



THE FUTURE OF **DATA CENTRES** IN THE FACE OF CLIMATE CHANGE

SUPPORTED BY:  DIGITAL REALTY

The ongoing global pandemic has shone a light on how dependent our economies have become on digital technology. With rapid digitalisation and the surge in demand for cloud-based services across the region, Southeast Asia is set to be the fastest growing region for the co-location of data centres over the next five years. Yet, the industry has among the highest carbon footprints in the business world today.

How can we decarbonise even while building better cloud solutions?

This white paper explores the viable solutions available to help data centre operators fight the rising tide of environmental challenges.

“The future of data centres in the face of climate change” is a white paper written and produced by Eco-Business Research, the research arm of Eco-Business, and supported by Digital Realty. Eco-Business is the leading media and business intelligence company serving Asia Pacific’s sustainable development community. Our platforms include the award-winning Eco-Business.com site, custom publications, research and high-impact bespoke events catered to deepen discussions on sustainability.

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TABLE OF CONTENTS

Foreword by Digital Realty and Eco-Business	5
Key takeaways	9
Executive summary	11
All eyes on Southeast Asia	11
Spotlight on Singapore	12
Key challenges	14
Viable solutions to sustainable growth	20
Impact of Covid-19	32
Spotlight on Malaysia and Indonesia	34
Attitudes towards more sustainable data centres	38
Future outlook and conclusion	41
APPENDIX 1: Detailed summary of online survey	44
APPENDIX 2: Research sources	50



FOREWORDS

The onset of Covid-19 has triggered the acceleration of digital transformation. It has also highlighted the invaluable role of data centres as the central nervous system of the digital economy. Asia Pacific is set to be the biggest market for data centers by next year, with a total market size to be around US\$28 billion by 2024 for colocation data centres. Southeast Asia (SEA) is one of the fastest growing regions globally and will be a key driver of the APAC's data centre market, representing around 13% of the region's total market size.

The region's data centre market continues to grow rapidly but we also need to be cognisant of the high energy required to power them. The importance of sustainable data centres is further exemplified by their high cooling needs, especially in SEA's tropical climate. Cooling needs account for 35 to 40% of total data centre energy demand, making energy efficient cooling technologies a key solution for data centre operators to reduce energy consumption. Consumers are also increasingly environmentally conscious. Even companies which have been putting sustainability on the back end are now making it a priority.

More companies are looking to invest in data centres that meet their goals as sustainability targets become more ambitious. This has cast a spotlight on green data centres. We value the importance of sustainability at Digital Realty and ensure our data centres are green, energy efficient, while meeting the demands of digital expansion at the same time.

Digital Realty's upcoming facility in Singapore (SIN12) reflects our strong commitment to industry-leading design standards while also being sustainable. The facility will be equipped with efficient cooling system design and controls, which aim to minimise evaporation losses and achieve the most competitive power usage effectiveness (PUE) for a commercial data centre in Singapore. We're also ramping up our sustainable efforts in other APAC facilities as we expand our regional presence, having recently announced new facilities in Korea, Hong Kong and Australia. As a company, we are dedicated to bring our emissions in-line with a significantly below two-degree climate change scenario by 2030.

Looking ahead, I believe it's best for all members of the data centre community to work closely together, share their expertise, and leverage each other's strengths to strive towards being more sustainable. Data centre players should also move away from conservative approaches and embrace modern technologies, such as liquid cooling solutions and Artificial Intelligence, which can radically help improve energy efficiency.

We're proud to work with Eco-Business on this whitepaper amidst rising awareness of sustainability in the industry. The whitepaper explored viable solutions which can help data centre operators achieve sustainable growth within Southeast Asia. I hope this report will provide you with valuable insights as we work towards reducing our carbon footprint.

FOREWORD BY DIGITAL REALTY



A handwritten signature in dark ink, appearing to read 'Mark Smith'.

Mark Smith

Managing Director
Asia Pacific at Digital Realty

Sustainable practices and environmental stewardship have evolved to become a priority in the global economy. Businesses have shifted their focus on sustainability, integrating it as a core aspect of their enterprise business strategy.

With the rapid growth of the digital economy, the demand for purpose-built data centres is growing in lock step. When taken as a class of building, data centres are among the highest consumers of power. It's more critical than ever for enterprises to maximize efficiency and seek clean energy solutions for their data centre infrastructure.

While efforts to improve the energy efficiency of data centres—such as cooling system upgrades, expanding the operating parameters of data halls, and optimising air flow by using smart sensors and controls—will remain an important area of focus, organisations are also capturing significant sustainability gains by switching to clean energy. With consumers becoming increasingly aware and interested in social and environmental issues, it is all the more imperative that organisations look to renewable and carbon-free energy as a sustainable resource for the long term.

Implementing green practices in data centres not only benefits the planet but is also good for business. The use of renewable energy resources can go a long way in helping businesses attract and retain customers while helping them achieve sustainable objectives.

As a company, we are committed to bring our emissions in-line with a significantly below two-degree climate change scenario by 2030. Some of our notable sustainability initiatives include our Global Renewable Energy programme which aims to make 100% renewable energy available to customers. Additionally, Digital Realty became the first data centre operator of our size and global reach to commit to setting a target with the Science-Based Targets Initiative (SBTi).

We are excited to share the findings of our joint study with Eco-Business in Southeast Asia (SEA). It is encouraging to see that most customers in the region view sustainability as a key consideration when choosing a data centre provider. We believe business success and environmental stewardship go hand-in-hand and sustainable innovation will play a critical role in the growth of the data centre industry in Southeast Asia.

FOREWORD BY DIGITAL REALTY



A stylized, handwritten signature in black ink, appearing to read 'Aaron Binkley'.

Aaron Binkley

Senior Director
Sustainability Programme
at Digital Realty

If there is one thing that Covid-19 has proven, it is that data has become an indispensable part of modern life and business operations.

Every day, millions of digital transactions happen behind the scenes without us noticing. But as we continue to grow products and services in this digital economy and rely on it to feed our human connections, we cannot ignore the growing energy footprint and planetary impact that goes along with it.

This new white paper, produced in partnership with Digital Realty, breaks new ground in highlighting the pressing challenges faced by the data centre industry as it expands to meet the rising global need for data. This is especially challenging in a region such as Southeast Asia where the tropical climate and policy environment does not necessarily provide the easiest of conditions.

But Southeast Asia is home to the fastest-growing economies in the world, and its rapid development will accelerate its demand for data services. Set amid this context, it is crucial that data centre providers find a way to meet this need while ensuring that they are playing a part in helping countries meet their climate targets.

To this end, the white paper outlines the significant opportunities and pathways available for the sustainable growth of the industry. Our findings reveal a key message: Technology that can reduce the carbon footprint and energy intensity of data centres is already available, or fast emerging.

Governments need to provide policy environments that allow the industry to step up and accelerate solutions such as the wider adoption of renewable energy, the use of hydrogen as a clean fuel source, and other efficient cooling methods.

Regulators need to create the right set of incentives to get operators and their clients to adopt best-available technologies, while data centre players must work with researchers to test-bed and scale up low-carbon solutions.

We hope this white paper will spark conversations in the region and spur further action among business, government and wider society to achieve the common goal of creating thriving digital economies while ensuring a resilient and sustainable future.

FOREWORD BY ECO-BUSINESS



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Jessica Cheam

Managing Director
Eco-Business



KEY TAKEAWAYS

1 The acceleration of digital transformation and exponential growth in data demand in Southeast Asia show no signs of abating

The Covid-19 pandemic has intensified the appetite for data and underscored the importance of digital technology and data centres. This presents the industry with a growing challenge as it finds ways to balance growth with the urgency to tackle climate change and reduce its environmental impact.

2 Solar energy is the stand-out source of clean energy in Southeast Asia

The region is witnessing several promising developments in renewable energy. Solar energy stands out in terms of its sizeable potential supply.

This trend is seen in Indonesia and Malaysia, which exhibit enormous future capabilities in generating solar energy, as well as in Singapore, which although is land-constrained can find ways to increase its solar energy supply through both domestic production and imports.

3 Major technological, research and innovation milestones open up opportunities to significantly reduce energy consumption

New developments, most notably in cooling technologies and smart innovations, present viable solutions to radically improve energy efficiency across the data centre industry.

More funding for research and development is needed, and greater uptake in these new technologies is required on a wider scale across the region.

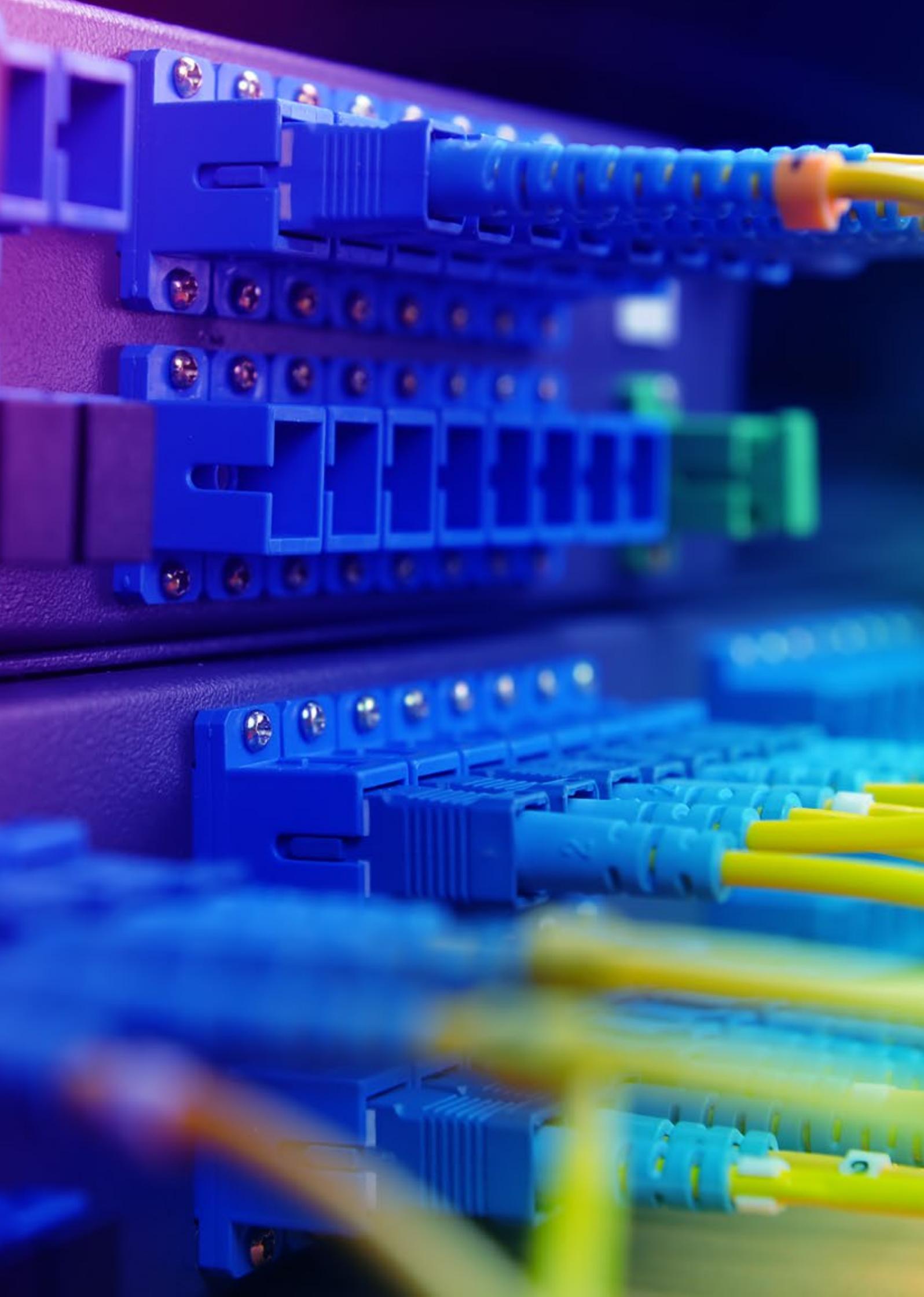
4 Tech companies and multinational third party data centre service providers lead the way in sustainable growth

Global tech giants Microsoft, Google, Amazon and Facebook, and other multinational data centre service providers, are setting ambitious targets to reduce their carbon emissions and help the industry meet the United Nations Sustainable Development Goals.

