

Singapore — food, water and energy resilience for a city-state

Government of Singapore

A small and densely populated island city-state, Singapore is heavily reliant on trade and disproportionately affected by global supply chain disruptions. Singapore imports about 95 per cent of its energy for electricity generation, over 90 per cent of food, and much of its water. Global food supply disruptions, triggered by the COVID-19 pandemic and exacerbated by climate change, have clearly demonstrated the vulnerability of small states. Singapore takes these risks seriously and has been building resilience against external shocks in its sustainable development journey.

Feeding a nation

Rapid urbanization and industrialization globally have exacerbated the impact of climate change and heightened the vulnerability of global agri-food production. Rising sea levels, changing rainfall patterns and wind speeds, and warmer climates have affected the productivity and yield of farming and food production, and could lead to the proliferation of various foodborne hazards. In line with Sustainable Development Goal (SDG) 2 on zero hunger, Singapore uses various strategies, such as import source diversification and local production, to strengthen food resilience and overcome the impact of potential disruption.

During the COVID-19 pandemic, in 2020, Singapore signed the Joint Ministerial Statement on Ensuring Supply Chain Connectivity with like-minded countries, which called for the unimpeded flow of essential goods including food and agricultural products.

To overcome its lack of natural resources and to strengthen food security, Singapore has set an ambitious “30 by 30” goal to build up the local agri-food industry’s capability and capacity to sustainably produce 30 per cent of nutritional needs locally by 2030. Efforts include:

- Making available the space and infrastructure for agriculture and aquaculture
- Facilitating regulatory reviews to further enable farm development
- Driving research on sustainable urban food production methods and future foods
- Encouraging ecosystem growth by incentivizing farms to adopt sustainable farming technologies and developing a local pipeline of skilled agri-food workers
- Encouraging offtake for local produce.

Water for all

Singapore is among the most water-stressed countries in the world. With achieving water sustainability an imperative and as part of its commitment towards SDG 6 on clean water and sanitation, Singapore takes an integrated and long-term approach toward water management to ensure a resilient and sustainable supply. The supply has been diversified through four national taps:

- Water from local catchments
- Imported water
- High-grade reclaimed water known as NEWater
- Desalinated water.

Operations of Singapore’s fourth and fifth desalination plants — the Keppel Marina East Desalination Plant and Jurong Island Desalination Plant — commenced in July 2020 and April 2022 respectively. These new plants feature innovative designs and are more energy-efficient than conventional desalination plants. In addition, technologies such as biomimetic membranes, which mimic the way plants and animals extract freshwater from seawater, are also being validated and scaled up to further lower the energy required for desalination. Singapore has also been exploring technologies to improve its used water recovery rate. A third NEWater factory in Changi is expected to be commissioned in 2025 and could enable the recovery of up to 90 per cent of treated used water, higher than the existing rate of about 75 per cent.

By 2065, Singapore’s total water demand is expected to nearly double, with the non-domestic sector accounting for about 60 per cent. Steps have been taken to actively manage the increasing demand. For instance, since 2018, amendments have been made to the Mandatory Water Efficiency Labelling Scheme to cover a wider range of household appliances. Under the Climate Friendly Households Programme introduced in 2020, households are provided with vouchers to encourage switching to more water-efficient shower fittings. For the non-domestic sector, large water users are required to monitor their water efficiency and submit a mandatory Water Efficiency Management Plan (WEMP) annually. The PUB, Singapore’s National Water Agency, has developed water efficiency benchmarks and best practices guidelines for the various sectors using data collected from WEMPs. Singapore also launched the Singapore Green Labelling Scheme in 2019 for commercial washing appliances, with further minimum



Image: Sustenir

Local production is a key prong of Singapore's food security strategy as it helps to mitigate the impact of supply disruptions. Located in an industrial building, urban farm Sustenir grows temperate produce such as arugula, kale, lettuce and spinach, within a tightly controlled environment that ensures optimal plant growth and year-round harvests

water efficiency requirements introduced in 2022. In addition, the Water Efficiency Fund was enhanced in 2020 to expand funding for water efficiency projects in businesses. From 2024, water recycling will be made mandatory for new projects in the water-intensive wafer fabrication, electronics, and biomedical industries.

Powering Singapore's sustainable development

Notwithstanding its alternative-energy disadvantaged status, Singapore is working towards a vision of a clean, secure, and efficient energy future in line with SDG 7 on affordable and clean energy. The city-state has transitioned from oil to natural gas since the early 2000s for cleaner power generation, and enjoys high system reliability, all while keeping energy costs competitive. Under the Singapore Green Plan 2030, the plan is to diversify the energy supply by accelerating solar deployment, facilitating the development of regional power grids, and leveraging emerging low-carbon alternatives, such as hydrogen and carbon capture, utiliza-

tion and storage (CCUS). Singapore is also promoting energy demand measures, such as demand response and energy efficiency initiatives targeted at households and businesses.

