ETH Zurich Department of Architecture
ARCHITECTURE OF TERRITORY
Chair of Architecture
and Territorial Planning
Professor Milica Topalović

The Production of Cloud
Spring 2026

Atlas

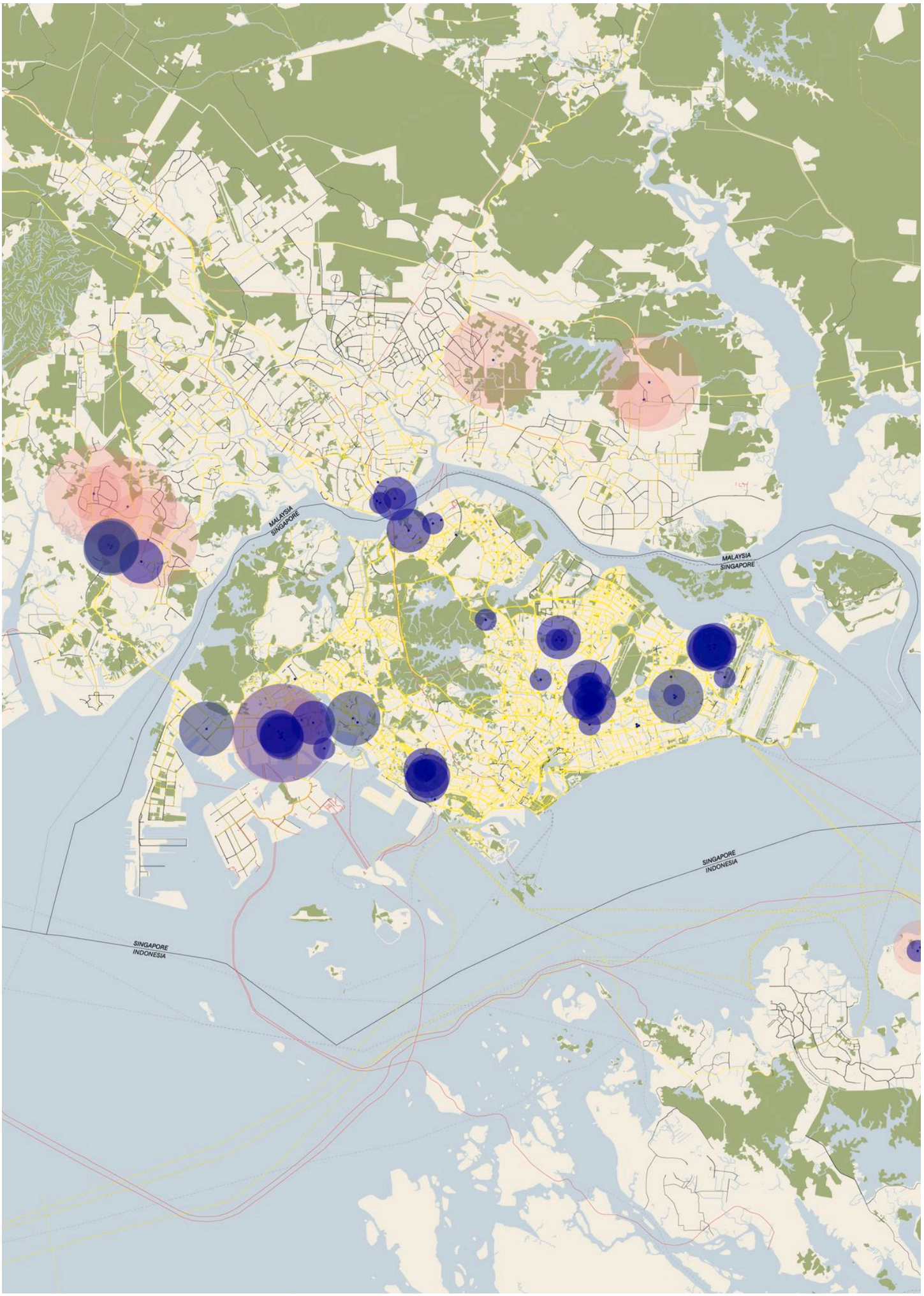
Singapore-Johor, SG–MY

Emma Kleinbölting, Antonia Johanna Karl, Beda Füssler, and Simone Graf

Over the past decades, Singapore has developed into one of the densest data centre clusters in the world and the largest in the Asia Pacific region. The city-state benefits from extensive digital infrastructure, including around 15 international subsea cables, as well as strong trade and connectivity agreements with neighbouring countries such as Indonesia and Malaysia. These factors make Singapore a strategic location for global cloud providers and internet infrastructure. However, the rapid expansion of the sector has also placed significant pressure on the country's limited land and energy resources. With capacities exceeding 100 megawatt (MW) per facility, many data centres require enormous amounts of electricity, raising concerns about energy supply and long-term sustainability.

