ENERGY STUDIES INSTITUTE

Policy *Brief* 43

27 May 2021

# The Role of the Blue Economy in Singapore's Sustainable Energy Transition

Mary Ann Quirapas-Franco, Melissa Low and Alex Ng

**SYNOPSIS**

Singapore recently launched the Singapore Green Plan 2030 (SGP 2030), a whole-of-nation movement to drive the city-state's national agenda on sustainable development. While the SGP 2030 primarily focuses on the green aspects or land-based solutions to climate change, Singapore should tap on its marine and coastal resources to complement and strengthen current efforts to achieve long-term and sustainable economic growth. This policy brief explores the opportunities to expand Singapore's blue economy, especially to transition to more sustainable energy sources.

**KEY POINTS**

- The blue economy refers to the sustainable use of ocean resources, seas and coasts for economic growth, improved livelihoods and jobs, and their ecosystem health.
- While Singapore's blue economy initiatives are focused more on reducing energy usage, waste and carbon footprint, other opportunities can be further explored in the areas of marine renewables, sustainable food production in coastal and marine environments (CME), water production through desalination of sea water, and sustainable marine transportation through vessel electrification.
- Multiple demands on the use of Singapore's limited coastal and marine areas will require holistic planning, continuous community engagement and affording businesses the opportunity to transform.
- There is currently no blue economy supply chain in Southeast Asia. Singapore can gain the first-mover advantage in region and secure market share leveraging its advanced marine and offshore engineering sector (M&OE) and maritime industry, and through the provision of sustainable energy services.

## INTRODUCTION

Singapore's total land area is approximately 725 km$^2$ while its coastline stretches 197 km and territorial seas up to 12 nautical miles is 744 km$^2$. The island city-state's maritime industry is a key economic pillar, contributing around 7 per cent in gross domestic product (GDP) in 2018. Nearly all marine and coastal areas are used for commercial purposes and other non-industrial usages such as residential development and recreational activities. As of 2017, Singapore's maritime industry employed around 170,000 people.

The World Bank defines the blue economy as the sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health. This extends to all economic activities in oceans, seas and coasts, which includes the closest supporting activities necessary for these economic sectors to function. It also emphasises social inclusion and preservation and ensuring environmental sustainability of the marine space, as explained in a *Blue Economy Report 2021* by Konrad Adenauer Stiftung (KAS).

While there are benefits from utilising the sea space for long-term national interests, doing so unavoidably affects—often adversely—the marine environment and ecosystem. This policy brief explores the opportunities to

Energy Studies Institute
29 Heng Mui Keng Terrace,
Block A, #10-01, Singapore 119620
Tel: (65) 6516 2000 | Fax: (65) 6775 1831
esi.nus.edu.sg

A Research Institute of NUS National University of Singapore

expand Singapore's blue economy, especially to transition to more sustainable energy sources. Specifically, it will outline existing government's efforts to achieve a sustainable blue economy and analyse any gaps in the current policy framework to drive blue economy activities in Singapore.

## ANALYSIS

### *Defining the Blue Economy in Singapore*

According to the *National State of Ocean and Coasts* (NSOC) 2018 report published by Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), an intergovernmental organisation based in the Philippines, Singapore's blue economy is defined as a sustainable ocean-based economic model. The industries identified as critical to Singapore's blue economy are: Fisheries and Aquaculture, Ports, Shipping and Marine Transport, Tourism, Resorts and Coastal Development, Marine Technology and Environmental Services, Oil and Gas, Ocean-related manufacturing, Seabed Mining, Renewable Energy, and Marine Biotechnology. The Singapore Business Review reported last January 2021 that Singapore remains the world's top bunkering hub despite the economic fallout last year from the coronavirus pandemic. The NSOC 2018 Report also noted that coastal and marine tourism contributed about USD 515 million (SGD 682 million) to the country's economy in 2016.

Ensuring the efficient use of domestic sea space is also critical. To improve food security, the Singapore Food Agency (SAF) has set the target to produce 30 per cent of Singapore's nutritional needs by 2030, which includes boosting local aquaculture production as a source of protein. Currently, 10 per cent of the country's fish consumption comes from local food fish farms, both on land- and sea-based sources. Around 122 fish farms, of which 110 are based in Singapore's coastal and Southern waters, produce 4,700 tons of fish. Finally, as a water-constrained country, Singapore faces the challenge of securing a stable and affordable water supply and utilises various water-based solutions to ensure the supply of high quality and affordable potable water through the establishment of desalination plants, wastewater treatment, and water reclamation.

