an owner and investor in Singapore's economic development (Chua, 2016; Dixon, 2022; McGregor & Coe, 2023; Yeung, 2011). In this context, the role of Temasek, one of Singapore's SWFs, is highlighted in driving the economic development of the resource-poor city-state by investing in key companies, projects and sectors (Dixon, 2022; Haberly, 2011; Yeung, 2011). SOEs, such as Keppel Corporation and Sembcorp Industries, received support from their parent company, Temasek, as well as local financial institutions like the SOB, DBS, enabling their expansion into regional and global markets with the strategic goal of establishing 'the 'external wing' of the Singapore economy' (Yeung, 2011, p. 638). This led to Temasek and its associated SOEs playing a critical role in enhancing Singapore's position in global and regional production networks (Dixon, 2022). While Temasek's investment mandate does not officially include strategic or developmental goals, its investment patterns suggest otherwise (Haberly, 2011). Accordingly, Alami and Dixon (2024) classify Temasek as a strategic investment fund which fosters economic growth through its targeted investments. These mechanisms demonstrate Singapore's 'disproportionately high institutionalized capacity to project global financial influence as [an] investor[...]' (Haberly & Wójcik, 2022, p. 12), effectively constituting it as a world government.

With regard to the energy sector, significant research has focused on how Singapore, despite lacking domestic oil or gas resources, has strategically positioned itself within O&G GPNs through state intervention. Breul et al. (2019, p. 14) show how Singapore anchored high-value, knowledge-intensive segments of the upstream O&G GPN, thereby positioning itself as a gateway 'in-between global headquarter locations of oil and gas companies and the resource peripheries' in Southeast Asia. The state facilitated this by creating favourable location factors to meet the strategic needs of the O&G industry, for example through industry-specific training programmes (Breul & Revilla Diez, 2018). Similarly, McGregor and Coe (2023) highlight the role of hybrid actors like the SWF Temasek, SOEs and Singapore's SOB, DBS, in strategically positioning the city-state across upstream, midstream and downstream segments of the oil GPN. Through their pioneering regional activities in the O&G sector, the SOEs Keppel and Sembcorp strengthened Singapore's domestic industry, attracted global lead firms and further cemented its status as a hub in Southeast Asia (Breul & Revilla Diez, 2018; McGregor & Coe, 2023). Thus, the state's involvement in the O&G sector was aimed not only at ensuring the country's national energy security, but also at positioning Singapore at the centre of the O&G GPN, thereby driving economic development.

With a view to Singapore's position in GFNs, Lai (2018) underscores the importance of state intervention in cultivating market niches, such as in FinTech and Islamic banking, enabling Singapore to 'stay[...] ahead of the curve in a rapidly changing global financial landscape' (Lai, 2018, p. 175). A particularly significant actor in this context is the Monetary Authority of Singapore (MAS), which, beyond its role in monetary policy and financial regulation, actively promotes financial innovation and the development of the financial sector, thereby positioning Singapore as an international financial centre (IFC) (Chow & Pei, 2018; Lai, 2018). Due to its relatively small domestic economy and its dependence on transnational capital, the island-state is in a constant pursuit of maintaining its relevance in the global economy by defining new competitive niches and forging new partnerships, for instance with emerging markets in ASEAN (Association of Southeast Asian Nations) (Bastide, 2011; Chow & Pei, 2018). Thus, by continuously adapting the domestic financial sector to shifts in the global financial landscape, the state has been instrumental in establishing and maintaining Singapore's position as an IFC within GFNs.

Thus, Singapore occupies a central position in O&G GPFNs (Grote et al., 2024), with the state playing an pivotal role in both production and financial networks. In the context of decarbonisation, the question now arises as to how the resource-scarce city-state strategically repositions itself to maintain its influence, and what role the state – particularly Temasek – plays in this transition.

3. Methods

This research employed a deductive-inductive methodology, integrating document analysis and expert interviews, to investigate Singapore's strategic goals in the context of decarbonisation and the role of state capitalist strategies in supporting them (Kuckartz & Rädiker, 2022). The methodology is structured around two key areas of analysis. Firstly, the study examines Singapore's strategic goals in realigning its energy and finance sector with global and regional net-zero transitions. To this end, policy and strategy documents were analysed alongside investment and sector reports, press releases and newspaper articles focusing on energy transition, green finance and the voluntary carbon market in Southeast Asia (Figure 2). This analysis provided a comprehensive understanding of Singapore's aims, the role extraterritorial assets from neighbouring countries in Southeast Asia play in pursuing these efforts and current stumbling blocks hindering related developments.

Secondly, the research investigates how Temasek is promoting the interplay between global and regional production and financial networks and transforming extraterritorial assets to align them with Singapore's strategic goals. A particular focus was placed on the activities of Temasek and its associated entities, using a multi-step approach to map their involvement. The initial phase involved screening websites of Temasek and its associated companies, applying a snowballing method to uncover interconnections between these entities and to gain deeper insights into their respective activities at a regional level. In this context, press releases, newspaper articles, corporate reports and speeches were screened and then systematically analysed using qualitative content analysis (Kuckartz & Rädiker, 2022).