To give the industry time to adapt and to allow both infrastructure and regulatory frameworks to develop, the Singaporean government introduced a temporary moratorium on new data centre developments in 2019. This pause also allowed policymakers to design stricter requirements for energy efficiency and sustainability in future projects. In 2022, the moratorium was partially lifted, and new projects were approved under tighter regulatory conditions. One prominent example is the new Meta data centre, which reflects the shift toward more efficient and environmentally conscious facilities. In 2025, Singapore introduced a second round of regulatory measures aimed at further improving the sustainability of the sector.

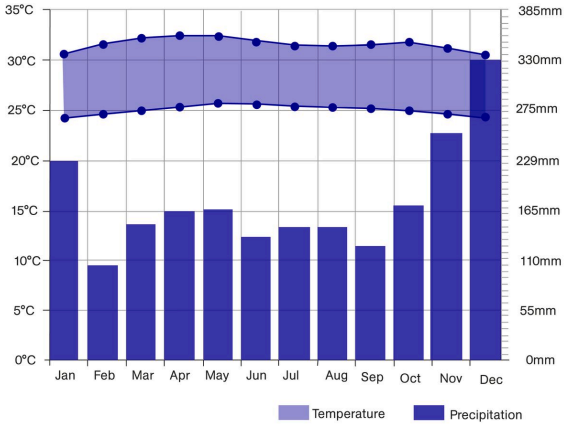
At the same time, the moratorium had noticeable spatial effects on the regional data cluster landscape. Mapping the development of the cluster shows that, since the ban was introduced, data centre expansion has increasingly shifted northward into Malaysia.


MALAYSIA
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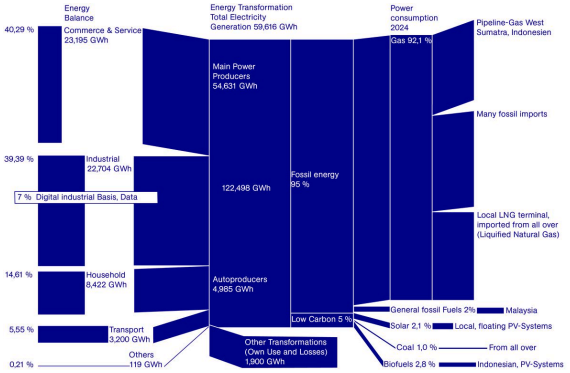
Territorial map of the Singapore data centre cluster. Drawing: the authors, 2026.

- Operational data centre >100 MW
- Operational data centre 50-99 MW
- Operational data centre 15-49 MW
- Operational data centre <14 MW
- Construction sites of data centres
- Electricity grid
- Pipelines
- Boat routes

Singapore and Its Metropolitan Area



Climate and precipitation in Singapore. Diagramme: the authors. Source: Singapore Climate Guide [https://www.climatestotravel.com/climate/singapore].