These set a positive example for the rest of the industry, which should be encouraged to set their own sustainability targets. This will not only contribute towards climate action, but also significantly reduce costs in the long term, and build greater credibility among customers.

5 All members of the data centre ecosystem need to work together

With all parties in the region collaborating and sharing expertise, the industry will be in an ideal position to achieve sustainable data centre growth and consolidate its strength in the global data centre market.



EXECUTIVE SUMMARY

The Covid-19 pandemic has triggered an unparalleled acceleration in digital transformation and underscored the invaluable role of data centres in the face of global disruptions. At the same time, there is rising global awareness of the urgency to address climate change and decarbonise our economies.

Southeast Asia is a prime market for data centre development and Singapore, in particular, continues to drive its growth. However, the country's thriving technology industry and high data centre demand has contributed to its energy consumption per capita being one of the highest in the world.

Singapore needs to address several challenges if it is to remain a competitive and sustainable market for data centres. Its limited land size, tropical climate, lack of cost-effective renewable energy supply, and shifting policies for data centre development — in particular, a moratorium on new data centres, which has been put in place until 2021 — are key challenges impeding the development of data centres.

But there are solutions today which can help achieve greener, more sustainable data centre operations. These include measures to increase renewable energy supply, as well as using viable cleaner fuel alternatives such as hydrogen.

Cooling needs represent 35 to 40 per cent of total data centre energy demand, making energy efficient UPS (uninterruptible power supply) systems and cooling technologies—including variants of liquid cooling—a key area where data centre operators can reduce energy usage as well as costs.

The use of seawater for cooling, as well as underground spaces for data centre development in the region, are also being assessed. In addition, experts are mulling the possibilities of running data centres efficiently using primarily natural cooling in Southeast Asia's tropical climate.

For continued industry growth, government authorities need to provide regulatory certainty and set out a long-term roadmap for data centre development that takes into account its climate impact. Government support for technological innovations such as hydrogen will help data centre developers and operators integrate these sustainable features into the design and siting of their data centres.

Emerging markets Malaysia and Indonesia also show huge potential. If investors are provided with political stability and the right policies, we can expect to see strong and sustainable growth in data centres.

Experts interviewed emphasised that industry players need to be bolder in testing and integrating new technologies to raise the efficiencies of data centres. Lastly, observers note that greater collaboration across the entire system — from consultancies to research houses, data centre providers to academic — will be key in raising awareness and seizing opportunities to achieve sustainable growth in the long term.

This will also help the industry to build resilience and ensure it is prepared for other global disruptions going forward.

ALL EYES ON SOUTHEAST ASIA

Southeast Asia is one of the fastest-growing markets for data centres in the world. According to a report by Cushman & Wakefield, the overall Asia Pacific co-location data centre market size will be worth US\$28 billion in 2024, overtaking regions such as North America to become the largest worldwide.

Southeast Asia is a key driver, accounting for an estimated 13 per cent of the region's total market size in value terms. The region is home to many fast-moving dynamic cities undergoing rapid transformation. Its economies are heavily characterised by social media, TV and video content streaming, e-commerce and banking, which all require robust IT infrastructure and data networks to support its growth.

Businesses continue to rapidly expand into and within Southeast Asia, further driving demand for digital services. Data centres are at the heart of this growth, and this region represents a key market for local and multinational data centre providers and tech giants to seize opportunities to feed the growing appetite for all things digital.



SPOTLIGHT ON SINGAPORE

The growing energy consumption of data centres — and its accompanying carbon emissions — have gained much attention locally and beyond.

According to major local telecommunications and data centre service provider Singtel, almost 7 per cent of the total energy used in the country was from data centres, significantly higher than the average of 1 to 2 per cent in the rest of the world. Furthermore, analysts estimate that by 2030, data centres will consume as much as 12 per cent of Singapore's total energy demand, highlighting the need to alleviate the industry's contribution to the country's overall carbon footprint.

On the other hand, global disruptions such as the Covid-19 pandemic have underscored the crucial role that data centres play in ensuring business continuity and economic growth. It is therefore important that the wider

community recognises the central role that data centres play and support its sustainable growth to ensure its progress is not detrimental to the climate.

Singapore is the most sought-after market for data centre operators in the Southeast Asian region. On a global scale, it is also one of the top-ranked data centre locations. According to the Cushman & Wakefield "Data Centre Competitiveness Index" report of August 2019, Singapore was the third most desirable place for operators to set up data centres, behind only Iceland and Norway, having also leapfrogged four spots and overtaken key markets such as Sweden, Switzerland, Finland and the US since the previous ranking was published in 2017.

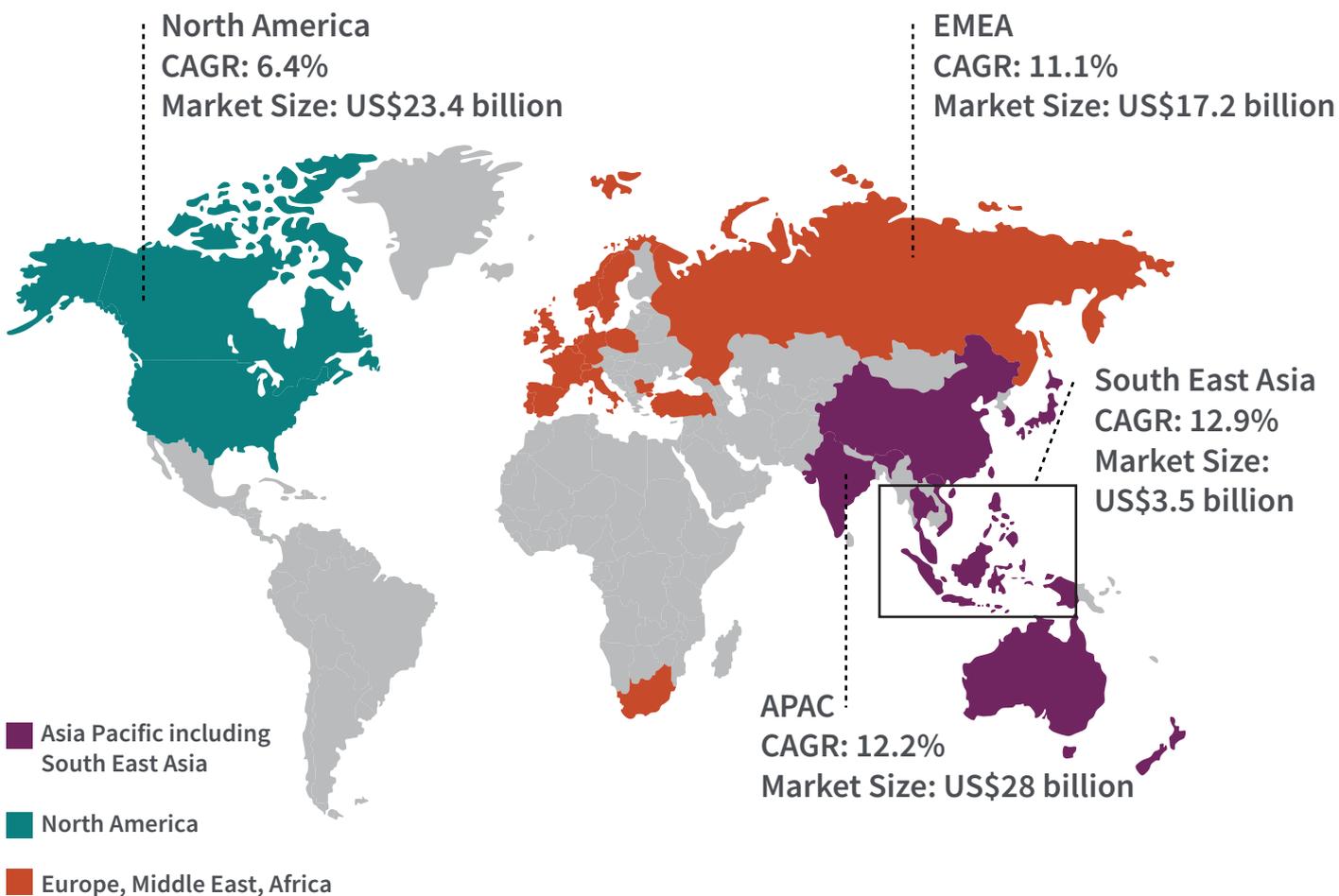
As of 2020, the country dominates the Southeast Asian market, accounting for an estimated 60 per cent of the region's total data centre supply. There are

many reasons why the country trumps other well-developed data centre markets in the region including Hong Kong, Shanghai, Sydney and Tokyo.

Singapore continues to be unbeatable when it comes to undersea cable connectivity, which is one of the core considerations for data centres. As observed by Director, Business Development, Data Centre Service Operations at ENGIE Southeast Asia, Joycelyn Longue, "Singapore has grown to be the data centre hub in Southeast Asia".

As of May 2020, Singapore boasts a comprehensive network of 24 undersea cables linking it to a multitude of key locations worldwide. This makes it the prime location to connect the region to the rest of the world, and through to the rest of Asia. When assessing cost versus risk, Singapore is attractive due to its extremely low country risk. In terms of geographic attributes, its low vulnerability

Fig 1: Data Centre growth and Colocation Market Size by Region: 2024



Source: Cushman & Wakefield, Structure Research

to natural disasters such as earthquakes, volcanic eruptions and fires, makes it a safer bet compared to other markets such as Japan, with its risk of earthquakes, or Australia, where the weather is unpredictable and more extreme.

Singapore’s stable, pro-business environment is also conducive for international investment and it offers a plethora of economic incentives and low corporate tax rates, a major plus for data centre players.

Furthermore, Singapore boasts around 20 years of experience in developing data centres – the industry emerged back in the 2000’s when it boosted investments in its telecommunications infrastructure. Longue points out that, “This didn’t happen by chance; it was part of Singapore’s Smart Nation plan to be a “Digital Harbour” that looked at delivering excellent connectivity,

resilient networks and infrastructure, making it the gateway for critical data and premium content companies to the Southeast Asia region”.

From 2014, Singapore’s journey towards becoming a Smart Nation led to high growth in businesses related to IT and e-commerce, helping to cement its position as the region’s hub for digital and cloud services. It has also resulted in Singapore being home to a highly skilled and well-trained data centre labour force, making it more favourable from a personnel and talent operations perspective.

According to the data centre colocation directory Cloudscene, as of May 2020, Singapore hosts 50 data centre service providers at 93 data centre sites, with multiple data centre players boasting new developments in the pipeline. Singapore will continue to be a magnet for data centres, and demand is expected to remain high.

“Singapore has grown to be the data centre hub in Southeast Asia.”