Building on this desk-based mapping, fieldwork was conducted during two research phases: February and March 2024 in Singapore, and August and September 2024 in both Singapore and Vietnam. Vietnam was selected as a case study region because the mapping revealed a substantial number of connections between Temasek-linked entities and Vietnamese partners. In addition, Vietnam constitutes a key target market for Singapore's regional energy and carbon market activities, making it a suitable site to examine how Singapore seeks to operationalise its ambitions as a regional energy and finance hub. In this context, seven of the semi-structured interviews that were conducted in this context provided additional insights into the activities and motives of Singapore's SWF, Temasek, and associated SOEs. Interview stakeholders include representatives from the SWF, representatives from the SOB in Vietnam, a representative from an SOE in Vietnam, two consultancies, a multilateral development bank and one renewable energy company located in Vietnam with a joint venture connection to the SWF (see Appendix in the online supplemental

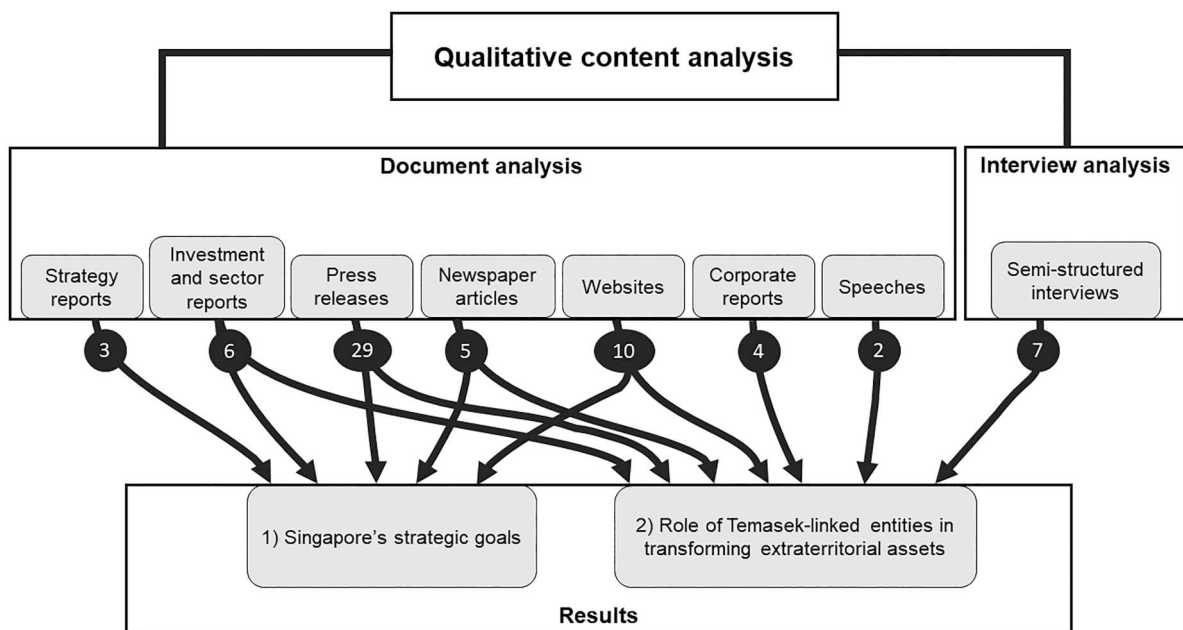


Figure 2. Methodological approach.

Source: Author's own design.

data). The interviews were recorded and transcribed using the transcription software Otter.ai, followed by qualitative content analysis using MaxQDA. This deductive-inductive approach allowed for a nuanced understanding of the specific strategies employed by Temasek and its affiliates to support Singapore's decarbonisation objectives. While this study does not claim to offer an exhaustive account of Temasek's activities, it aims to provide insights into the diverse strategies used to achieve Singapore's strategic goals and the role extraterritorial assets play in this context.

4. Results and discussion

4.1. Aligning Singapore's energy and finance sector with net-zero transitions

4.1.1. Driving energy transition and industry transformation through regional renewable energy imports

Currently, most of Singapore's energy needs are met by natural gas, with 60% supplied via pipelines from Indonesia and Malaysia and the rest shipped from countries like Australia, Qatar and the USA (EDB, 2024a). However, in response to climate change, Singapore has committed to achieving net-zero emissions by 2050 (NCCS, 2022). To meet this target, the government has outlined ambitious plans to intensify decarbonisation efforts, particularly in the power sector and the industry sector (MTI, 2022). The majority of carbon emissions in the industry can be tied back to the refining and petrochemical sector on Jurong Island which greatly contributes to Singapore's economy (NCCS, n.d.-a; EDB, 2021). '[A]s an export-oriented sector, it helps plug Singapore into the world, hence helping to maintain its relevance' (EDB, n.d.). Singapore aims to transform Jurong Island into a sustainable energy and chemicals (E&C) park by fostering sustainable production processes, for example by adopting low-carbon hydrogen (MOE et al., 2021; MTI, 2022). Thus, access to renewable energy is essential for meeting Singapore's net-zero goals.

Given Singapore's limited land area and low renewable energy potential, it plans to import low-carbon electricity from neighbouring countries through regional power grids by 2035 (EMA, 2024). Southeast Asian neighbours offer favourable conditions for renewable energy development, making the access to these extraterritorial assets integral for Singapore's energy transition strategy. However, the planned ASEAN-wide power grid, required to facilitate these imports, has so far seen limited progress due to a '[l]ack of cross-regional grid connections and cooperative mechanisms' (Hardcastle et al., 2024, p. 13). While recent ASEAN net-zero initiatives have reignited discussions on the grid's expansion (ASEAN Secretariat, 2023; NCCS, 2022), challenges such as fragmented regulations remain. Thus, there is a need to develop the transition infrastructure for clean energy before Singapore is able to tap into renewable energy produced in the region.

Beyond infrastructure, ASEAN's renewable energy sector faces project development and financing barriers. In 2021, only \$197 billion was pledged toward renewable energy across Asia – well below the \$545 billion needed annually by 2030 (UNCTAD, 2023). Like other emerging markets, high capital costs, policy uncertainties and macroeconomic risks deter private sector investment in Southeast Asia, making long-term financing difficult (IEA, 2024; IRENA & CPI, 2023). According to a sector report, de-risking measures – such as blended finance, which combines public and private funds to lower investment risks – could help attract the needed private capital (Hardcastle et al., 2024). Public funding is therefore considered a crucial element to scaling up renewable energy in Southeast Asia and for enabling Singapore to leverage those extraterritorial assets that are necessary to keep Singapore plugged in to E&C GPNs.