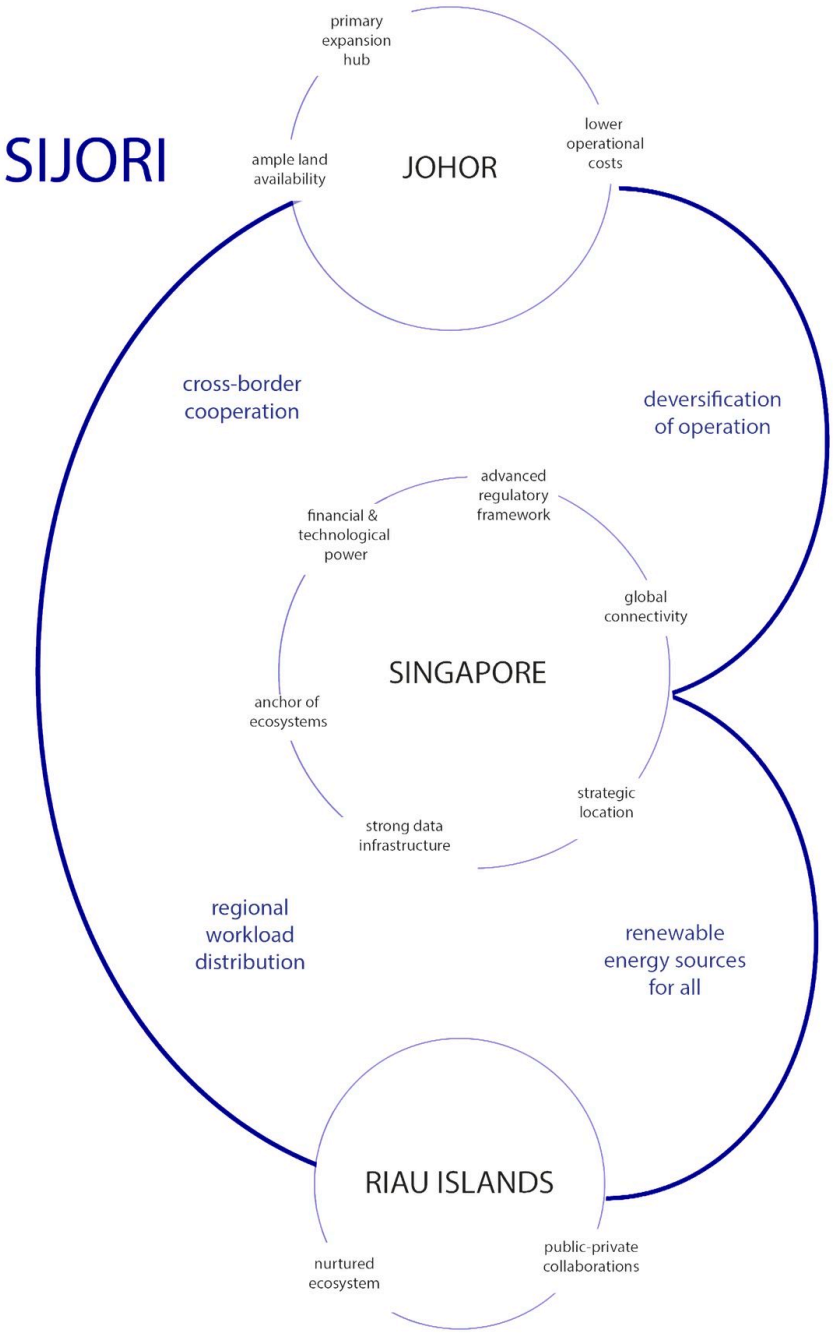
Energy supply chain. Diagramme: the authors. Source: Singapore Energy Statistics 2025 [https://www.ema.gov.sg/resources/singapore-energy-statistics].

The city-state of Singapore faces severe constraints in terms of land availability and natural resources. As a result, many essential goods and materials must be imported from abroad. The same applies to the country's energy supply, which largely depends on external sources. This high level of dependency makes resource management a key challenge for Singapore's long-term development.

In 2020, data centres accounted for around 7 % of Singapore's total electricity consumption. Most of the country's energy is generated from natural gas and other fossil fuels. A large share of these energy resources is imported from neighbouring countries such as Malaysia and Indonesia. This reliance on external energy supply highlights the growing tension between digital infrastructure expansion and energy security.

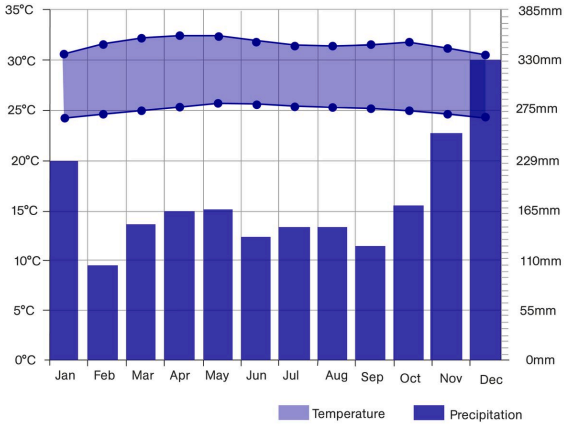
Both Malaysia and Indonesia are part of the SIJORI Growth Triangle, a regional economic cooperation zone linking Singapore with Johor in Malaysia and the Riau Islands in Indonesia. The initiative aims to strengthen cross-border economic collaboration and regional development. Through this framework, Singapore is able to access additional labour, land, and resources from neighbouring regions. The SIJORI Triangle therefore plays an important role in supporting Singapore's economic and infrastructural growth.

Singapore's climate is characterised by consistently high temperatures and humidity throughout the year. These conditions create a significant demand for cooling in buildings and infrastructure. Data centres in particular require large-scale cooling systems to maintain stable operating conditions. As a result, climate conditions further increase the energy consumption of digital infrastructure in the city-state.

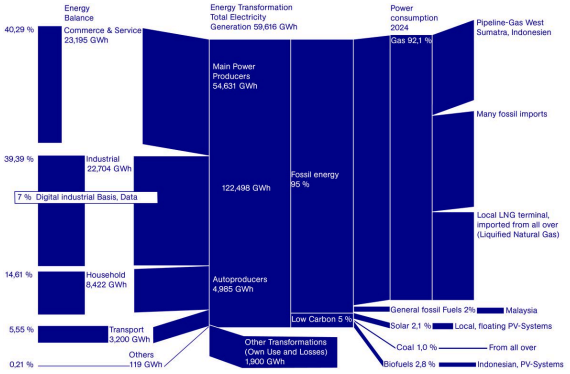


SIJORI Growth Triangle. Diagramme: the authors. Source: digitaldistrcit.org [https://www.digitaldistricts.org/catalytic-projects/sijori-tech-triangle].