Joycelyn Longue
 Director, Business Development, Data Centre Service Operations at ENGIE Southeast Asia



KEY CHALLENGES

Despite Singapore's success in attracting tech companies and hosting data centres, it faces some key market and environmental challenges which need to be addressed if it wants to remain competitive in the longer term.

The challenges can be grouped into three key areas: the country's land constraints, its tropical climate, and its policies.

Land constraints in Singapore

Singapore's tiny land area of 724sq km means there is limited space for data centres. This has resulted in increasing competition among data centre players vying for sites on which to build their large-scale operations. Land is at a premium and, accordingly, real estate prices are amongst the highest in the world.

Due to Singapore's relatively high manpower costs, data centres need to set aside significant budgets for staff salaries, as well as outsourcing maintenance fees and IT systems upkeep. Latest figures from the Ministry of Manpower show Singapore's median gross monthly income at SG\$4,563 per month (US\$3,285) in 2019. This is more

than 10 times the average monthly net wage of an Indonesian working in the infocomm sector, considered a higher-than-average occupation in the country¹. This adds to high initial capital expenditure required, and longer-term operating costs.

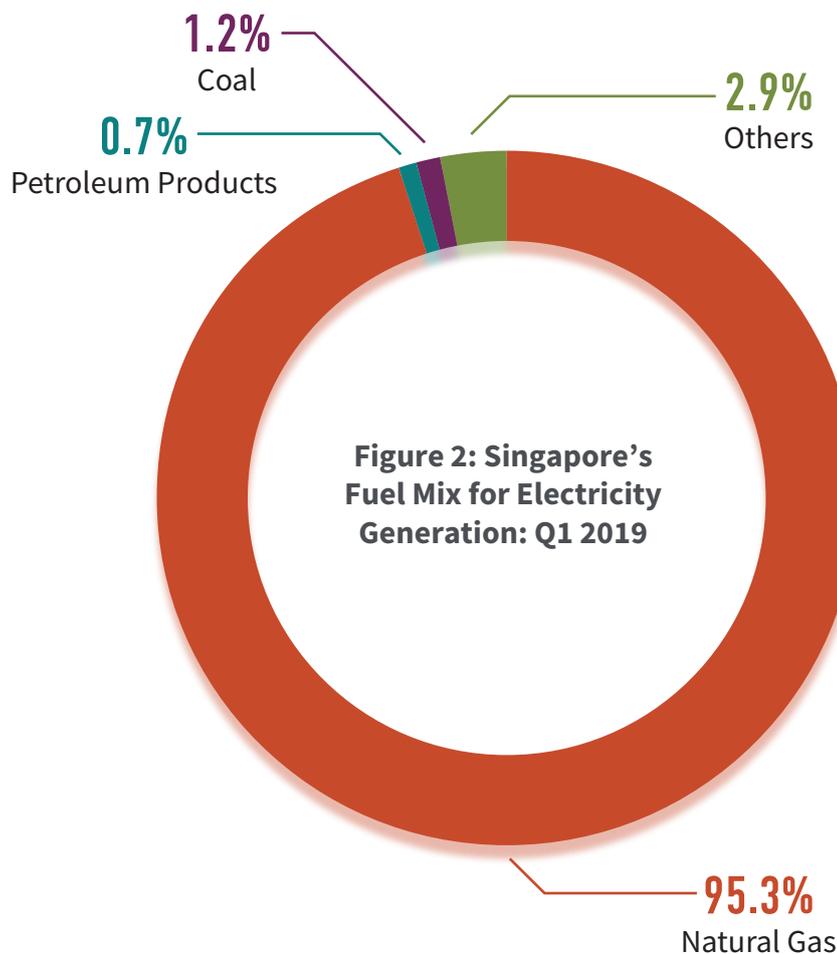
When it comes to data centre construction, operators have to contend with zoning controls which come with necessary but restrictive obligations. B2 zoning rules under the Urban Redevelopment Authority (URA) property guidelines, which data centres are subject to, include a nuisance and health and safety buffer of more than 50 metres, and a requirement for sufficient distance between the site and residential estates.

Such regulations, whilst necessary, add to the challenge of developing data

centres on Singapore's limited land. One resultant characteristic of data centres in Singapore are that they are high-rise buildings of between five and seven storeys, a stark contrast to the expansive data centres in the US and Europe which occupy sizeable land space and are rarely taller than two storeys. For data centres, building upwards entails extra measures to ensure air flow and cooling.

Industry experts also highlighted limitations when it comes to back-ups or redundancy. Data centres would typically include a secondary site, in addition to the primary site, for disaster recovery and business continuity planning.

Data centres may build one location in the east of Singapore and one in the west, but the island stretches a mere 50km when measured from east to west.



Source: Energy Market Authority (EMA)

Note: numbers may not add up to the total due to rounding

Operators may consider other options, including building their secondary site in neighbouring Malaysia. However, this brings about other cross-border challenges. Singapore's space constraints also result in difficulties in providing renewable energy supply for data centres. In other parts of the world, the industry has made significant steps in generating and using renewable energy to fuel its operations.

In April 2020, leading global data centre provider, Digital Realty, broke new ground when it signed a seven-and-a-half-year credit agreement with Citi to procure energy from a wind project in Texas to power a portion of its 13 data centres in Dallas, US.

In Singapore, 95 per cent of its energy is generated from natural gas – the clean-

est-burning fossil fuel, but nonetheless a source of carbon emissions. As of 2019, less than 1 per cent² of the country's energy came from solar power.

The country also lacks space to build wind turbines. Its lack of rivers means it is not able to accommodate hydropower. As such, well-known approaches such as wind power and hydroelectricity, which are key drivers of sustainable data centre development in other markets, cannot be readily applied to Singapore. The government has suggested that the dominance of natural gas is also unlikely to change in the future.

Experts interviewed observed that while the industry is aware of the technologies needed to generate renewable energy, the environmental constraint is very real. The lack of clean energy sources

puts Singapore at a disadvantage, and whilst efforts are being made to procure renewable energy, it is clear that clean energy cannot be relied upon as the only solution to drive the sustainability of data centres.

As stressed by Regional Sales Manager, East Asia Japan, Schneider Electric Energy and Sustainability Services, Valerie Choy, "The biggest challenge here [in Singapore], and for any corporate buyer who is serious about hitting their commitments, is being able to get [renewable energy] at the scale and the price that is required."

In the future it is going to be a challenge because we are very limited in Singapore by space to have renewables capacity to satisfy the demand by all these data centre customers."



Southeast Asia's tropical climate - a thorn in the region's data centre energy efficiency

A key characteristic of the Southeast Asian region is its hot tropical climate and high humidity, which present a far-from-ideal environment for data centre operations. Servers and IT equipment which are housed in data centres typically need to function within specific recommended temperature and humidity ranges, otherwise they are prone to degradation and are at higher risk of breaking down.

The global industry consensus on optimum conditions for the longest equipment lifespan, which uses recommendations from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), is

for the equipment to be stored at an ambient temperature of between 22 to 24 degrees Celsius and 45 to 55 per cent relative humidity (RH).

Singapore's average temperature and relative humidity is much higher, averaging 24 to 32 degrees Celsius, and 70 to 80 per cent respectively. This has led to a huge reliance on air cooling compared to other regions. Industry experts share that between 35 to 40 per cent of total energy usage goes towards cooling a typical data centre in Southeast Asia, whilst the global average is 30 to 35 per cent. While many countries are increasingly deploying "free" or natural cooling by using outside air to cool data centres, this is something which Singapore and the rest of Southeast Asia has so far rarely done.

The heavy use of air conditioners means higher carbon emissions, as well as

energy usage which does not even go towards the running of core data centre facilities. This, alongside other energy inefficiencies, has meant that the Power Usage Effectiveness (PUE) ratio — the international measurement used to reflect the total power supplied to the data centre versus the amount of power consumed by the core IT equipment — is generally between 1.5-1.6 in Singapore. This ratio is above 1.0, which presents a perfect score.

Although this has improved significantly from 5 to 6 years ago when the PUE was between 1.8 to 2.0, it is still a far cry from the PUE levels achieved in other markets like the US and Europe, which can be as low as 1.1 to 1.2. Key opinion leaders share that in the region, temperature and humidity are arguably some of the biggest challenges to improving the operational efficiency of data centres.



Data centre service providers feel the heat from local policies

Tackling climate change is high on the Singapore government's agenda – the island may be at low risk of natural hazards such as earthquakes and hurricanes but it is increasingly vulnerable to the rise in sea levels, as well as rising average temperatures and erratic rainfall. One of the government's key long-term goals is to improve energy efficiency and sustainability of business practices. It ratified the Paris Climate Agreement in 2016 and pledged to reduce carbon emissions by 36 per cent by 2030 from 2005 levels, as well as stabilise emissions with the aim of peaking around 2030.

The Energy Conservation Act (ECA) mandates energy efficiency requirements and energy management practices to promote energy conservation, improve energy efficiency and reduce environmental impact. First introduced in 2012, it was revised multiple times, most notably in 2017 when a clause containing a set of strict Energy Management Practices were introduced to oversee the development of data centres (Subdivision 3, clause 26A – 31).

Data centres wanting to build new facilities or expand operations need to have

their proposed factory design assessed rigorously using a specific methodology, and then approved for energy efficiency by the National Environment Agency (NEA)³. They will need to regularly monitor and report energy performance of their systems which account for four-fifths of their facility's total energy consumption. Existing data centre facilities must also now appoint an energy manager, and report energy use and GHG emissions on an annual basis, and follow strict reporting guidelines. They are also required to submit an energy efficiency improvement plan to be reviewed annually.

While the intention is to ensure data centres run sustainably, any potential data centre development is currently dictated heavily by this legislation, and some experts say the government would benefit from easing its policies to safeguard its competitive edge within the region.

Carbon tax is neither here nor there

Another challenge is Singapore's introduction of a carbon tax, which although is a step in the right direction, is insufficient to drive a significant shift towards reduced carbon emissions.