4.1.2. Positioning Singapore as a green finance hub by leveraging the region's need for net-zero transitions

Singapore sees the low-carbon transition as an opportunity to foster green growth by developing new industries and job opportunities (MOE et al., 2021). In particular, Singapore is focusing on emerging areas such as green finance, carbon services and carbon trading (MOE et al., 2021) as ways to maintain its position as an IFC. In this context, the city state sees great potential in supporting the region's transition to net zero by facilitating investment and mobilising capital for green projects (MOE et al., 2021). Southeast Asia's economic growth is fuelling a high demand for energy, which is still largely met by coal-fired power plants. As a

result, there is a high demand for green finance to manage the needed energy transition (UNCTAD, 2023), which in turn presents investment opportunities for global financial players.

However, private sector financiers remain hesitant to invest in green projects in Southeast Asia due to the associated investment risks. According to a sector report, new financial mechanisms are required to create viable business cases for investors, thereby encouraging investment in green activities (Hardcastle et al., 2024). Thus, in addition to a stable regulatory environment and favourable policies, the availability of sound investment opportunities – enhanced through blended finance and de-risking mechanisms – is considered crucial in attracting global investors to Southeast Asia (Lim, 2024). The potential for the city-state to position itself as a green finance hub is thus contingent on the resolution of persistent regional investment barriers and the creation of sustainable, investable projects for GFN actors.

4.1.3. Establishing Singapore as a carbon services and trading hub by leveraging regional natural resources

Singapore aims to establish itself as a carbon services and trading hub where global firms can purchase high-quality carbon credits from Asia to offset emissions (Ong, 2023). A study commissioned by Enterprise Singapore and the Economic Development Board highlights the need for an early-mover advantage in this sector by building a robust ecosystem and developing technical expertise in carbon markets (South Pole, 2021). On the policy front, Singapore is the first country in Southeast Asia to introduce a carbon tax for heavy emitting companies, which is gradually increasing (NCCS, n.d.-b). Since 2024, companies subject to the tax can offset up to 5% of their emissions with international carbon credits¹ (NCCS, n.d.-b), creating domestic demand. Additionally, Singapore has prioritised international carbon market cooperation, establishing agreements with 19 countries, including ASEAN partners such as Vietnam, Laos and Cambodia (CMC, n.d.-a).

Besides a domestic market, ‘Singapore aspires to develop into a carbon services and trading hub by tapping on its thriving ecosystem and locality in Southeast Asia, one of the largest carbon credit sources’ (CMC, n.d.-b). Given Southeast Asia’s abundant natural resources, the region has the potential to generate carbon credits from nature-based solutions, agroforestry and renewable energy projects (EDB, 2023b). Many ASEAN countries are committed to leveraging carbon markets to meet climate goals, making the region a potential global supplier of carbon credits (South Pole, 2021). Given the city-state’s geographic proximity, Singapore sees economic opportunities in financing and trading carbon credits originating from Southeast Asia (South Pole, 2021), thus harnessing these extraterritorial assets. The voluntary carbon market in the region, however, faces challenges related to the integrity, transparency and quality of carbon credits, which currently undermine investor trust (KPMG, 2024). Concerns over the legitimate use of credits for corporate decarbonisation efforts and insufficient transparency regarding project risks further contribute to market uncertainty. Strengthening credibility across the value chain – from project development and verification to carbon exchange – is therefore considered crucial to build stakeholder confidence and thus for Singapore’s ambition to establish itself as a carbon services hub.

The results highlight the significance of extraterritorial assets in Southeast Asia – ranging from renewable energy potential to the need for green finance opportunities and carbon credit generation – for Singapore’s pursuit of economic objectives in the context of decarbonisation. At the same time, they indicate that these assets must be transformed, for example through strategic de-risking mechanisms, to become viable and attractive for GPFN actors.

4.2. Temasek’s role in promoting the interplay between global and regional production and financial networks

4.2.1. Shaping regional green investment through capital mobilisation and de-risking mechanisms

A number of Temasek-linked entities are engaged in green finance and investment activities which aim to transform the above-mentioned extraterritorial assets needed for the city-state to pursue its economic goals (Figure 3). DBS, with Temasek holding a 29% stake, is considered a SOB whose actions align closely with Singapore’s development goals. Traditionally functioning as Singapore’s development bank, ‘it is in [their] DNA’ (I_SOB) to support Singapore’s development projects (I_Cons1). Building on this legacy, DBS is actively financing projects that support Singapore’s energy transition. These includes issuing green