The SIJORI Growth Triangle comprises three key regions: Singapore, Johor (Malaysia), and the Riau Islands (Indonesia). This trade pact coordinates various economic sectors, with a significant focus on data centres and their energy requirements. The primary advantages for the data centre industry lie in Singapore's advanced infrastructure coupled with the lower land and operational costs available in Malaysia and Indonesia.



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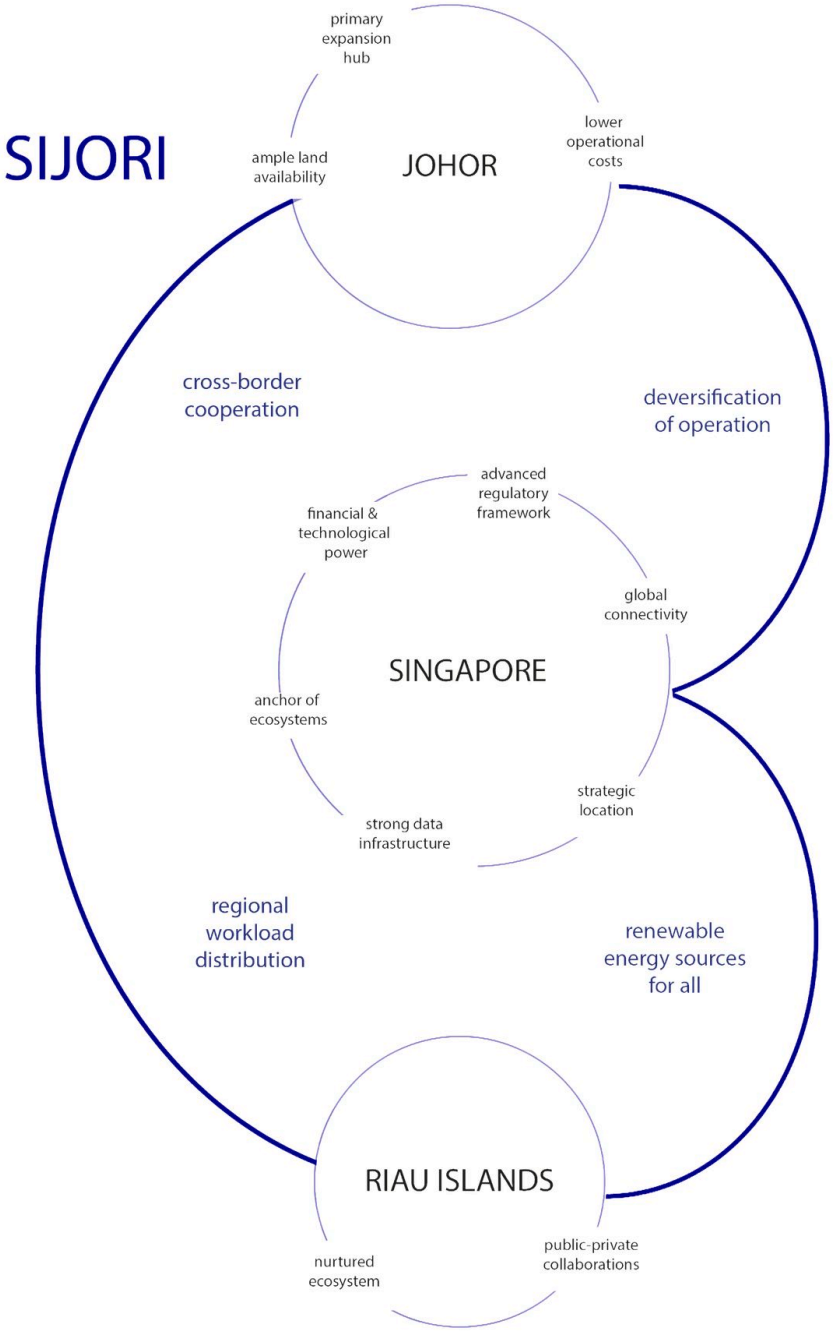
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Exponential Growth of the Cluster



1967: SEACOM SUBMARINE CABLE
Submarine fibre cable linking Southeast Asia to global networks, which results in a major boost for regional connectivity.