In January 2019, the country became the first in Southeast Asia to impose a

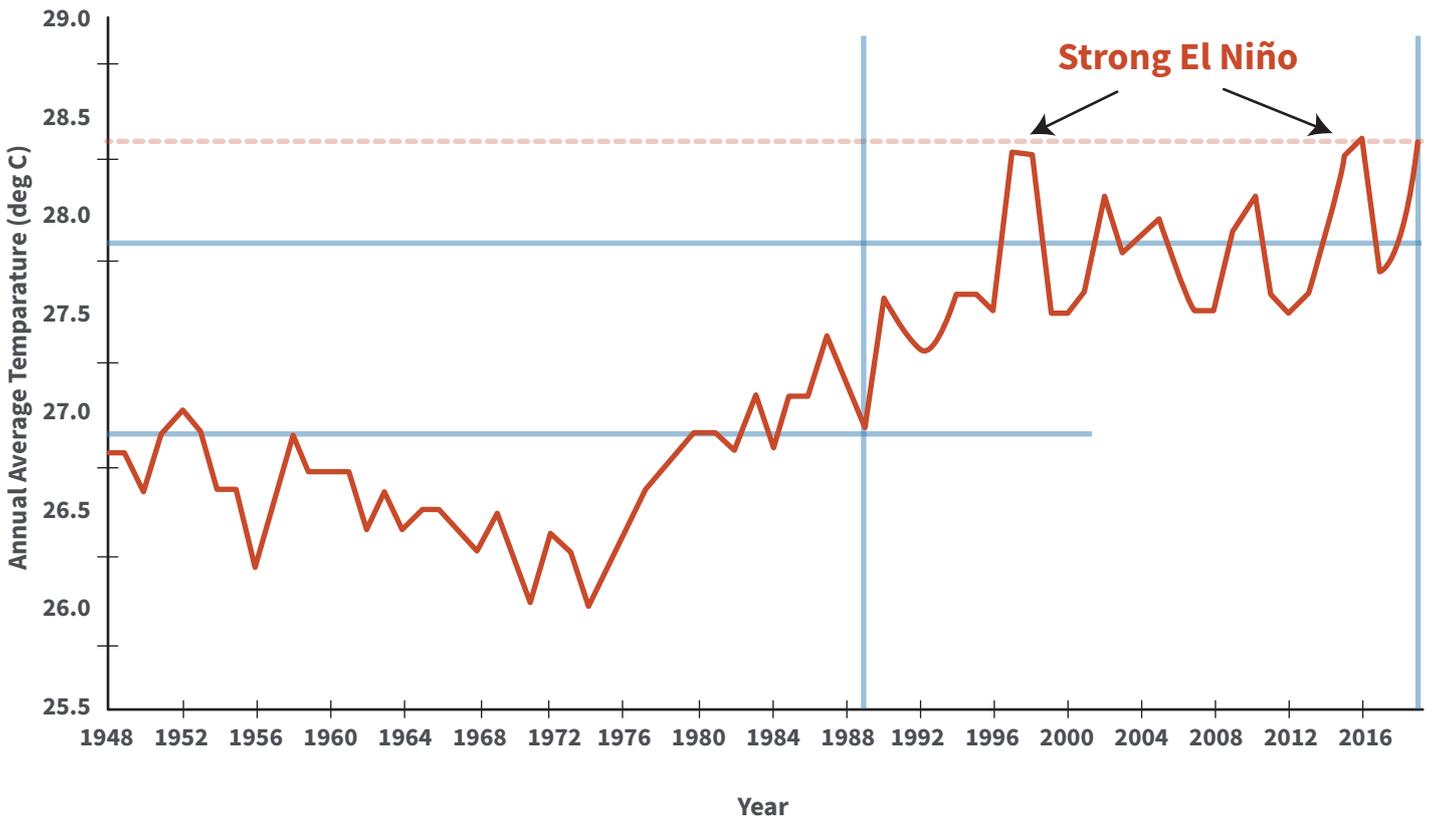
carbon tax on facilities which emit 25,000 or more tonnes of greenhouse gases annually. The rate is set at SG\$5 (US\$3.6) per tonne of GHG emissions (tCO₂e) and fixed until 2023, although by 2030, it could rise to SG\$10-15 (US\$7.20 to 10.79) per tonne. In a 2018 speech, Finance Minister Heng Swee Keat announced that the government expects to raise SG\$1 billion over five years from this tax, which will in turn be used to fund the Productivity Grant and Energy Efficiency Fund, both which support measures to help businesses in adopting low-carbon technologies and solutions.

While the initiative is strategically important for climate action, the rate is very low compared to other markets – the highest carbon tax in the world is in Sweden at SEK 1,180 (US\$123) per tonne of fossil CO₂ emitted. As such, the tax is expected to have minimal impact on lowering carbon emissions.

Carbon taxes need to be raised significantly to serve as a more effective tool in mitigating carbon emissions and promoting the industry's sustainable growth. Industry players which place a priority on sustainable growth in the region will need to support this move.

As seen in countries such as Sweden, high carbon taxes can help reduce the carbon impact of industries and achieve sustainable economic growth.

Fig 3: Annual mean temperature in Singapore, 1948 - 2019



Source: Meteorological Service Singapore

Moratorium may lead to investors looking elsewhere

In 2019, the Singapore government imposed a moratorium on new data centres due to concerns over the industry's carbon footprint. According to the news site Data Centre Dynamics, the moratorium could last until 2021⁴. This move is understood to buy time for the government to reassess the market, as well as allow the industry to come up with new and more energy efficient power solutions.

While the completion of several projects already underway will ensure strong supply of data centres in the short term, experts estimate that by late 2021 and beyond, the moratorium will cause a slowdown in supply, potentially affecting Singapore's attractiveness as a data centre hub for the region. The moratorium prevents any potential data centre

development, even those which may offer a high level of energy efficiency.

As seen in other markets such as the Netherlands, applying a moratorium long-term has proven to be disadvantageous in the long run, as data centre providers will be driven to search for alternative locations in the region. With other markets such as Indonesia and Malaysia investing heavily in improving their infrastructure and welcoming data centre service providers, Singapore may lose out in the data centre race.

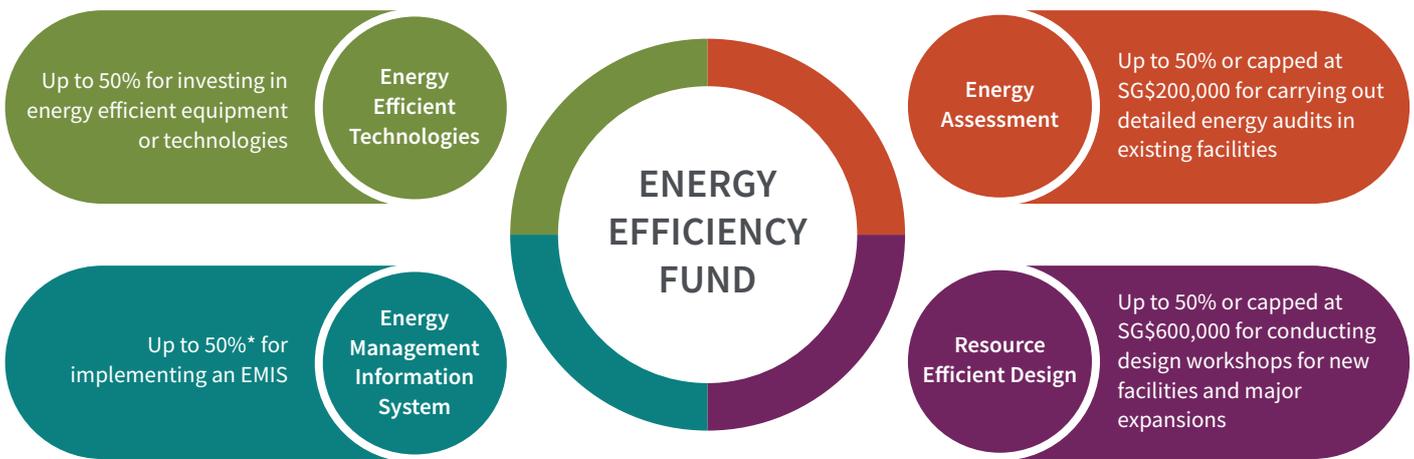
With the above in mind, Singapore remains competitive but ongoing challenges, combined with significant developments in other markets, means there is increasing spill-over in investments region-wide. In other parts of Southeast Asia, rapidly emerging IT infrastructure, a fast-growing and potentially huge consumer base of digital-savvy users, and more abundant land will drive investors to look beyond Singapore to identify investment oppor-

tunities. Data centres are also looking to increase their footprint within local markets so they are physically closer to their customers and can serve them better through reduced latency.

Closer physical proximity is also understood to be more beneficial to the environment as it also lowers the carbon footprint of a data centre.

As pointed out by International Business Development director for RED (A trading brand of Engie Impact), Simon Young, "The location of DCs can have a fundamental effect on their carbon footprint. For example: locating DCs as close [as possible] to their primary source of power cuts down transmission losses which can be up to 30 per cent in some networks around the world. When this is applied to a 100MW DC you are in effect saving 30MW before you have started your DC design." The anticipated expansion of data centre operations at a more local level will drive growth throughout the region sustainably.

Figure 4: Singapore's Energy Efficiency Fund



Source: National Environment Agency

*capped at SG\$250,000 for energy-intensive facilities (annual energy consumption) and SG\$125,000 for other companies

Government incentives are beneficial but more are needed

To foster greater sustainability and energy efficient business practices, some incentives and financial support are available in Singapore. These include the Energy Efficiency Fund (E2F), established in 2017, which supports efforts of businesses with industrial facilities to improve energy efficiency (EE).

However, key opinion leaders, particularly in research and academia, stress that much more support is needed in this region than is currently available, to encourage interest and relevant innovations for sustainable data centre solutions. Greater investments in research and test bedding of solutions would send a strong signal of the government's determination to support sustainable data centre growth for the long term.

BCA-IMDA Green Mark could be even greener

The government has taken steps to enforce the greening of data centres through two mandatory accreditation schemes — the SS564:2013 and BCA-IMDA Green Mark scheme, which advocate “green high-rise” data centres. Such certifications work well in helping to achieve greater sustainability amongst new data centre ventures setting up in Singapore.

Furthermore, users searching for data centre service providers which are aligned with their own sustainability goals will be able to leverage the Green Mark to assess how green the data centre is. In 2018, the BCA launched an additional data centre accreditation – the Super Low Energy (SLE) data centre, to encourage even greater energy efficiency levels.

However, as with all industries, and particularly with data centres which have very high investment costs, an

additional budget to obtain the Green Mark may play a role in deciding which of the four tiers the building designers decide to adhere to. If costs are prohibitive, designers may opt to achieve the lowest Green Mark rating.

To encourage companies to obtain a higher tier Green Mark rating, the government could introduce additional incentive schemes to reward players which achieve the highest accreditation.

This would incentivise businesses which are already facing high costs. Some data centres that do not place a priority on greening may also be incentivised to do so. It will also put greener equipment makers and innovators of cleaner technology in a stronger and more attractive position, as data centres will prioritise these players over those which are less efficient.

Those players who are not providing sustainable solutions will be squeezed out. It will also benefit data centre clients, who are increasingly placing sustainable business practices as part of their corporate goals.



VIABLE SOLUTIONS TO SUSTAINABLE GROWTH

Singapore needs to address challenges within its already well-established industry which includes nudging along players who are resistant to change.

So far, several positive developments are emerging in Singapore which support sustainable data centre growth. However, more can be done, particularly around cooling technologies and new innovations such as Artificial Intelligence (AI).

Maximising efforts for Singapore's limited renewable energy

Despite the country's limitations in producing its own renewable energy, Singapore still plans on increasing its solar power deployment, setting ambitious targets in both domestic production and commercially, through importing from overseas. Whilst this may still not be sufficient to meet enough of the country's energy demand, these efforts reflect the interest in environmental sustainability, and will still go towards reducing the country's overall carbon footprint.

Under the government's "SolarNova" programme, an initiative jointly run by

the Housing and Development Board (HDB) and the Economic Development Board (EDB), the number of solar photovoltaic (PV) systems across the country has continued to grow, rising from 2 megawatt peak (2MWp) in 2009 to over 350 MWp in 2020. In October 2017, the government also invested SG\$6.2 million (US\$4.57 million) to fund research on solar energy output and support its target to expand solar energy capacity to 2 gigawatt peak (GWp) by 2030 - the equivalent of 4 per cent of the country's electricity demand.

High profile projects currently underway or already completed include the SolarLand (installation of solar panels on vacant land) and SolarRoof (installation of solar panels on rooftops) projects by JTC Corp, and a 1.65 MWp

solar energy installation on Singtel's Bedok Data Centre rooftop, which contributes to 10 per cent of the company's total data centre energy needs. Data centre operators can support the governments' ambitions by collaborating closely with building designers to maximise the surface area of their buildings to deploy solar energy as much as possible, as well as procuring from local solar developers. With the increasing number of options to procure solar energy over the next several years, solar could become a solution to part of the data centre industry's energy needs.