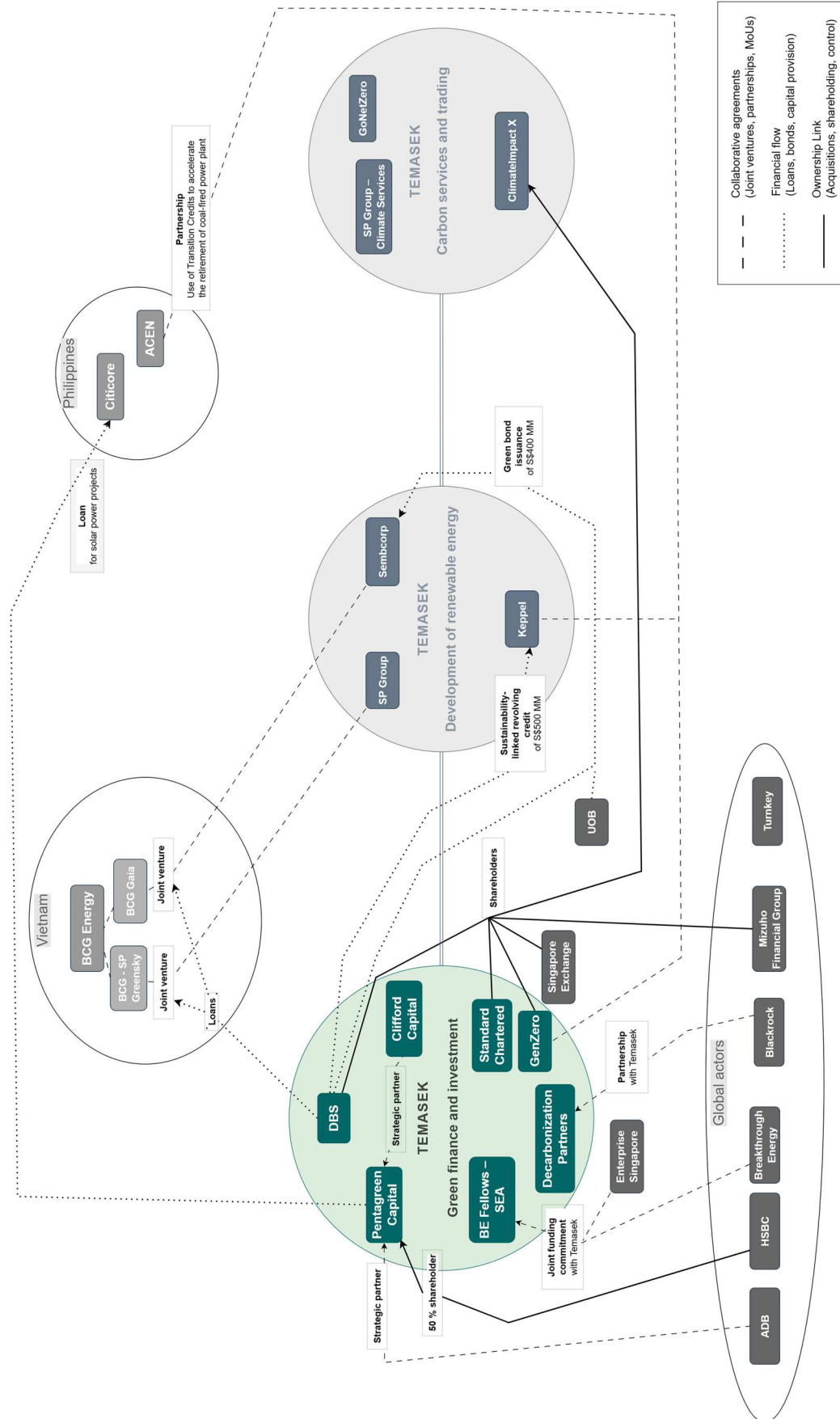


Figure 3. Shaping regional green investment through capital mobilisation and de-risking mechanisms.
Source: Author's own design based on results.

bonds and providing loans to Sembcorp, which is 49% owned by Temasek, for its renewable energy expansion as well as providing sustainability-linked loans to Keppel, another Temasek-linked company, to import renewable energy (BCG, 2023a; BCG, 2023b; Keppel, 2024; Sembcorp, 2021a). The SOB is therefore involved in mobilising capital for the development of renewable energy projects and infrastructure in the region, necessary for Singapore's energy transition.

In addition to traditional banking, Temasek-linked entities collaborate closely with MAS to close financing gaps for renewable energy in the region by implementing de-risking mechanisms. MAS maintains a close relationship with Temasek, leveraging its market insights to identify and address financing gaps (I_SWF). To support this, MAS launched the Finance for Net Zero Action Plan to mobilise financing for net zero goals and position Singapore as a regional green finance hub. A key initiative under this plan is the Financing Asia's Transition Partnership (FAST-P), which aims to mobilise up to USD 5 billion for green and transition projects in Asia by bringing together public, private and philanthropic stakeholders (IFC, 2024; Leong, 2024). The Singapore Government has committed up to USD 500 million to match concessional capital contributions from other governments, multilateral development banks and philanthropic organisations to attract private investment (MAS, 2024). Together with the Asian Development Bank (ADB) and the Global Energy Alliance for People and Planet, Temasek is one of the initial partners of the FAST-P initiative (EDB, 2024b) and a key actor in the implementation of a number of programmes. For instance, Clifford Capital, 40.5% owned by Temasek, manages financing for regional energy transition projects, including grid development and renewable energy, while Pentagreen Capital, a debt financing platform jointly established by Temasek and HSBC, supports marginally bankable infrastructure projects in the region by combining public and private capital (Leong, 2024; Pentagreen, 2021; Temasek, 2014). These vehicles illustrate Temasek's role in implementing MAS' initiatives to encourage investment in renewable energy projects in the region by de-risking private capital through blended finance.

Apart from this debt financing platform, Temasek has set up various investment platforms with private sector stakeholders to invest in low carbon economy solutions across varying growth and maturity stages (Temasek, 2024c). The hope is that these investments at some point 'benefit both [the] portfolio company and of course, the broader ecosystem in the broader region' (I_SWF). Breakthrough Energy Fellows (BE Fellows) funds early-stage climate technologies in Southeast Asia (Temasek, 2024b). Decarbonization Partners, a joint platform with Blackrock, invests in globally in proven green technologies at growth stage (I_SWF; Temasek, 2024a). GenZero, a fully Temasek-owned platform, invests globally across the carbon credit value chain, from emission reduction projects, climate advisory services and monitoring technologies to and carbon trading infrastructure like the carbon credit platform ClimateImpactX (GenZero, 2022). While globally active, regional decarbonisation it prioritised 'to bridge the gap between Southeast Asia's Net Zero ambitions and concrete achievement' (Hardcastle et al., 2024, p. 7). The aim is to build capabilities along the whole carbon value chain, thereby enhancing the integrity and transparency of carbon credits from Southeast Asia. By establishing connections to private financial entities, Singapore is positioning itself at the forefront of regional advancements and further reinforcing its status as a strategic destination for private investors, multilateral banks and philanthropic organisations seeking to finance green activities in the region (I_MDB; Temasek, 2024b). Many of these financing activities therefore do not take place in isolation and exclusively through Temasek-linked entities, but rather in targeted cooperation with private actors: regional green investments are created jointly in public-private partnerships with the aim to attract relevant stakeholders to Singapore as the green finance hub.