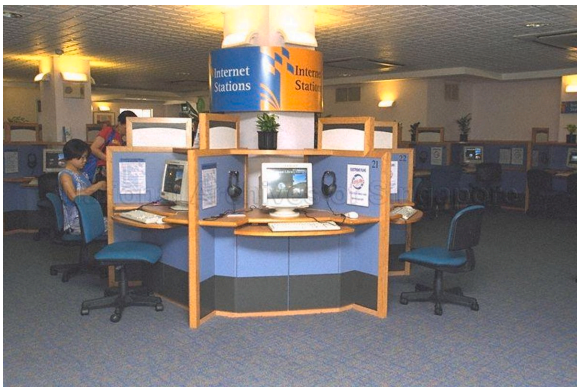
1971: TELEX 126 GLOBAL LINKS
The Telex network expands quickly, linking Singapore to 126 countries and strengthening global trade.



1981: NATIONAL COMPUTER BOARD (NCB)
The NCB drives computerisation of the civil service and education and builds national IT skills and digital expertise.



1992: IT2000 MASTERPLAN "INTELLIGENT ISLAND"
Vision by the government to transform Singapore into a fully networked "Intelligent Island" economy.

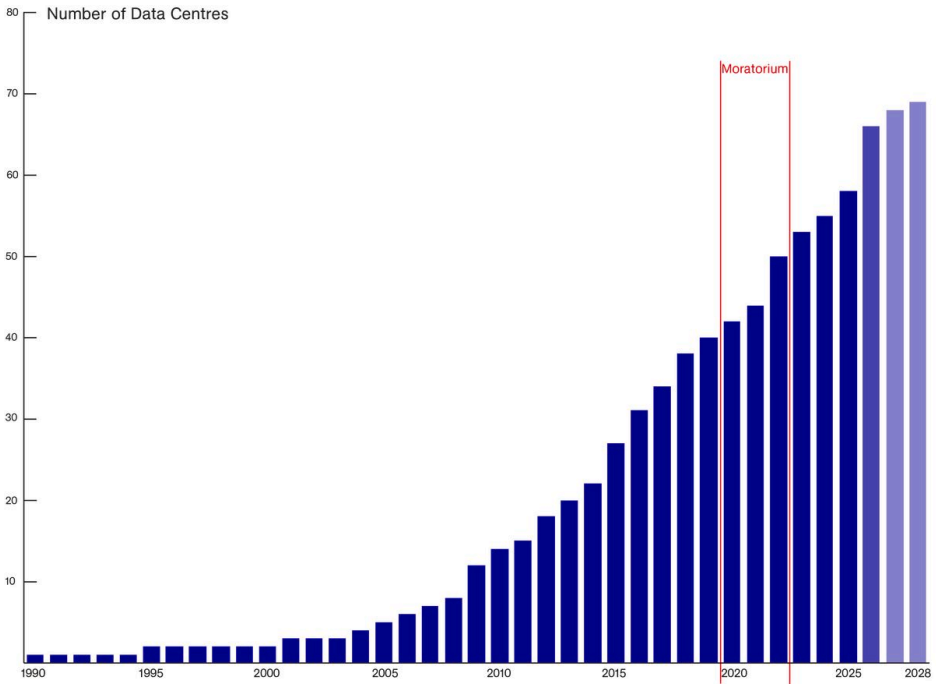


1997: SINGAPORE ONE NETWORK
Nationwide broadband project, high-speed internet, online services, and multimedia for homes.



2005: INTELLIGENT NATION 2015 (iN2015)
10-year national Information and Communication Technology plan to expand broadband, digital services, and global connectivity.

Singapore has been making strong progress in telecommunications for a long time. There were several major decisions by the government that helped Singapore develop its infrastructure very early. In the past with copper cables, today with fiber-optic cables, Singapore is very well connected resulting in Singapore becoming the most important telecommunications hub in Southeast Asia.



Estimated growth of the cluster. Diagramme: the authors, 2026.