Today, about 95 per cent of Singapore's electricity is generated using natural gas, the cleanest fossil fuel. Natural gas will remain an important part of the energy mix until electricity imports and low-carbon options can be scaled up significantly. In the meantime, Singapore will continue to tap on and invest in natural gas infrastructure, and diversify the country's import sources to safeguard energy security. Singapore has also implemented policies to encourage companies to invest in equipment and technologies that can improve generation efficiency and reduce carbon emissions. At the same time, Singapore is introducing new emission standards for power generation units in 2023, which will require all new generation units to be at least 30 per cent by volume hydrogen compatible, with the potential to be retrofitted to become 100 per cent hydrogen compatible in the future to the extent possible.



Image: Singapore Aquaculture Technologies

Fish farm Singapore Aquaculture Technologies (SAT) is a closed-containment farm that comes with high-tech features including artificial intelligence, sensors and camera sensors. It partnered global technology company Siemens to enhance its aquaculture operations with automation and digital technology

Solar energy remains Singapore's most viable renewable energy source. Despite land constraints and a highly urbanized environment, Singapore has adopted innovative ways to deploy solar photovoltaic systems at locations such as water bodies, or temporary vacant land. As of end-2022, Singapore has over 800 megawatt-peak (MWp) of installed solar capacity. The country aims to reach at least 2 gigawatt-peak (GWp) by 2030, although this will only meet around 3 per cent of the total projected electricity demand. Singapore has also deployed energy storage systems (ESS) to address solar intermittency and enhance grid resilience. In December 2022, Singapore commissioned a 285MWh ESS facility, the largest in Southeast Asia. These investments have made Singapore one of the most solar-dense cities in the world.

Singapore is working with regional partners to develop regional power grids and import up to 4GW of low-carbon electricity by 2035, which will make up around 30 per cent of Singapore's electricity supply. To pave the way for these electricity imports, Singapore has been working with various partners on pathfinder projects to co-create the relevant technical and regulatory frameworks.

The Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS PIP), which imports up to 100MW of renewable hydropower from Lao PDR to Singapore via Thailand and Malaysia, commenced on 23 June 2022. This marked a historic milestone as the first multilateral cross-border electricity trade involving four ASEAN Member States, and the first project to import renewable energy into Singapore.

On 16 March 2023, Singapore's Energy Market Authority (EMA) issued a conditional approval for the country's Keppel Energy to import 1 GW of hydropower, solar, and potentially wind power from Cambodia's Royal Group Power Company.

Singapore has also recently signed an MOU with Indonesia to facilitate investments in the development of renewable energy manufacturing industries in Indonesia and cross-border electricity trading projects between the two countries.

To reduce its carbon footprint in the longer term, Singapore is exploring emerging low-carbon technologies such as advanced geothermal, hydrogen, and CCUS. In October 2022, the Singapore Government announced the National Hydrogen Strategy to develop hydrogen as a major decarbonization pathway, with the potential to meet up to 50 per cent of projected electricity demand by 2050. Singapore also initiated an Expression of Interest process in December 2022 to assess the feasibility of developing an end-to-end low or zero-carbon ammonia power generation and bunkering solution. The Singapore Government has also committed to investing US\$ 130m in R&D under the Low-Carbon Energy Research Funding Initiative to support the development of low-carbon technologies including hydrogen.

International engagement and collaboration

Singapore remains a steadfast supporter of global efforts to advance the SDGs. On clean water, a Singapore Water Exchange has been developed as a global marketplace of innovative water companies that collaborate and co-create solutions. This helps to bring discoveries made in the laboratory to industrial application as quickly as possible.

Singapore also joined other United Nations Member States in submitting voluntary contributions to the Water Action Agenda, where a pledge was made to implement smart water meters, conduct R&D to improve the energy efficiency of desalination and used water treatment processes, and build expertise on coastal protection and flood management. Singapore has worked with UN-Water on an SDG 6 Acceleration

Case Study, which outlined best practices and lessons learned from Singapore's journey in building water sustainability. Furthermore, the Make Every Drop Count water conservation campaign and Singapore World Water Day celebrations held every year in conjunction with the United Nations World Water Day on 22 March serve to raise awareness of Singapore's water challenges in the face of climate change and to educate people on the need to conserve water.

Singapore also engages stakeholders and shares experiences on energy management through technical assistance and capacity-building programmes for fellow developing countries. In 2022, Singapore worked with the US to conduct

the Singapore-US Third Country Training Programme on renewable energy for more than 30 ASEAN participants. The Singapore-International Energy Agency (IEA) Regional Training Hub has also conducted six programmes since 2018, including a 2023 programme on Seizing Opportunities with Regional Power Grids, attended by more than 160 participants from Southeast Asia.

In addition to the Training Hub, discussions are ongoing with the IEA to establish a regional office in Singapore to support the IEA's collaborations in the Asia-Pacific region. Singapore welcomes closer collaboration with more countries and partners in these challenging areas.

How electricity is imported from Laos to Singapore