As investors and financiers in GFNs, Temasek-linked entities directly engage in capital mobilisation and de-risking mechanisms thereby shaping regional green investments – and thus transforming extraterritorial assets in line with the strategic needs of GFN actors. In addition, these financial flows link to the GPNs of decarbonisation and carbon market GFNs, thereby promoting a further interplay between regional and global production and financial networks.

4.2.2. Advancing renewable energy development through SOE investments

Several Temasek-linked SOEs are investing in renewable energy projects across the region to advance the regional renewable energy infrastructure, necessary for its own energy transition (Figure 4). Sembcorp, 49% owned by Temasek, is transitioning from oil and gas to renewable energy and urban development, positioning itself to support Singapore's decarbonisation goals through the development of a regional clean energy

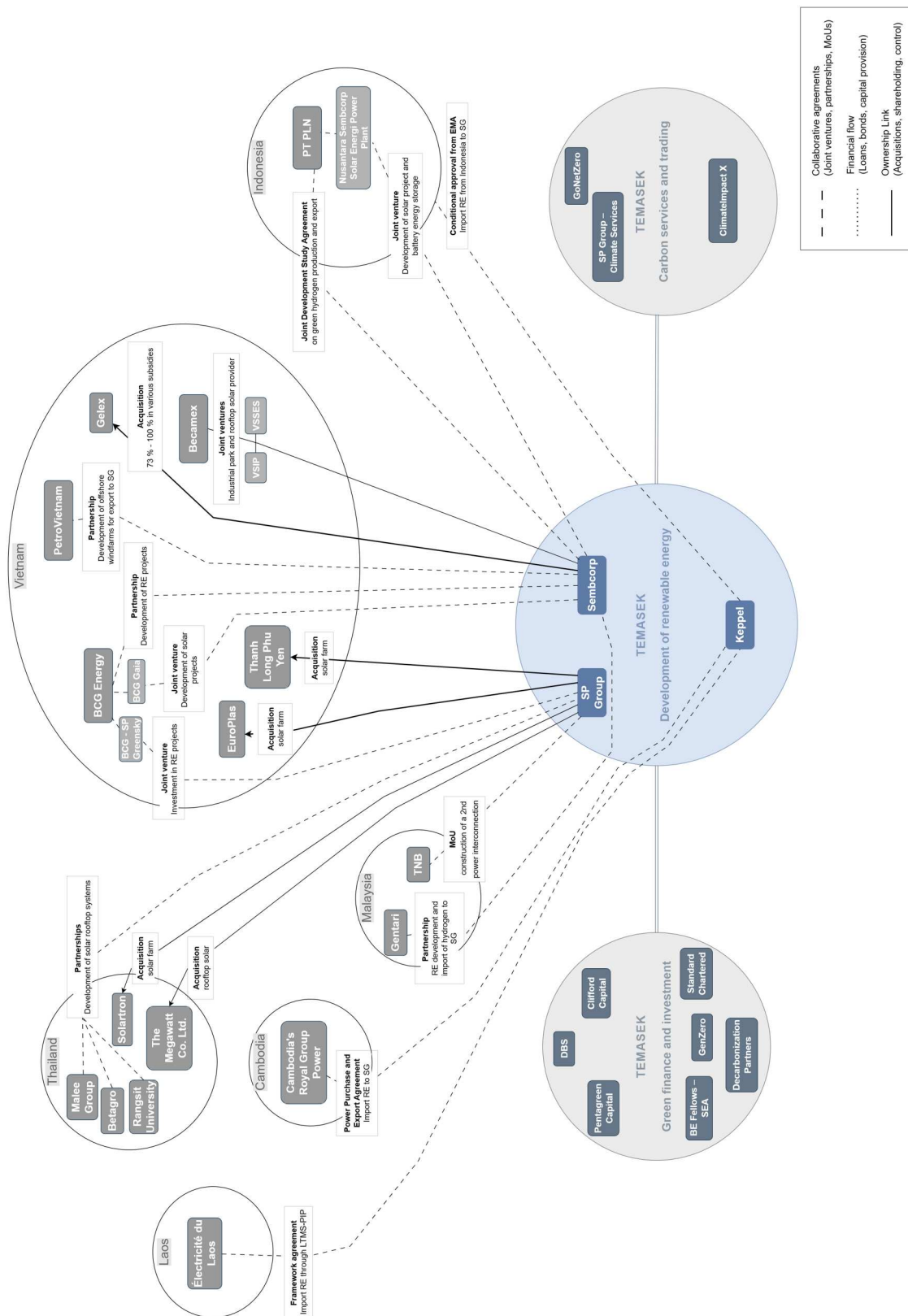


Figure 4. Advancing renewable energy development through SOE investments.
Source: Author's own design based on results.

network (Sembcorp, 2023a). Its regional activities include building transmission infrastructure and renewable energy projects for export to Singapore, such as a conditional approval to import 1.2 GW of low-carbon electricity from Vietnam, supported by offshore wind projects with PetroVietnam (EMA, 2023; Sembcorp, 2023a). In Indonesia, Sembcorp collaborates with PT PLN (Persero) to explore green hydrogen production for export to Singapore, while in Malaysia, the company partners with Gentari on renewable energy trading and import as well as hydrogen production and trading (Sembcorp, 2023a, 2023b, 2023c). In addition to its regional projects, Sembcorp has launched Southeast Asia's largest energy storage system (ESS) on Jurong Island.

Beyond imports, Sembcorp is expanding its regional renewable portfolio, having reached 9.8 GW in 2023, with a target of 25 GW by 2028 (Sembcorp, 2023a). This growth strategy combines greenfield projects, acquisitions and partnerships, such as acquiring majority stakes in Gelex Group subsidiaries, expanding its onshore wind, solar and hydro assets in Vietnam (Lim, 2023; Sembcorp, 2023a). The SOE also partners with BCG Energy to develop wind and solar projects and established two joint ventures, which operate two solar farms and invest in further solar projects (BCG, 2023b; Sembcorp, 2021b). Additionally, Sembcorp collaborates with Becamex through Vietnam-Singapore Smart Energy Solutions JSC (VSSES) to implement rooftop solar solutions in industrial parks owned by Vietnam Singapore Industrial Park J.V.Co (VSIP) (I_ReC). In Indonesia, Sembcorp entered the utility-scale solar market via a joint venture with PT PLN (Persero) (Wong, 2024). By engaging in projects that address challenges linked to ASEAN's underdeveloped power grid, Sembcorp's investments contribute to expanding the region's renewable energy capacity, which in turn is critical for Singapore's energy transition. With their ties to Temasek, Singaporean SOEs have access to significant resources and capital to 'lead the way' (I_ConS2) in new developments.