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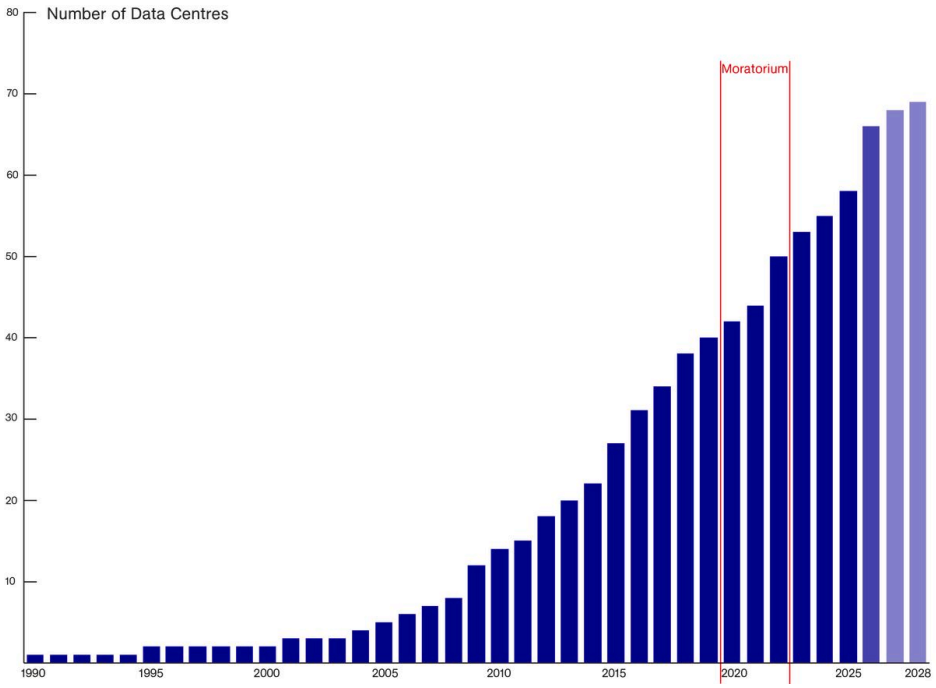


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The Data Centre Ban: Towards Regulated Growth



Cluster expansion before 2010



Cluster expansion 2011–2015



Cluster expansion 2016–2020



Cluster expansion 2021–2025



Cluster expansion in the future

The Singaporean government imposed a moratorium on the approval of new data centre construction in 2019. This measure temporarily halted further expansion in order to reassess the sector's rapid growth. The moratorium was lifted in 2022, after which a controlled approval process was introduced. A second round of regulated approvals followed in 2025 as part of this new framework.

Like many countries around the world, Singapore has set ambitious net-zero emissions targets. Policymakers recognised that allowing the rapid expansion of data centres without regulation could jeopardise the country's ability to meet its climate goals. In addition, Singapore faces limitations in terms of clean energy production and overall energy supply capacity. The moratorium therefore gave the government time to evaluate how the data centre sector could continue to grow in a more sustainable and energy-efficient way.

During this period, the government introduced new regulations for the construction of data centres. These include a complex sustainability assessment based on the "Green Mark" rating system, which projects must meet in order to receive approval. The system evaluates different aspects of environmental performance and sets minimum efficiency standards for new developments. In particular, the regulations focus on improving hardware and software efficiency to reduce the overall energy consumption of data centres.

At the same time, the moratorium allowed Singapore’s energy infrastructure to expand and adapt to the increasing demand created by the digital sector. This period provided an opportunity to strengthen energy supply systems and explore more sustainable solutions for future growth. By slowing development temporarily, the government aimed to better align digital infrastructure expansion with long-term environmental and energy strategies.