Global tech giants have been the most active in deploying solar power and have achieved 100 per cent renewable energy for their data centre operations, or close to it. Their accomplishments in Singapore



are driven by their global corporate sustainability targets, which prioritise the use of renewables globally. Apple and Microsoft run their data centre operations purely on solar power, with both players procuring it from local developer Sunseap Group. Facebook's upcoming data centre at Tanjong Kling will also be powered by solar energy, via major solar energy player, Sembcorp.

Getting creative with new solar panel surfaces

While the bulk of solar panel deployment for data centres in Singapore is on rooftops and some vertical surfaces of buildings, there are also pockets of supply emerging in other locations, including on water surfaces such as reservoirs and offshore.

Data centres would benefit from procuring solar energy from these locations as part of their sustainability goals. Singapore's 17 reservoirs collect and store rainwater and have begun hosting solar installations. As of 2020, "floating" solar panel systems at Bedok Reservoir and Lower Seletar Reservoir are being built. In February 2020, Sembcorp was successfully appointed to design and construct a 60MWp solar

farm at Tengeh Reservoir near Tuas, the largest and highest profile project, which is expected to be completed by 2021. Also expected to revolutionise Singapore's solar energy is an even larger floating solar panel system along the Straits of Johor, near the Woodlands Waterfront Park, designed and constructed by local sustainable energy provider, Sunseap Group. At 5 ha, it is expected to be one of the world's largest floating solar panel systems, generating 6,388 MW annually.

Besides leveraging water surfaces, other areas around Singapore's city are also being assessed, and are being funded for feasibility by research consortiums, Solar Energy Research Institute of Singapore (SERIS) NUS and the Energy Research Institute @ Nanyang Technological University (ERI@N). Other existing land areas, such as over-building PV systems above flood canals, highways and other "hard surfaces" like un-shaded parking lots are amongst the considerations to install solar power.

Mobile PV systems which can be set up easily and then dismantled and relocated at no significant cost in case the land is needed for other uses, are also being studied as a viable solution to generate solar energy. Installing PV systems on noise barriers, an exercise which is

already widely deployed in several European countries such as Switzerland, Germany and the Netherlands is also on the cards.

The March 2020 Updated Solar Photovoltaic Roadmap for Singapore report by SERIS also identified two local islands, Jurong Island and Pulau Semakau as potential locations to expand solar energy capacity. With such research underway, a handful of options in solar energy is expected to become available to data centres in the mid-to long-term future, boosting efforts on clean energy usage.

On a potentially larger scale is the opportunity for Singapore to import solar electricity from Australia. The Sun Cable project by Sun Cable Pte Ltd, linking a giant solar farm in Australia to Singapore via a 3,800km subsea cable is being planned and targeted to be commercially operational by 2027.

If successful, the project could reportedly supply 20 per cent of Singapore's national energy needs. Data centres such as Singtel have already indicated an interest in tapping solar energy from Australia. More players are expected to be keen on this option, underpinning its potential to be a viable option in helping Singapore become a green data centre hub.

Figure 5: Installed Capacity of Grid-Connected Solar Photovoltaic (PV) Systems by User Type, 2014 - 2019

MWp	2014	2015	2016	2017	2018	2019
Residential	2.0	3.6	5.2	6.9	9.3	12.1
Non-Residential	30.9	55.7	120.3	146.2	198.9	337.2
Public Service Agencies	3.1	4.0	5.3	6.6	10.0	18.8
Town Councils & Grassroots Units	9.5	15.1	57.0	62.4	82.8	131.7
Private Sector	18.3	36.7	58.0	77.2	106.1	186.7
TOTAL	32.9	59.3	125.5	153.1	208.2	349.3

Source: Singapore Power PowerGrid Ltd (SPPG)

Hydrogen presents huge potential

Hydrogen is expected to emerge rapidly in the next few years and could become a viable alternative fuel option for sustainable data centre development in Southeast Asia. Engie Impact, a leading energy company which specialises in low carbon data centre solutions, is one of the players exploring the potential of hydrogen as a sustainable fuel source, particularly as backup power for data centres.

Director, Business Development Data Centre Service Operations at ENGIE Southeast Asia, Joycelyn Longue, explains: “Addressing the exponential energy consumption problem in data centres, hydrogen and fuel cell technologies have the potential in meeting the energy reliability and sustainability power needs of data centres. Fuel cells can be used to support critical loads for their ability to generate high quality and reliable power.”

Considering the high energy needs required by Uninterrupted Power Supply (UPS) in data centres, hydrogen can reduce costs significantly, as well as offer a cleaner fuel source than natural gas. In March 2020, five local businesses, PSA Corp, Jurong Port, City Gas, Sembcorp Industries and Singapore LNG Corp, together with Japanese companies, Chiyoda Corp and Mitsubishi Corp, signed an MoU⁵ to develop ways to

utilise hydrogen as a low-carbon energy source.

They will work to develop a business case for the feasibility of importing and using hydrogen in Singapore. It is also supported by the National Research Foundation (NRF) and the Maritime and Port Authority of Singapore, signalling huge interest and intent in this area.

In April 2020, local data centre player Keppel also signed an MoU with Dutch player, Royal Vopak, to study the commercial viability of hydrogen in data centres. It is understood that both hydrogen and LNG will be the fuel generators for Keppel’s latest venture, its Floating Data Centre Park (FDCP)⁶.

Efforts by both the government and major local players means hydrogen will most likely become available for data centres to incorporate as part of sustainable solutions. Currently, the availability of hydrogen is limited, as the infrastructure is still lacking.

A distribution network in Singapore and the rest of Southeast Asia needs to be set up to fully support the import, storage and supply of hydrogen. Hydrogen pipelines need to be established and agreements to procure hydrogen need to be developed for this to become a viable option for large-scale use.

However, industry experts agree that this is one of the promising ways in which to lower the carbon emissions of data centres and reliance on the national grid.

New technologies will drive Southeast Asia’s sustainable data centre growth

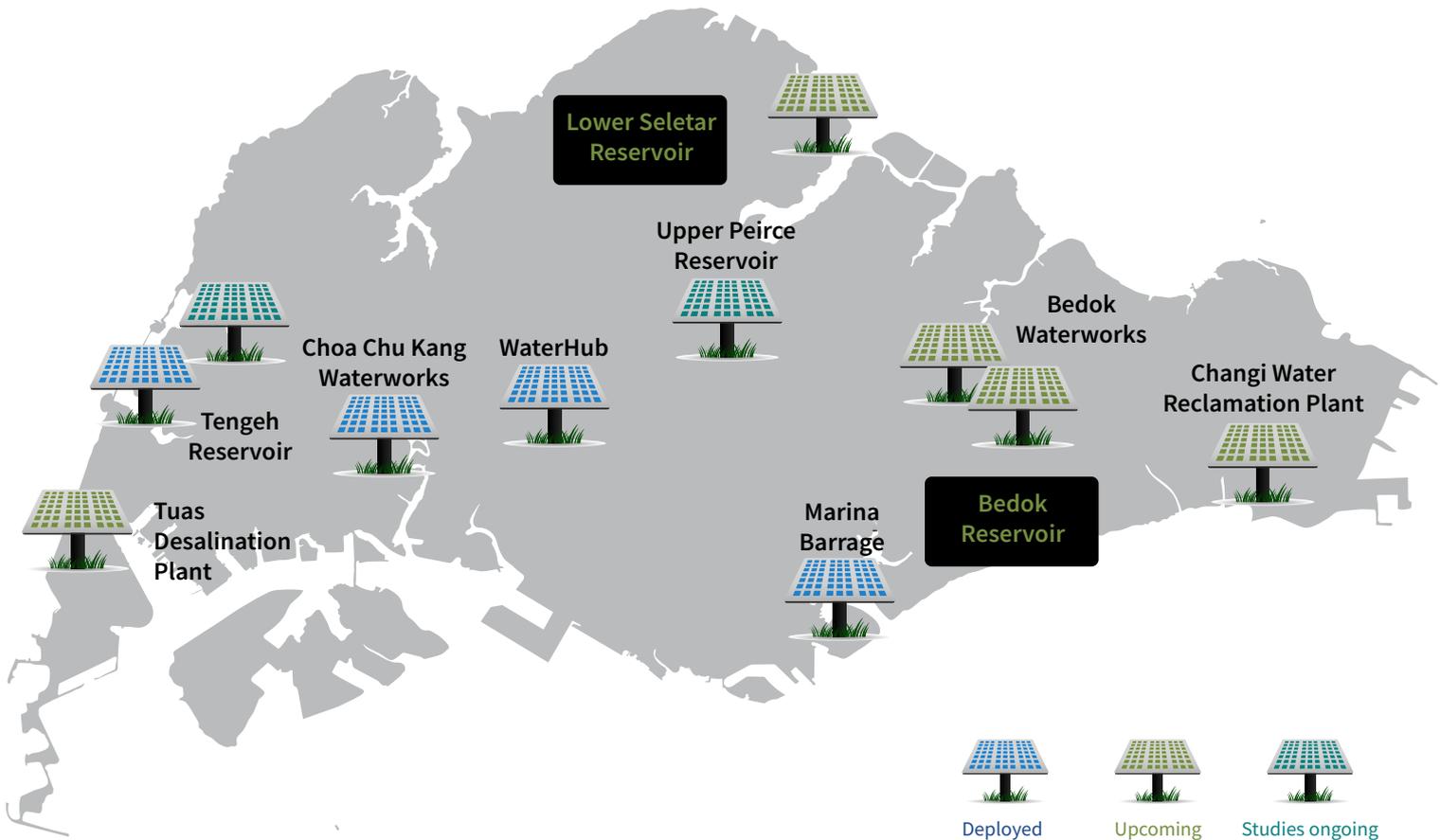
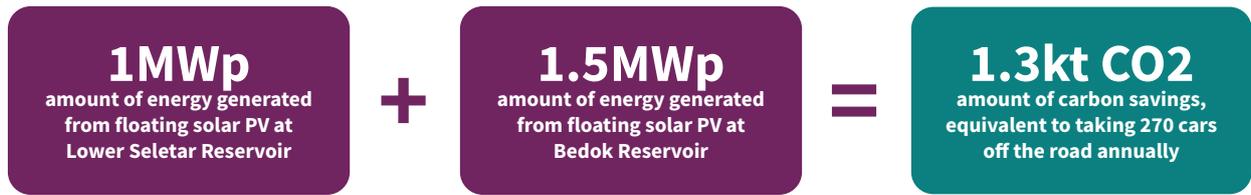
With renewable energy sources still accounting for a small share of Southeast Asia’s energy mix, finding ways to improve energy efficiency in other areas will be key to reducing the carbon footprint of data centres in the immediate term. Three ways of doing so in Southeast Asia are:

1. Deploying better technologies to improve cooling – data centres’ biggest energy guzzler.
2. Improving the energy use of facilities and IT systems.
3. Adopting new technologies which allow for more energy efficient cooling such as liquid cooling, and adopting “smart” approaches and AI to identify where energy can be reduced.