Like Sembcorp, Keppel, 21% owned by Temasek, is shifting from its oil and gas origins to a greener portfolio, aiming for 7 GW of renewable energy capacity by 2030 (Keppel, 2023). Keppel is developing renewable energy in ASEAN and the infrastructure needed for imports into Singapore. The company participates in the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP), serving as a pathfinder for ASEAN's multilateral power grid vision and has received conditional approvals to import renewable energy from Cambodia and Indonesia (Keppel, 2023). Additionally, Keppel is developing Singapore's first hydrogen-ready power plant to support the energy transition (Keppel, 2023). By advancing renewable energy and hydrogen infrastructure in the region, Keppel aims to make ASEAN's renewable energy potential more accessible, thereby supporting Singapore's energy transition.

Singapore Power Group (SP Group), fully owned by Temasek, complements these efforts as Singapore's national grid operator and a renewable developer across Asia (SP Group, 2024b). The company collaborates with agencies and importers to enhance technological capabilities and facilitate renewable energy imports into Singapore (SP Group, 2023b). Additionally, SP Group is involved in a range of renewable energy projects, including solar projects that are already in operation, under construction or in planning in Thailand (SP Group, 2024a; SP Group, 2024b), as well as recent acquisitions of solar farms in Vietnam (Nguyen, 2023; SP Group, 2024b). Together, the SOEs – Sembcorp, Keppel and SP Group – are involved in regional projects that aim to advance the ASEAN power grid and enable renewable energy imports into Singapore. In doing so, the SOEs are therefore seeking to tap those extraterritorial assets that are necessary for city-state's energy transition and to stay integrated into E&C GPNs.

4.2.3. Shaping carbon market development through strategic positions in regional value creation

In order to address current deficits in the regional carbon market and enhance its development, Temasek-linked entities are taking up strategic positions in regional value creation (Figure 5). In addition to renewable investments, Sembcorp and SP Group are positioning themselves in the carbon market through the development of carbon credits and renewable energy certificates (RECs). In 2022, Sembcorp launched GoNetZero, a platform for buying and selling carbon credits and RECs, sourced from its own projects or selected global partners (Sembcorp, 2023a, I_SOE, GoNetZero, n.d.). The platform thereby seeks to address ongoing concerns regarding the credibility and transparency of carbon credits in the market. Similarly, SP Group offers carbon credits and RECs from projects across the region and has partnered with Turnkey, a global ESG data solutions company, through greenfield projects, acquisitions and partnerships to further expand its carbon services portfolio (SP Group, 2023a, n.d.-a, n.d.-b). SP Group specifically aims 'to support Singapore's development as a carbon services and trading hub, facilitating the growth of the

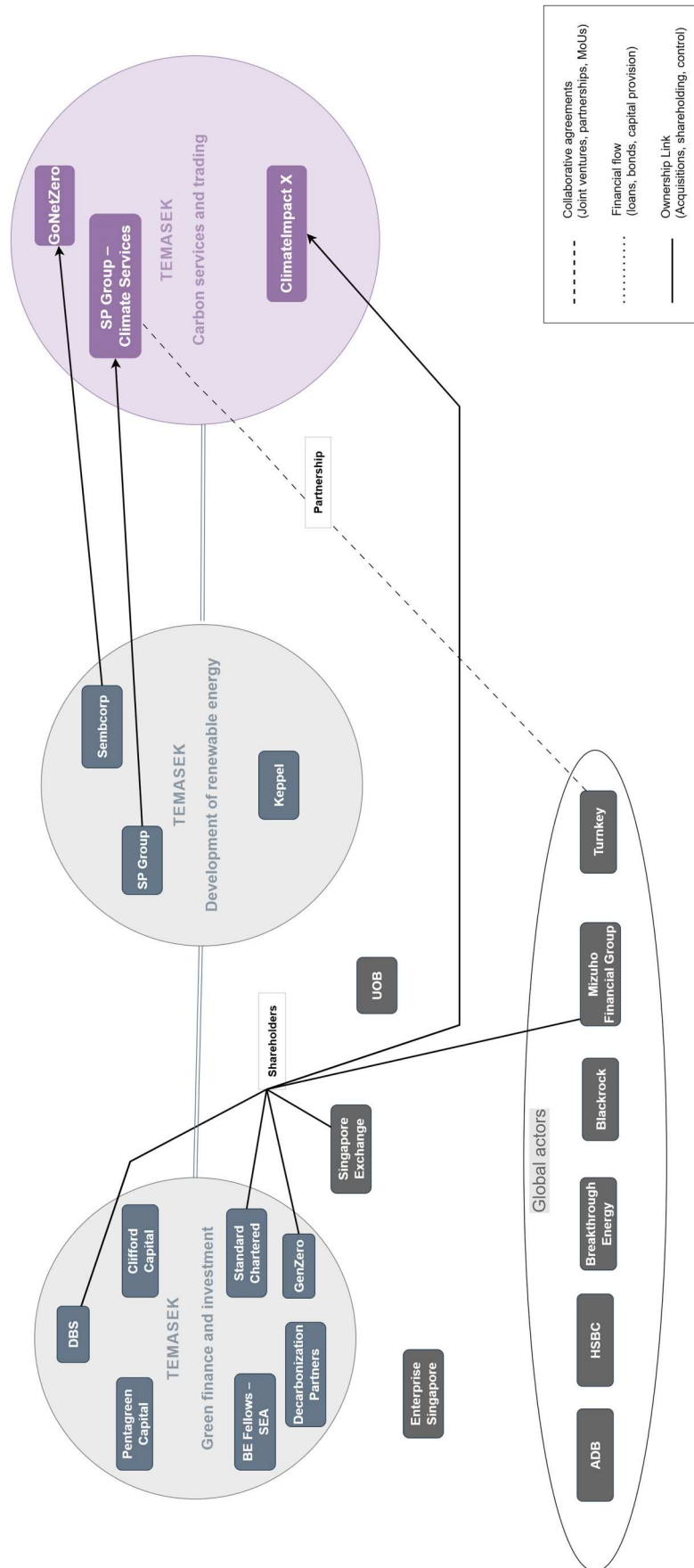


Figure 5. Shaping carbon market development through strategic positions in regional value creation.
Source: Author's own design based on results.