Cluster expansion before 2010



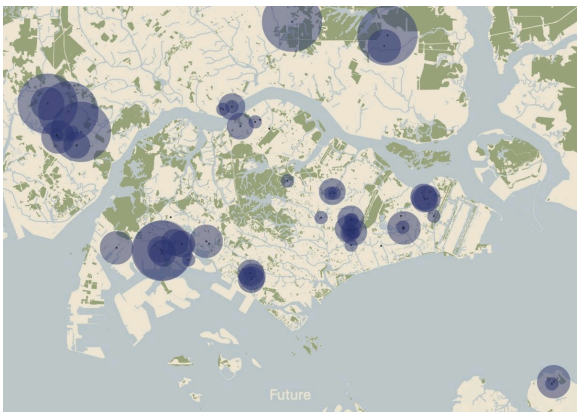
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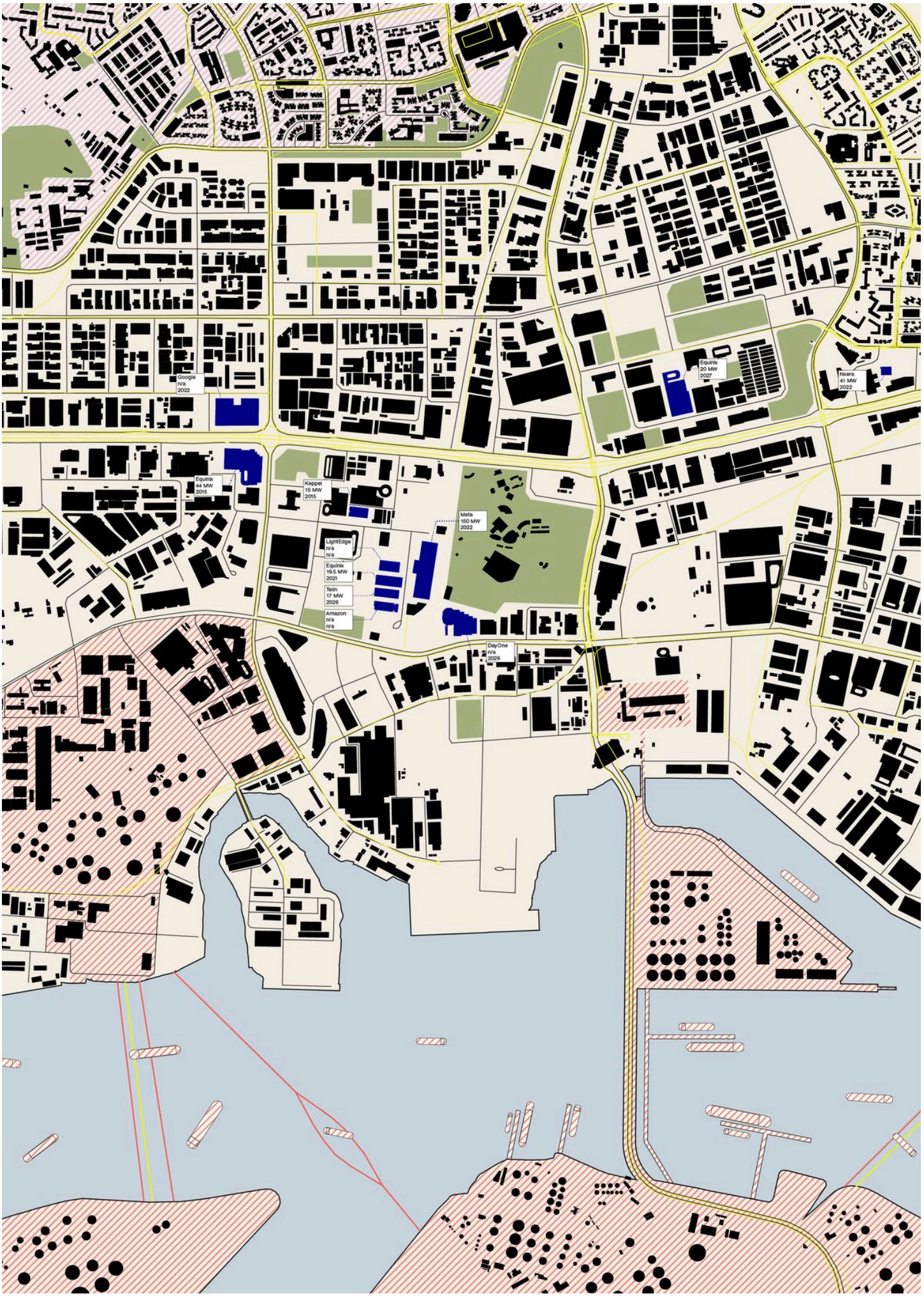
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The Results of the Ban


Google
n/a
2022
Equinix
44 MW
2015
Kappel
15 MW
2015
Meta
150 MW
2022
LightEdge
n/a
n/a
Equinix
19.5 MW
2021
Telin
17 MW
2026
Amazon
n/a
n/a
DayOne
n/a
2026
Equinix
20 MW
2027
Nxera
41 MW
2022



Singapore, urban plan of the data centre cluster north of above Jurong Island. The cluster is a hub for fossil fuels, in parts to generate electricity. In addition, there is a submarine cable landing point for fiber-optic cables on the island. Drawing: the authors, 2026.

- Data centre
- Residential zone
- Industrial areas: general
- Industrial areas: fossil fuel
- Electricity grid
- Pipeline

META—SINGAPORES BIGGEST DATA CENTRE

Data Center

Singapore Data Centre Moratorium Lifted; What next?