### *Current Initiatives and Efforts*

Multiple demands on the use of limited coastal and marine areas in Singapore have led to the setup of various projects, policy, and regulatory mechanisms. At the regional level, Singapore is part of the PEMSEA and also a proponent of the Blue Economy Model Program under the Asia-Pacific Economic Cooperation (APEC). Locally, the government adopts and implements the integrated urban coastal management (IUCM) framework which enables the management and regulation of the sea space, its reduction of energy usage, waste and carbon footprint. This framework promotes a whole-of-government approach to ensure the protection and preservation of the coastal and marine areas. For example, the Maritime Singapore Green Initiative (MSGI) seeks to reduce the negative environmental impact of shipping and other related activities to achieve sustainable ports. Singapore also started the liquefied natural gas (LNG) bunker-ready port pilot programme to encourage the usage of alternative fuels in the shipping sector. The SGP 2030 announced in March 2021 also emphasised Singapore goals to promote sustainable fuels for international trade and travel through the International Civil Aviation Organisation's fuel efficiency improvement and the International Maritime Organisation's initiative to reduce GHG from international shipping. In April 2021, Singapore's Maritime and Port Authority announced a new SGD 120 million fund for a maritime decarbonisation centre in Singapore with support from industry partners.

With Singapore's vision as a City in Nature, the government encourages the conservation of Singapore's urban greenery and biological diversity through proper management of parks and nature reserves and preservation of national heritage. Local research institutes like the NUS Tropical Marine Science Institute (TMSI) spearheads the reef rejuvenation project of the local coral population, while the Singapore Institute of Biology proposed the Singapore Blue Plan in 2018 for the conservation of the marine ecosystems. The SGP 2030 also reiterates Singapore's positioning as a sustainable tourism destination; to encourage a new generation of travellers who have a better appreciation of protecting nature and culture, including coastal and marine areas, to visit the country.

To protect the quality and sustainability of local aquaculture, the Marine Aquaculture Centre (MAC) was set up in 2003—now under the SFA—to research and develop work across the entire hatchery production process. The government also supports various research, development, and demonstration (RD&D) activities to harness ocean renewable energy (ORE). ORE refers to harnessing power from tidal currents, tidal range, waves, temperature, and salinity gradients. For instance, the MAKO Tidal Energy Site opened at the Sentosa Boardwalk in September 2019 to convert the kinetic energy in flowing water into electricity for local use or for charging batteries; and is a two-year project composed of academia, industry actors, and government agencies.

***New Opportunities for the Blue Economy: The Energy Dimension***

Other opportunities can be explored under Singapore's blue economy. One is the marine and offshore engineering sector (M&OE) that goes beyond traditional sectors such as shipping, transportation, and coastal management, to include emerging areas like the marine renewable energy sector (MRE). MRE refers to anything in the marine space used to generate renewable energy. This includes the various types of ORE, floating solar photovoltaic (PV), and offshore wind. The *M&OE Industry Transformation Map* (ITM) launched by the Singapore Ministry of Trade and Industry (MTI) on 22 February 2018 considers the offshore wind market, which is expected to surge past USD 130 billion (SGD 172 billion) by 2023 at the global level. At the national level, the M&OE sector's contribution towards the blue economy could be further enhanced.

Despite the COVID-19 pandemic causing a dip in economic activity, Singapore's M&OE sector is pivoting to new growth areas like LNG and MRE, such as offshore wind and floating solar PV systems. In 2019, Singapore firms secured SGD 1.5 billion for LNG and SGD 1 billion for offshore wind projects. Industry players are taking advantage to push for cleaner energy. In March 2021, Sunseap Group installed a 5MWp offshore floating solar farms in Singapore. As one of the largest floating PV projects in the world, it is expected to produce around 6 million kWh of energy per year and offset an estimated 4,258 tonnes of carbon dioxide. Singapore can also look at establishing a regional energy grid powered by renewables. Such a grid would open the possibility of similar floating solar PV systems in the waters of neighbouring islands, such as Batam, which is less than 20km from mainland Singapore. Such collaborative cross border projects would enable Singapore's blue economy to expand beyond its own territorial waters.

The SGP 2030 and *Singapore's Long-term Low Emissions Development Strategy* also highlighted plans to tap on the hydrogen economy for decarbonisation. According to a report done by OceanPixel called the *Status of ORE in Southeast Asia 2017*, ocean energy companies in the region are exploring the possibility of using ocean thermal energy conversion (OTEC) for hydrolysis and storing energy using hydrogen fuel cells to transport and supply power for various applications outside the OTEC plant. The proposition of transporting energy using a storage system like hydrogen fuel cells can be explored because it can be achieved over a long distance without the need for a costly transmission line.