carbon services ecosystem in Singapore and positioning the country as a regional gateway for carbon services' (SP Group, 2023a). Therefore, both companies are seeking to build confidence in the Southeast Asian carbon credit market, making it more attractive for private sector carbon service providers and strengthening Singapore's position as the base for their regional activities.

Besides these initiatives, Climate Impact X (CIX) plays a central role in advancing the carbon market in Singapore. Co-founded by the Temasek-linked entities GenZero, DBS and the bank Standard Chartered, alongside Singapore Exchange Limited (SGX), CIX was established as a global carbon marketplace and exchange, which curates carbon credits from global and regional nature-based solution projects (ClimateImpact X, 2022). Against the background of the currently limited integrity and trust in carbon credits, the platform aims to create high-quality credits and build trust through transparent data and reliable buyers and sellers (ClimateImpact X, 2022; EDB, 2023a). In doing so, CIX aims to be 'a promising solution to the problem we face today of fragmented carbon credit markets characterised by thin liquidity and credits of questionable quality' (Menon, 2021). It also serves as a 'test bed' (Menon, 2021), piloting new instruments such as transition credits to finance the early retirement of coal-fired power plants in Asia (Temasek, 2024a). Together with Temasek, several Temasek-linked companies, and other stakeholders, CIX develops financing instruments aimed at addressing the region's specific needs (MAS, n.d.-b). Although globally active, CIX recognises Southeast Asia's potential for nature-based solutions and its own proximity to the region which 'enable[s] CIX and its ecosystem partners to work closely with project developers to procure a supply of high quality carbon credits' (Menon, 2021). Besides production-related activities, this Temasek-linked entity is thus focussing on the enhancement of the carbon trading segment.

Thus, a number of Temasek-linked entities have taken up strategic positions in the regional value creation of carbon credits, from financing and production to trading, in order to address existing market gaps related to trust and transparency. The aim is to transform Southeast Asia's extraterritorial assets for carbon credit generation in line with the requirements of GPFN actors, thereby shaping the development of the regional carbon market.

4.3. *Sticking to power: Singapore's extraterritorial agency in net-zero GPFNs*

The results demonstrate that Singapore is strategically repositioning itself within the green economy as it pursues its net-zero target. This repositioning involves transforming its energy sector and existing industries, establishing itself as a green finance hub, and capitalising on the emerging carbon market. In the past, Singapore has maintained a central position in O&G GPNs (Breul & Revilla Diez, 2018; McGregor & Coe, 2023), a position reinforced by its role as a financial centre and the strong interconnection between the oil industry and financial services sector, leading to Singapore's *sticky power* in the sector (Grote et al., 2024). Today, Singapore is actively shifting away from the fossil fuel-based economy and is seeking to capitalise on new economic opportunities arising from the shift towards renewable energy and related financial services, including green finance and carbon trading. Its goal is to maintain attractive to private sector actors in the finance and energy while aligning with global and regional decarbonisation. A key element of this strategy is the exercise of extraterritorial agency to leverage assets from neighbouring Southeast Asian countries to attract GPFN actors. These extraterritorial assets include the potential for renewable energy production, the demand for green finance to support energy transitions, and the opportunity to produce carbon credits. However, as the findings indicate, the attractiveness of these assets is currently limited, hampering the strategic coupling process with GPFN actors. In this context, Singapore's SWF Temasek, alongside associated SOEs and SOB, play a central role in addressing these challenges by strategically transforming these extraterritorial assets.

In this context, our findings revealed three mechanisms of extraterritorial agency. Firstly, *capital mobilisation and de-risking*: Singapore's SOB, DBS, provides financial backing to SOEs investing in renewable energy projects and infrastructure in the region. Moreover, Temasek has established new entities in the green finance sector that deploy blended finance to improve the risk-return profiles of projects and attract private investment. The SWF thereby acts as a 'source of patient capital' (Alami & Dixon, 2024, p. 34). Additionally, Temasek is focussing on targeted cooperation with private actors in mobilising green finance, thereby enhancing its position as the regional green finance hub and increasing its appeal to GFN actors. Secondly, *SOE investments*: Singaporean SOEs are investing in renewable energy generation

and transmission infrastructure across ASEAN, with the aim to leverage the region's potential to develop renewable energy and ensure clean energy imports to Singapore, necessary for the decarbonisation of its industrial sectors. These activities are partly supported by the SOB, which provides the necessary financial backing. Thirdly, *strategic positions in value creation*: Temasek-linked companies have moved into central roles in the production and trading of carbon credits, seeking to enhance credibility and transparency of regional carbon credits. Collectively, these mechanisms enable Singapore not only to overcome barriers to private investment but also to actively reshape the geography and structure of decarbonisation GPFNs.