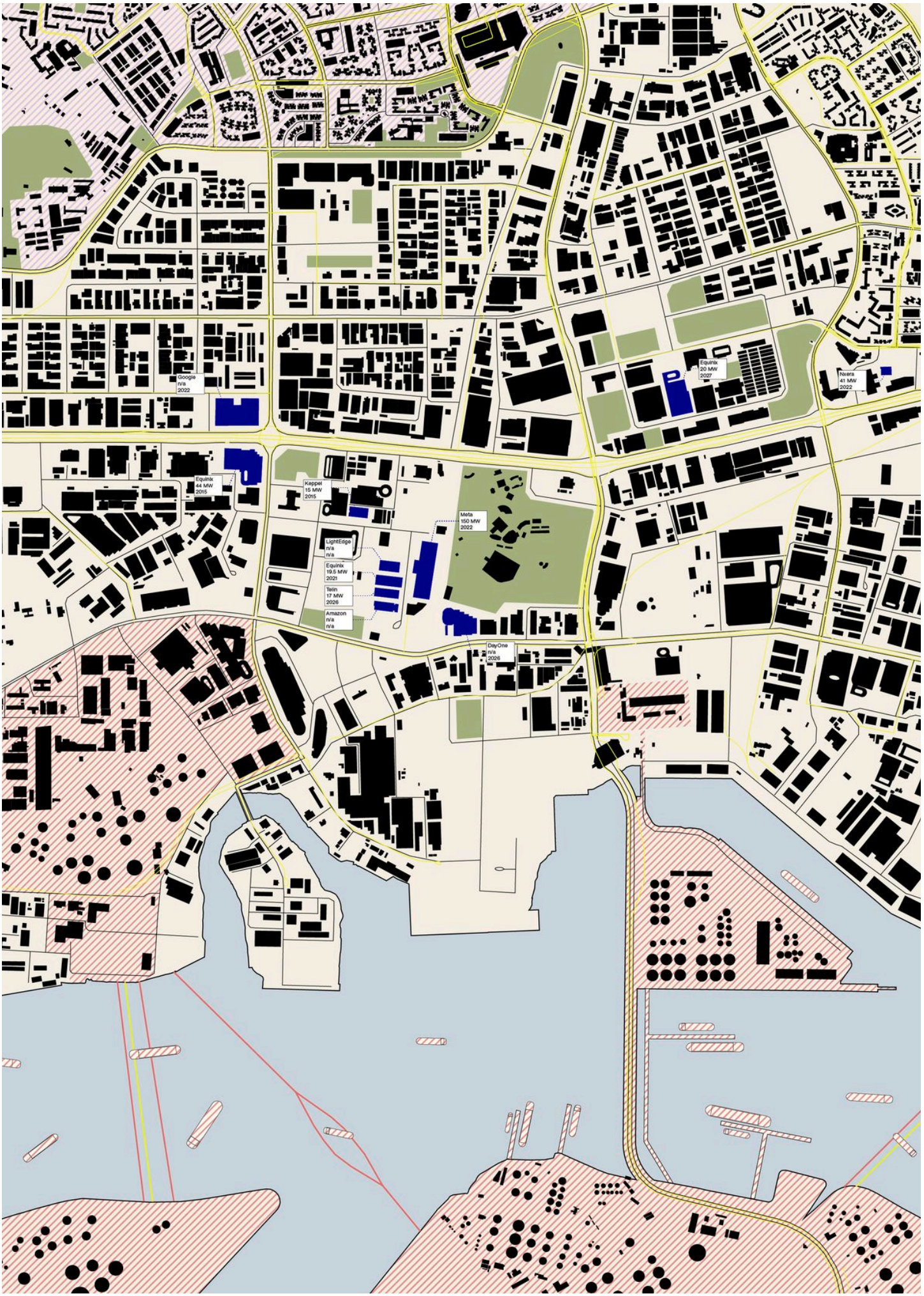
By Venkatesh Ganesh

June 21, 2022 at 12:37 PM GMT+8

A prime example is the 150 MW Meta building, where construction began in 2022. While it currently stands as the largest data centre in the SIJORI region, even larger facilities are already under construction or in the planning stages in Malaysia.

Meta has implemented strict guidelines to ensure more efficient energy use, guided by the principle: “We cannot reduce what we do not measure.” To this end, they track their greenhouse gas (GHG) emissions using activity data. By multiplying the quantity of a specific activity by its associated emission factor, they calculate the total environmental impact. For instance, the kilowatt-hours of electricity consumed at a Meta site are multiplied by country- or region-specific emissions factors to determine the site’s total footprint.

Water is another critical resource for their cooling systems. In 2022, Meta increased the operating temperature in selected data halls from 85°F to 90°F as part of a pilot program. Preliminary results show a reduction of over 50 % in water usage during the summer months, with negligible impact on overall data centre operations.


Google
n/a
2022
Equinix
44 MW
2015
Kappel
15 MW
2015
Meta
150 MW
2022
LightEdge
n/a
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19.5 MW
2021
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Growth, Limits, and New Directions

Over the past decades, Singapore has become one of the world’s most important data centre hubs, thanks to strong digital infrastructure and global connections. But this growth also puts pressure on limited land and energy resources. In 2019, the government paused new data centre projects to rethink sustainability and efficiency. Since 2022, new projects are allowed again, but under stricter environmental rules. As a result, some expansion has moved to nearby Malaysia.

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Architecture of Territory
Professor Milica Topalović

TEACHING TEAM
Dorothee Hahn
Martin Kohlberger
Yiqiu Liu
Milica Topalović
Jakob Walter
Jan Westerheide

Prof. Milica Topalović
ETH Zurich
ONA G41
Neunbrunnenstrasse 50
8093 Zurich
Switzerland
+41 (0)44 633 86 88
www.topalovic.arch.ethz.ch