Cooling needs to be more efficient

Between 35 to 40 per cent of total energy consumed by data centres in Southeast Asia does not go towards the running of the servers and IT equipment. Rather, it is used to run energy-intensive cooling equipment that maintain the controlled environment of the servers and IT facilities. This energy wastage is not viable if the industry wants to achieve

Fig 6: Singapore's Push for Solar Power



Source: Public Utilities Board (PUB)

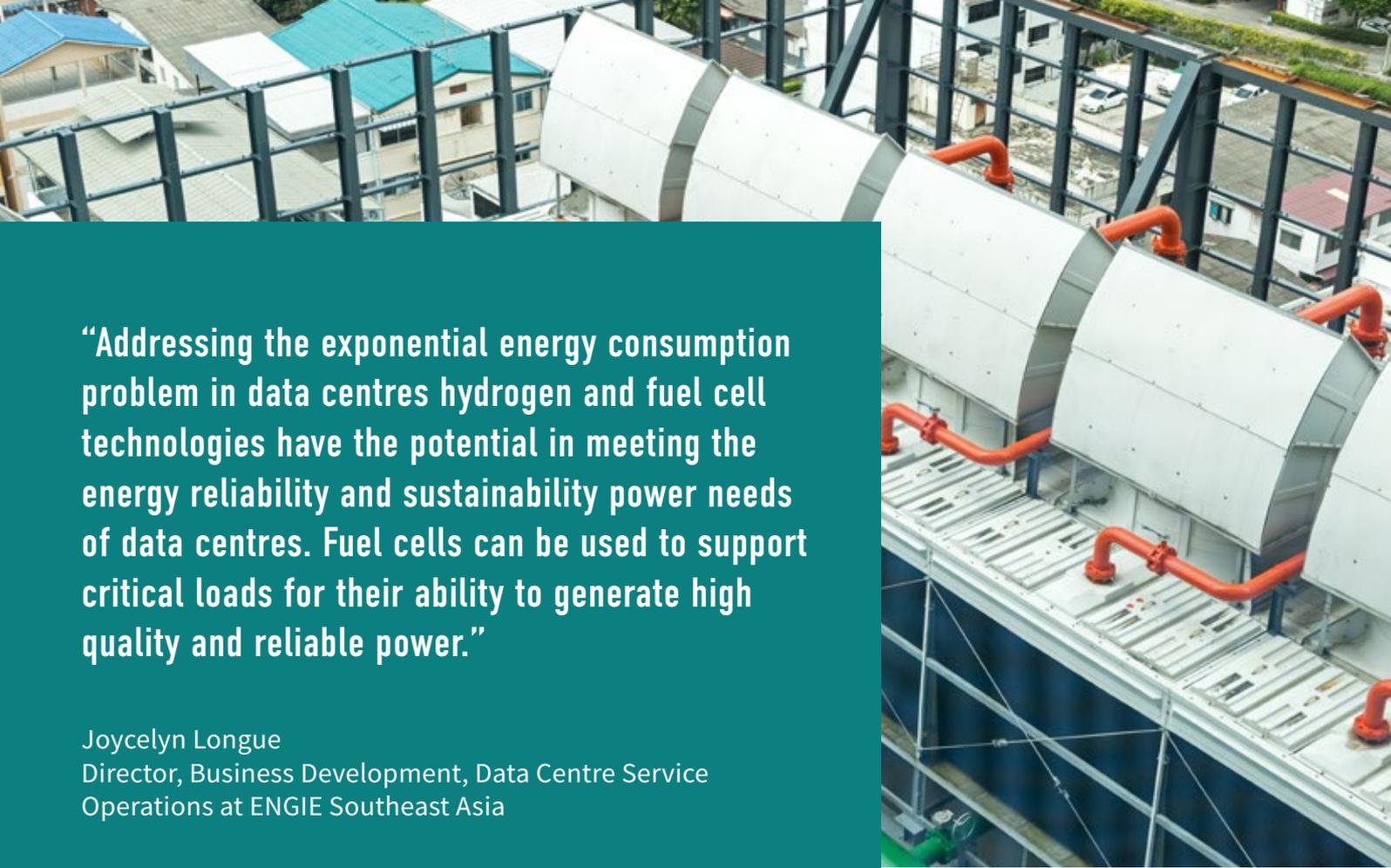
sustainable growth in the long term. Results from a jointly-led survey by Eco-Business and Digital Realty⁷ for this report indicate that among those respondents involved in supplying and building data centres for their company, 58 per cent considered cooling infrastructure and technology to be important in making data centres more energy efficient. Only when data centres can reduce the amount of energy used for cooling will we see more sizeable reductions in carbon emissions and costs.

Over 95 per cent of data centres in Southeast Asia still use air-based

cooling, a highly inefficient system. Some initiatives have emerged to make existing processes more efficient, such as the 2020 joint project between the Faculty of Engineering at the National University of Singapore (NUS) and local specialist of solar thermal hybrid air conditioning, Ecoline Solar, which produced the “hybrid solar-thermal air conditioner”⁸ using “thermal hybrid air technology” – a process which makes use of solar as an energy source to power the cooling refrigerant in the air conditioner. Although the process still partially uses air cooling, the system is an improvement from standard air

conditioning, as it leverages Singapore’s naturally sunny climate, resulting in a reduced need for energy and a lower amount of dissipated heat into the environment.

These systems are expected to reduce utility bills by 30 to 55 per cent, and have been well-received in the local market. They have been installed in several commercial and residential buildings, including the NCS (National Computer Systems), Starhub and Singtel buildings, as well as at vertical farms, condominiums and hotels.



“Addressing the exponential energy consumption problem in data centres hydrogen and fuel cell technologies have the potential in meeting the energy reliability and sustainability power needs of data centres. Fuel cells can be used to support critical loads for their ability to generate high quality and reliable power.”

Joycelyn Longue
Director, Business Development, Data Centre Service
Operations at ENGIE Southeast Asia

Liquid cooling – the best option to achieve sizeable energy reduction

One of the most talked about developments for the future will be the advancement and incorporation of liquid cooling in data centres. Liquid cooling technology is already widely used in high-performance, energy-intensive sectors such as computing and gaming, and is long considered the preferred solution to effectively cool down heat-intensive CPUs and SSDs.

Liquid cooling has numerous advantages over air-based cooling, most notably since liquid conducts heat better than air. Liquid cooling, if placed at heat-intensive spots, can rapidly reduce temperature in a targeted manner, requiring less energy to do so than air while generating less noise. It also uses less water. Industry experts observe that liquid cooling can reduce power consumption by 20 to 30 per cent, and

water usage by up to 50 per cent. Performance-wise, liquid cooling is also highly effective at cooling intense heat loads, making it more suited to the increasingly large volumes of data being generated from the rapid growth in data-driven technologies such as AI, machine learning, IoT and 5G. It will be necessary for players to modernise their cooling processes with liquid cooling to keep up with the ongoing wave of digital developments.

2019 and 2020 witnessed some players taking liquid cooling technology seriously and integrating them into their newest projects. Energy and automation digital solutions company Schneider Electric refreshed a research project it had started earlier with cooling technology specialist, Iceotope, and technology company Avnet in late 2019.

Digital Realty’s third data centre in Singapore at Digital Loyang II (SIN12), set to open in Q1 2021, is understood to feature indirect evaporative cooling, a form of liquid cooling that is well-suited

to tropical climates. Facebook’s Tanjong Kling data centre, slated to open in 2022, is also expected to deploy indirect evaporative cooling via State-Point Liquid Cooling Technology (SPLC) through its partnership with US-based Nortek Air Solutions.

As of May 2020, SPLC is recognised as the most sustainable data centre cooling technology globally, as it can reduce liquid cooling’s water and power consumption by up to 50 per cent and 20 per cent respectively, translating into both the lowest and most efficient Water Usage Effectiveness (WUE) and Power Usage Effectiveness (PUE) of all indirect evaporative cooling methods. More players may follow suit, but the adoption is expected to be slower than what is needed.

Industry players need to make the switch faster and consider the benefits, both in terms of costs and environment, that liquid cooling can bring to their data centre operations. Once set up, it is easier to maintain than air cooling. If



sealed properly, liquid cooling systems remain self-contained and shielded from outdoor hazards such as dust, heat and air pollution, which air-cooling systems are exposed to.

The main challenge in adoption is expected to lie with existing and older data centres. Players reluctant to invest in liquid cooling cite high upfront costs, complications and time involved to redesign and potentially overhaul data centre infrastructure. Joshua Au, Head, Data Centres, IT Shared Services (ITSS), at Agency for Science, Technology and Research (A*STAR), a statutory board under the Ministry of Trade and Industry, states, “The customers have to agree to use the likes of liquid cooling - if customers don't agree, it's not going to happen.”

Data centre players that do not embrace more efficient cooling technologies face greater cost and operational problems in the longer term. Industry experts have highlighted that given the rate of growth in data usage and the newest digital technology, air-based cooling will not be sufficient to serve the needs of data centres due to the growing power density demand from servers in the long term. At the minimum, older data centres could consider solutions which do not require a complete infrastructure overhaul, but that can be integrated with or added to existing infrastructure. One such solution is the chiller-less hybrid cooling solution by local player, CoolestDC⁹, which during testing, managed to achieve a partial power usage effectiveness (pPUE) score of 1.2, with the potential of dropping to 1.1 (with the ideal score being 1).

The system uses a two-pronged approach, where components with high heat dissipation are cooled using liquid cooling, whilst components emitting less heat are air-cooled. This eliminates the need for a cooled water supply via a chiller, as well as computer room air conditioning (CRAC) – two of the biggest sources of energy consumption in data centres – subsequently reducing overall energy use. The system is flexible enough to be incorporated into existing building infrastructure, making it highly attractive for existing data centres.

In summary, data centres in Southeast Asia must rethink their cooling systems. If they are to keep up with cooling needs in an energy efficient manner, operators must be receptive to some form of liquid cooling. If air cooling is replaced by liquid cooling on a large scale, it will bring down PUE, but also Water Usage Efficiency (WUE) and overall energy efficiency and costs. Data centres will be in a stronger position to drive ongoing growth in power densities that will come with the new generation servers.

Singapore is leveraging its LNG domestic distribution network

Liquefied natural gas (LNG) could represent another viable way of cooling data centres, especially in Singapore. If made available on a wider scale, it could be another game changer in the sustainable growth of data centres across the region. Natural gas is, and

will continue to be, Singapore's go-to energy source. Close to 30 per cent of it is acquired in liquified form and brought in via the country's 6 million tonne-per-annum capacity LNG terminal on Jurong Island, before being distributed to users.

In late 2019, a research team at NUS Engineering, together with local data centre player Keppel and Singapore LNG Corporation (SLNG) joined forces to develop a cooling medium which would make use of the cold energy from the LNG regasification terminals¹⁰. The process would involve transporting cold energy from the terminal into the data centres, to be circulated within the cooling loop in each data centre. The technology, “Semiclathrate Thermal Energy Carrier System” (ScTECS), could improve data centres' PUE by 20 per cent and reduce the space needed for cooling infrastructure. Such a milestone would represent a breakthrough in enhancing the industry's environmental impact, particularly as it draws energy from an existing energy source. Furthermore, with a second LNG terminal anticipated in Singapore, the technology could be replicated and help to cool more data centres.

A prototype is expected to be available by 2022, and if the technology comes into fruition, could help reduce the energy demand of data centres in Singapore. Both existing and new data centres in the region could potentially tap into this efficient cooling method.



Seawater as a cooling medium – a viable solution?

Keppel Data Centres is one of the pioneers in creating and investigating sustainable solutions for data centres in the region. One of its latest projects will explore the feasibility of a Floating Data Centre Park (FDCP) – the first of its kind in Southeast Asia.

The company signed an MoU with transportation and logistics company Toll Group to study the viability of developing a floating data centre at Loyang Offshore Supply Base, a 32-hectare offshore facility operated by Toll Group.