The results highlight that Singapore's economic development strategy reflects both continuity and adaptation. As before, the state continues to play a dual role as both a facilitator (Breul & Revilla Diez, 2018; Chow & Pei, 2018; Lai, 2018) and an investor (McGregor & Coe, 2023) in creating an attractive environment for private sector actors. While the shift towards net-zero introduces a new context, the underlying economic goal of maintaining Singapore's central position in GPFNs remains unchanged. Singapore is leveraging its position as a world government with a 'disproportionately high institutionalized capacity to project global financial influence as [an] investor[...]' (Haberly & Wójcik, 2022, p. 12). Through its SWF and associated SOEs and SOB, Singapore mobilises its own capital to transform extraterritorial assets according to the needs of GPFN actors, thereby actively shaping the interplay between regional and global production and financial networks. In doing so, Singapore not only aims to advance its domestic energy transition but also positions itself as an essential player in these GPFNs of decarbonisation. Moreover, the mechanisms employed to transform extraterritorial assets promote the interaction between GPNs and GFNs. For example, de-risking mechanisms not only make green infrastructure projects more attractive to GFN actors, but also expand the renewable energy infrastructure, which on the one hand enables imports to Singapore and the decarbonisation of its industries, and on the other hand enables the production of carbon credits. Similar dynamics were previously observable in the O&G sector, where SOEs were supported by local financial institutions, including the SOB DBS, in their regionalisation strategy (McGregor & Coe, 2023; Yeung, 2011), enhancing their position in GPFNs of oil. Thus, by fostering synergies between GPNs and GFNs of decarbonisation, Singapore again seeks to generate a self-reinforcing process within the GPFN which reinforces its central position in both production and financial networks and enables the city-state to *stick* to its power.

The results highlight that world governments are able to exercise extraterritorial agency to shape and reshape GPFNs in ways that secure their central position within these intertwined economic networks (Grote et al., 2024). Furthermore, we showed that this extraterritorial agency can transform and mobilise extraterritorial assets – through capital mobilisation and de-risking, SOE investments or strategic positions in value creation – to advance the interests of world governments, where regional assets are missing. These insights underline that, even as global economic landscapes shift under the pressures of decarbonisation, forcing production and financial systems to adapt, the power does not readily shift away from the dominant geographies and actors in GPFNs. Instead, their power and position are consolidated and strengthened through self-reinforcing dynamics.

5. Conclusion

This paper set out to explore how Singapore intends to maintain its role as the region's trade and finance hub in the context of net-zero transitions. Our findings reveal that Singapore is repositioning itself by transforming its energy sector and existing industries while establishing itself as a hub for green finance, carbon services and trading. As GPN and GFN actors adjust their operations in response to growing market and regulatory pressures linked to climate change, Singapore adapts its economic strategy to maintain its core objective: preserving the interconnectedness of the energy and finance sectors to sustain its *sticky power* within GPFNs – a position previously anchored by the oil industry (Grote et al., 2024).

Given its limited domestic resources, Singapore relies heavily on a diverse range of extraterritorial assets from neighbouring Southeast Asian countries – including renewable energy potential, investment needs tied to regional energy transitions, and carbon credit generation. Yet, significant infrastructural and investment barriers currently limit GPFN actors from strategically coupling with these assets. In this context, Singapore's SWF Temasek, alongside associated SOEs and SOB, addresses these challenges through three

mechanisms of extraterritorial agency: mobilising capital and de-risking, leveraging SOE investments and taking up strategic positions in value creation. These mechanisms transform extraterritorial assets according to the needs of GPFN actors, while shaping the interplay between regional and global production and financial networks is shaped. In doing so, Singapore seeks to generate self-reinforcing dynamics that strengthen its central position in both production and financial networks and thus, enable the city-state to *stick* to its power. Reflecting on earlier developments in the O&G sector, these findings raise the question of whether we are witnessing a *new* form of state capitalism in Singapore's case. While clear parallels exist – particularly in Singapore's effort to maintain its GPFN position through state-capitalist strategies – the current approach appears more sophisticated. Singapore is not only making extraterritorial investments but actively transforming extraterritorial assets to align with its strategic priorities.

On a broader level, the results therefore highlight how world governments can exercise extraterritorial agency to transform and mobilise assets beyond their borders, especially where domestic assets are lacking. Thereby, we show that *sticky power* in GPFNs does not readily shift away from dominant geographies and actors (Grote et al., 2024), even under systemic pressures, such as decarbonisation. Rather, these actors have the means to consolidate their central positions and benefit from self-reinforcing dynamics. Furthermore, our findings show that beyond extraterritorial institutions (Kalvelage & Walker, 2024), the state itself can exercise extraterritorial agency directly through SWFs and SOEs as a market player in pursuit of strategic objectives. In this sense, our findings also highlight that the state-finance nexus within economic development strategies extends beyond facilitation (Lai, 2018; Lai, 2023): as both investor and owner, the state can shape private sector behaviour – by deploying de-risking mechanisms or by taking up strategic positions in value creation to enhance market development.

Finally, our research demonstrates how world governments with extraterritorial influence shape GPFNs in line with their economic development objectives, thereby contributing to the growing body of work on states exercising such extraterritorial agency (see also: Kalvelage & Walker, 2024; Lim, 2018; McGregor & Coe, 2023). Further investigation is needed to shed more light on other governments which 'cannot act at the global scale' (Grote et al., 2024). This is particularly relevant since strategic investments by foreign state-linked actors are often met with scepticism in host countries (Babic, 2023; Dixon, 2022). Future research could therefore explore how host regions resist, negotiate or leverage extraterritorial investments – not as passive recipients but as active agents pursuing their own goals and strategies. Moreover, given the rapidly changing geopolitical landscape and shifting national commitments to net-zero targets, it is crucial to consider the broader implications. The recent withdrawal of major US banks from the Net-Zero Banking Alliance following Donald Trump's inauguration (Gayle, 2025) highlights the potential fragility of net-zero financial commitments. Against this background, the question arises to what extent net-zero commitments will in fact shape economic development strategies in the long-term and how a potential shift away from these commitments might influence such strategies.

Note

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

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Ethics statement

We confirm that informed consent was sought and granted verbally by all the participants in this research before each interview. A detailed informed consent guideline was explained to each participant, including the permission to publish material and evidence gathered from the interviews.

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