The nexus of energy and other vital sectors like water and food can also be further explored. A renewable energy-driven desalination system can be customised to have a multi-output system that produces electricity and water simultaneously. This presents a significant opportunity for integrated developments towards supplying multiple infrastructures while addressing various societal needs of electricity and water in Singapore. It also opens the export potential for island communities and near-shore cities in Southeast Asia.

Aside from deploying technologies in the coastal areas, nature-based solutions should be explored as part of the decarbonisation strategy. According to International Union for Conservation of Nature, blue carbon is the "carbon stored in coastal and marine ecosystems." This includes seagrasses, tidal marshes, and mangroves. It is said that mangroves can typically store three to five times more carbon per hectare compared to other forest types. They also guard the coastline by building up sediments that catch up with rising sea level. In terms of food security, efficient sea space usage is vital to

cater for Singapore's domestic food production growth. Last year, members of the Society of Floating Solutions Singapore (SFSS) published a concept paper of a multi-level floating farm for fish and other agricultural production. Finally, Singapore can further develop sustainable maritime tourism by replacing the diesel-powered engines currently used by the ferries with a new generation of electric ones. Around 50 boats ferry approximately 300,000 visitors annually in both the Northern and Southern parts of Singapore, to islands such as Pulau Ubin and the Southern Islands. Ferry vessels, like buses inland transportation with predictable routes and short distance stops, would be the easiest for transitioning to full electric propulsion.

**CONCLUSION**

Advances in technology and processes from marine and maritime-related sectors present significant opportunities for Singapore to push for a more integrated approach in developing a blue economy. New and improved policy and regulatory frameworks can incentivise efficient, innovative, and future-proof solutions that will go a long way in sustainably using the marine space. Despite the limited sea space catering to various users, Singapore can further develop its blue economy activities by utilising its existing knowledge and expertise present in the M&OE sector towards more niche areas like the ocean and marine renewable energy where interest is growing. Aside from the traditional ocean economy sectors like shipping, transportation, and fishing, the city-state can create more opportunities by advancing MRE sectors like offshore wind and floating solar PV for domestic and overseas markets.

Furthermore, given the current lack of an existing specialised blue economy supply chain in Southeast Asia, Singapore can gain the first-mover advantage in the region and secure market share through its advanced M&OE and maritime industry. Much of the required capabilities already exist locally with minimal re-training or skill transformation needed. This market growth can also translate to new local jobs and contribute towards a green post-pandemic economic recovery. The blue economy perspective also focuses more on the nexus among other sectors like food, water, tourism, and transport. There are existing off-the-shelf solutions that can be tweaked and localised to suit Singapore seawater conditions. Examples are floating urban farms with hybrid energy systems, or solar farms that perform a dual function of generating power and serve as floating charging stations for electric vessels. With a holistic planning process, continuous community engagement and affording businesses the opportunity to transform, Singapore can achieve sustainable and efficient utilisation of marine space and environment.

**WHAT TO LOOK OUT FOR**

- New and improved efforts to develop Singapore's blue economy as part of the country's decarbonisation strategy.
- Nature-based solutions at the marine space which is in line with the SGP 2030 and the global blue economy initiatives.
- Ability of the government in managing the multiple demands on the use of limited coastal and marine areas in Singapore which will involve trade-offs.
- Promotion of Singapore as a regional blue economy hub.

*Mary Ann Quirapas-Franco, PhD and Melissa Low are Research Fellows at the Energy Studies Institute, National University of Singapore. Alex Ng is a Director in Orcades Marine Asia Pte Ltd.*

Keywords: *Blue Economy, Singapore Green Plan, Coastal and Marine Environment, Sustainable Development, Marine Energy*

The authors would like to acknowledge the valuable feedback from Dr. Christopher Len, Dr. Philip Andrews-Speed and Dr. David Broadstock of ESI and Dr. Michael Abundo of OceanPixel Pte Ltd for this policy brief.

**The views and opinions expressed in the *ESI Policy Briefs* are those of the authors and do not necessarily represent or reflect the views of the Energy Studies Institute, NUS.**

**Copyright © 2021 Energy Studies Institute. *ESI Policy Briefs* can be reproduced, provided prior written permission is obtained from ESI, the content is not modified without permission from the author(s), and due credit is given to the author(s) and ESI. Contact: Ms Jan Lui <jan.lui@nus.edu.sg>**