The plans involve deploying LNG as an energy source, as well as leveraging on patented water-cooling technologies of US-based company, Nautilus Data

Technologies, which Keppel purchased an interest in back in 2017, to utilise the surrounding seawater as a natural cooling medium.

If successful, this could be another solution to incorporate alongside other energy efficiencies. For Keppel itself, the player's expertise in offshore and logistics means this solution could potentially be replicated at other strategic locations internationally. The discharge of heat from data centre cooling systems into the sea could pose challenges, experts noted. Simon Young, International Business Development director for RED (A trading brand of Engie Impact PTE LTD), commented, "We're talking about the effects of expelling, you know, hundreds of megawatts of heat into the water. What would that look like? How would that affect the local environment? What consequences would we have?"

Singapore is banking on lower temperatures underground

With land in Singapore at a premium, alternative locations have come up as possible solutions to allow data centre growth. Strategies expected to take centre stage in the future include not only offshore sites such as Keppel's FDCP, but also the prospect of developing data centres underground. Underground temperatures are naturally lower than on-land, offering immediate environmental and operational benefits.

In 2016, a revolutionary 5km-long underground district cooling network opened at Singapore's Marina Bay district, piping chilled water and providing energy efficient cooling to commercial buildings in the vicinity. The underground infrastructure not only

“The biggest challenges that you find are that they [data centres] are expanding and adding data centre space without careful consideration in terms of... optimising the IT assets that (are already) in place.”

Chang Tsann
Director, Dell Technologies Services

presents a sustainable cooling solution, but also reduces customers' energy bills by over 40 per cent. If data centres in Asia applied underground cooling solutions, they can expect to reap major savings, as well as significant efficiencies in energy utilisation.

Local player Keppel Data Centres has been toying with the idea of underground data centre design. In 2017, the company signed a MoU with property developer JTC to study the design of data centres underground that could offer the same level of performance that is seen in data centres on-land. If successful, this would indeed benefit the industry in several ways, including avoiding encroachment on Singapore's land space, as well as cost and environmental advantages.

Nevertheless, there remain risks in building data centres underground. A key factor in data centre design is adequate ventilation, which presents a major challenge underground. This has been achieved in other developed data centre markets, including the US and Europe.

Singapore's tropical climate may pose bigger challenges in having a data centre

located underground. When servers produce heat, even underground where temperatures are slightly lower, there needs to be proper ventilation involved to ensure the safety and health of workers and equipment. Rising heat and insufficient ventilation does not bode well for data centres, particularly in Singapore with its tropical climate.

Finding greater efficiencies in IT systems

Besides cooling technology, modifications to facilities within and around the data centre building are crucial to lower energy consumption. This includes addressing the use and make up of servers, storage, network, and operating systems, and upgrading them to be more energy efficient.

Industry experts stress that long-term efficiency cannot be achieved without addressing the key aspects of the data centre ecosystem. According to one Key Opinion Leader, “If you want to drive the sustainable portion, we have to revolutionise the finer product - and how we manufacture the servers is the key to the

next step”. Two of the key aspects that need to be considered as the industry aims for the next generation of more intensive, sustainable data demand is the requisite to support a much higher data capacity, yet do this within a restricted or regulated physical space.

This is particularly when planning a new data centre in a small space like Singapore, or when upgrading an existing data centre building with a fixed dimension. This needs to be done on top of achieving cleaner energy operations and long-term energy efficiency.

In fact, to address the fast-rising need for data storage and servers, many players tend to focus on expansion through constructing new data centre space, but modernising existing infrastructure could also be a viable solution to achieving greater energy efficiency without needing to expand.

According to Chang Tsann, Director, Dell Technologies Services, “The biggest challenges that you find are that they [data centres] are expanding and adding data centre space without careful consideration in terms of...optimising the IT assets that (are already) in place.”

Figure 7: List of viable solutions for sustainable growth of data centres in Southeast Asia

Solution	Benefits
Solar energy	Pockets of solar energy are becoming increasingly available for data centre operators to tap into
Hydrogen	Hydrogen represents a cleaner alternative fuel, especially for data centre backup power
Energy efficient cooling technologies	With 35-40 per cent of energy usage generated from cooling needs, more efficient technologies such as liquid cooling can significantly reduce the carbon footprint
Liquefied Natural Gas	Singapore's existing LNG network offers potential as a source for cooling energy
Utilising seawater	Whilst there are challenges on a large scale, seawater presents a natural cooling system
Underground locations	Lower temperatures underground make this option a worthwhile solution to consider
Modernising IT infrastructure	Modern solutions such as Lithium-ion batteries and Hyper-Converged Infrastructure (HCI) offer major energy efficiencies, particularly in light of rising data demand
AI and machine learning	AI can be used to identify in real time where energy wastage is occurring

Source: Eco-Business from trade interviews, desk research

Lithium-ion batteries and hyperconverged infrastructure - compact higher-performance solutions

One key development which should be considered as a viable, cost- and energy-saving solution, particularly for smaller data centres, is high performance Lithium-ion batteries, which are the mainstay battery in consumer electronics products such as smartphones. Lithium-ion is increasingly being used in the modern data centre's uninterrupted power supply (UPS).

Compared with the traditional VLA and VRLA batteries, it is not only able to accommodate a significantly higher energy density within a much more compact size, but also boasts a much longer life expectancy. They can also be operated at higher ambient temperatures compared to conventional VLA or VRLA batteries, making them an ideal solution for warmer environments like Southeast Asia's. Several data centres have incorporated Lithium-ion batteries to leverage these benefits. Energy

operator, Total, uses Lithium-ion batteries in its data centre back-up system in Singapore, benefiting from both its efficiency as well as its compact size, which is better suited to the high-rise location at Frasers Tower in the heart of Singapore's Central Business District.

Hyper-Converged Infrastructure (HCI) solutions, an all-in-one software infrastructure which integrates storage, compute and other resources into one single turnkey system, are also a more efficient solution for data centres. Latest HCI platforms from vendors such as Cisco, Dell, Hewlett Packard, Lenovo and NetApp can condense and consolidate equipment into a system which is not only easier and more streamlined for data centre staff to manage but, more importantly, can hold a denser data volume without the need for more physical space.

Rather than adding more racks, an HCI solution, such as VX Rail by Dell, can replace the traditional approach which requires 10 racks, and instead consolidate the same amount of storage capacity into two racks or fewer. Data centre users can manage their footprint by finding ways to "expand" their

capacity through modernising current IT assets, as well as expanding physically. Fuel cells, which have long been used in vehicles, are another development expected to increasingly be featured in Southeast Asia due to their flexible, modular format, and scalability. They are also cheaper than electricity.

They would be a feasible option for supporting more remote locations where portable power systems are needed and lacking, such as places in Malaysia or Indonesia not yet accessible via cable, or on Singapore's smaller islands such as Pulau Semakau. The island has been earmarked for potential data centre development by industry experts, but it is not fully connected yet.

Most importantly, fuel cells provide a source of cleaner energy, as they have little emissions and their only by-products are electricity, heat and water. Nevertheless, several players continue to be deterred by the high initial set up costs and the hassle of upgrading their systems. HCI solutions have some drawbacks in terms of flexible scalability, as their all-in-one system means that if one component of the system needs to be expanded, the whole HCI resource



needs to be expanded. Nevertheless, vendors of HCI solutions are increasingly developing more options, including systems which are more modular and more flexible to the user.

As of 2020, upfront costs to install Lithium-ion batteries remain high at typically 1.75 times of standard VRLA batteries. Yet, once in place, Lithium-ion batteries offer cost efficiencies in the long term because of their longer lifespan and energy cost savings. HCI solutions offer cost and energy savings through a more streamlined and integrated system. In a climate like Southeast Asia, more efficient variants such as Lithium-ion will require less energy to cool the battery – costs to cool the battery will be reduced by a significant 70 per cent. Data centres still using VLA and VRLA batteries need to switch from using outdated, more bulky traditional batteries and servers, and consider more modern alternatives.

Can we make data centres even smarter with better BMS, DCIM and AI?

Building Monitoring Systems (BMS) and Data Centre Infrastructure Management (DCIM) software can monitor and measure data centre operations and help to identify areas where energy is being wasted. As such, they can help data centres improve their carbon emissions

and become greener. Modern data centres which have invested in DCIM technologies are able to monitor and measure power and energy usage, as well as cooling, temperature and humidity patterns and fluctuations. Through this, data centre energy usage can be better aligned with actual energy requirements. On top of this, AI and machine learning technologies must be embraced to modernise green data centres. Several new players are coming up with AI offerings and advanced tools to enable fresh ways to operate faster and more efficiently.

Predictive platforms such as Avril Digital by Engie offer advanced analytics and machine learning in real time to anticipate operational threats and predict future outcomes to increase energy efficiency across the data centre faster. Singapore- French company Beebryte uses AI to control energy consumption by air conditioners. However, interviews with key opinion leaders revealed that data centres in the region have been slow to adopt AI technology.

Most data centres do not yet value the potential advantages of AI in maximising energy efficiency. The Eco-Business online survey results demonstrate the lack of interest in building monitoring systems - over 60 per cent of respondents thought that building monitoring systems were not important in making data centres more energy efficient.

This is clearly an untapped opportunity to increase the sustainability of data

centres—research and advisory company Gartner predicts that by 2020, more than 30 per cent of data centres that fail to implement AI will cease to be operationally and economically viable.

Data centres in Singapore can make use of the supportive environment in the country to benefit from AI. The government fiercely supports AI, having launched its National AI Strategy¹¹ to become a global AI hub and attract AI solutions. As part of its 2020 plan for Singapore's science and technology research, Deputy Prime Minister and Minister for Finance Heng Swee Keat announced that over SG\$500 million would be set aside to boost AI systems and meet cyber security needs.

Residential and commercial developments such as Tengah housing estate and Punggol Digital District readily feature AI technology to maximise energy efficiency, and many local players have used AI to their benefit. Singapore Power launched a micro-climate control solution in late 2019, which uses AI to reduce energy consumption of a building by over 30 per cent. SP Digital's AI system, Energy Brain, is also being deployed across several parts of Singapore, including at industrial sites such as Sembcorp Marine's shipyards¹².

Google's DeepMind AI research team has reported major cooling cost savings¹³. There are many technologies available for data centres to explore and incorporate.

Can we reduce our need for cooling? A look at tropical data centres

A key aspect that players should look at more closely, particularly in the tropics, is the possibility of whether servers, storage, racks and equipment can be customised to function safely and effectively in warmer climates such as Singapore, Malaysia and Indonesia.

With a significant portion of energy being used for cooling purposes, any reduction or elimination would make a profound difference to energy efficiency and overall energy usage. Ongoing research studies and international guidelines show that servers and equipment can still function effectively in hot climates of up to 35 degrees Celsius. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), the professional association which offers international guidelines around data centre temperatures, allows a temperature window of up to 45 degrees Celsius for data centres which fall under Class A4, the class with the widest range of environmental parameters.

This means huge potential savings if data centres were to run at hotter temperatures – according to industry experts, a single degree Celsius increase in temperature can result in 2-3 per cent savings in power consumption. In 2016, a cross-industry partnership in Singapore was set up and driven by Infocomm Media Development Authority (IMDA) together with key players including Dell, ERS, Fujitsu, Hewlett Packard Enterprise, Huawei, Intel, Keppel Data Centres, The Green Grid, and Nanyang Technological University, which sought to establish guidelines around building a data centre in the tropics, and assess whether data centres can function properly in tropical environments.

With industry players loaning out essential data centre IT equipment for testing, the initiative was able to create various test environments to observe how IT equipment would operate and react in harsher tropical environments.

After over two years of testing, it is understood that the results proved IT equipment can operate effectively at hot temperatures. Even at 35 degrees Celsius, too hot an environment for staff members to work, the IT equipment still did not show any signs of degrading.

As such, if servers and other IT equipment were to operate in an environment of 28-29 degrees Celsius, significantly higher than the typical 21-25 degrees, the IT equipment will still be able to run effectively. Although there would still be energy usage from fans needed to work within the servers, the running of IT equipment at hotter temperatures would offer significant potential savings in the cooling system.

However, while both ASHRAE guidelines and tests in conditioned environments show that IT equipment, particularly newer models, can function well in hotter temperatures, other factors still need to be taken into consideration, most notably the effect of the humidity and pollution, as well as the dangers of hot environments on the health and safety of data centre onsite personnel. It is understood that whilst heat does not cause problems to the IT equipment, exposure to the outside air does. High levels of humidity cause condensation, and pollutants in the air such as dust and nitrates expose the servers and IT equipment to corrosion, subsequently disrupting the performance and overall lifespan. Effective protection from the outside environment is therefore key when considering data centres equipment in the tropics.

Also, an environment of 35 degrees Celsius may be tolerated by the IT equipment but would be too hot for data centre employees to work. Furthermore, when functioning at 35 degrees Celsius, the heat dispelled from servers is even higher, potentially exceeding 40 degrees Celsius, which is hazardous to the health and safety of the working staff.

As such, if data centres are too warm, this could create more significant problems both on a personnel level, and potentially on an environmental scale as well. A safe upper limit needs to be

agreed and adhered to, to maintain safety and equipment quality. The health and safety of data centre staff remains a priority.

Few companies have incorporated higher temperatures in their data centre operations to date, despite technology giants such as Google, Facebook, Microsoft, Intel and Oracle already doing so and substantially reducing their energy consumption. Industry experts explained that the tech companies can control the development of their own data centres, which are built solely for their own use. On the other hand, third-party colocation data centre providers need to meet their customers' needs, including those that are not ready to operate in a hotter environment. One Key Opinion Leader who was interviewed, added that, "The challenge for ourselves is we are a multi-tenant data centre. So, we have all kinds of different tenant specifications."

All parties including server manufacturers are needed to support this shift for tropical data centres. Suppliers need to offer equipment which can withstand tropical climates more readily, and enterprises and data centre users need to recognise the importance of upgrading their equipment to be compatible with environments which may not incorporate as intense a cooling process than previously.

Servers which can function at higher temperatures and can withstand higher levels of humidity will be a highly lucrative area of growth in the next few years. The industry needs to come together and review the way that servers are conventionally built, and how networks can operate in a warmer, tropical climate. It is essential for players to consider factoring in the usage of materials and technologies to protect servers from humidity and heat.

Users of data centre providers need to be educated so that they become more open and aware of this aspect, whilst data centres and the government should also support the development of this category and lead the way for more sustainable growth in the long-term.





IMPACT OF COVID-19

Covid-19 results in challenges but confirms the critical role of data centres

The impact of the Covid-19 pandemic on the data centre industry is unprecedented. “Social distancing” measures implemented by governments and companies led to a surge in internet traffic across networks globally.

In Singapore, Internet Service Providers (ISPs) reported a rise of up to 60 per cent¹⁴ in internet traffic, not only during the usual evening peak times, but throughout the whole day, as businesses adopted “work-from-home” and telecommuting practices. Virtual meetings through Zoom and other

software became the go-to method to ensure business continuity. Global tech players experienced record levels of demand – opinion leaders interviewed for the white paper cited how Microsoft had 15-20 million users before the onset of Covid-19, which increased to an estimated 75 million users by April 2020. Streaming service Netflix acquired 16 million new user sign ups globally between January to March 2020 and forecasted a further 7.5 million signing up between April to June 2020¹⁵.

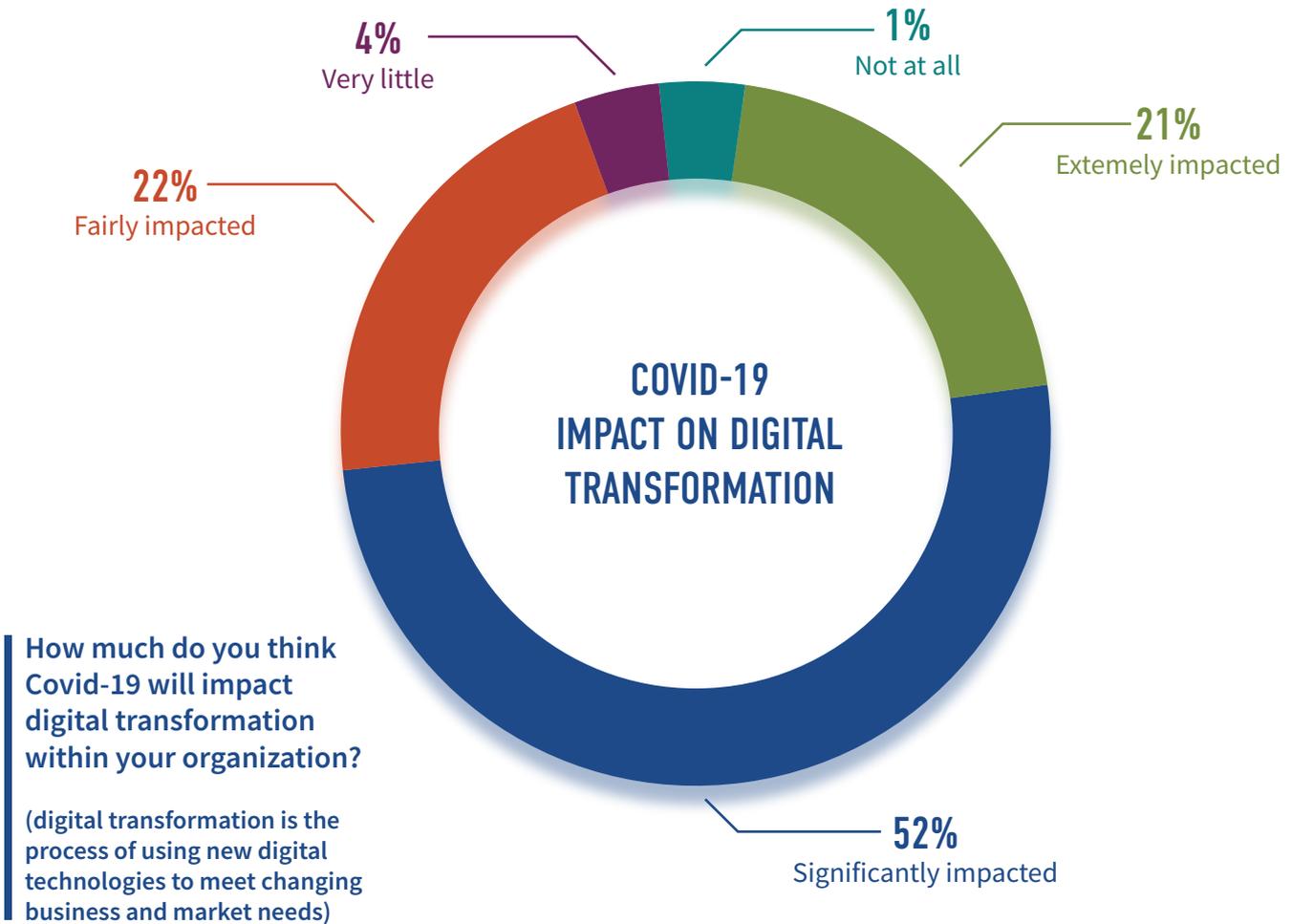
Despite enjoying phenomenal demand, data centres also faced numerous challenges. Operations were forced to defer essential activities during the Covid lockdown period as they prioritised safety of personnel and limited the number of staff onsite, which put a squeeze on operations amid heightened

demand. When it came to securing agreements and transactions, industry experts shared that virtual tours became the norm for both existing and potential clients in the region, affecting the number of contracts which could be signed. Quality and certification checks, such as those by the Uptime Institute, also had to be conducted virtually.

The construction sector also faced major delays, particularly in Singapore, where the outbreak of Covid-19 in the migrant worker community led to the government implementing a hiatus for all construction projects between March and June 2020, and disruptions in other associated businesses which relied on migrant workers.

Local fibre provider, NetLink Trust, struggled to meet the influx of new

Figure 8: Survey highlights - Covid-19 impact on digital transformation



Source: Eco-Business/Digital Realty online survey “Sustainable Growth of Data Centres in light of Global Disruptions”, May 2020-July-2020; 208 respondents

broadband orders as its staff, mainly made up of migrant workers, were on stay-at-home notices and unable to work. Disruptions in the global travel industry also hit supply chains, with one industry expert commenting that inter-continental supply, particularly from Europe, became particularly difficult during the lockdown.

Like the rest of the world, Southeast Asia’s ecosystem of suppliers and subcontractors relying on hard hit markets such as China and Italy were unable to deliver on their contractual agreements, losing much-needed revenue.

In the long-term, Covid-19 is expected to have a positive impact on the growth of data centres. The pandemic showed the importance of digitalisation and

technology to enable business continuity in Singapore. Data centres provided critical support to ensure economic and other activities ran smoothly. They were classified as “essential” businesses that needed to remain open during the lockdown, underlining the critical role they play to sustain the modern economy.

Players with robust digital infrastructure were much better positioned to handle the government curfews and safe-distancing practices. Those that were less connected, or refused to go online, found themselves being forced to accelerate their digitalisation programmes, or fall by the wayside.

Going forward, we can expect to see every organisation making digitalisation a priority. Simon Young, International

Business Development director for RED stressed that “a digital age will now be embedded further into daily lives and those without platforms for operating digitally will now be left behind. “It means that we will see more and more digitisation and we are already seeing this with the robotic controls in parks to the way we socially interact, it will only lead to the continued exponential growth of data and data usage and storage.”

The Covid-19 pandemic also highlighted the need for sustainable growth. Sylvie Ouziel, International President, Envision Digital, observed: “Covid-19 made everyone, from government and corporate decision makers to ‘the man on the street’ more acutely aware of the emergency to proactively address health and environment challenges now”.



SPOTLIGHT ON MALAYSIA AND INDONESIA

Looking beyond Singapore – the case for Malaysia and Indonesia

Indonesia and Malaysia are rising stars which are developing rapidly and expected to increase their share of the region's data centre pie. Both markets are at a much earlier stage of data centre development compared to

Singapore. Being newer to the data centre game, their infrastructure is less organised and their workforce, less experienced. Nonetheless, both markets offer ease of access and much lower cost of entry than Singapore.

They also have a young, fast-growing, and sizeable base of digital and tech-savvy consumers, which drives a dynamic e-commerce and technology industry and escalating data storage

needs. In terms of sustainable growth potential, these markets have an abundance of land mass for data centre operations to expand, which gives them the physical capabilities to generate their own supply of renewable energy.

Whilst it is early days, these countries are in a strong position to attract data centres and, with the right policies in place, spearhead the sustainable growth of data centres in the region.

Indonesia's improved infrastructure and massive domestic market will drive demand

As the third-biggest democracy in the world, the largest economy in Southeast Asia, and the only member of ASEAN in the G20, Indonesia is a huge draw for potential data centre investors. Its young and extremely tech-savvy domestic market is sizeable enough to attract a plethora of tech companies – as of December 2019, it had over 170 million internet users, the highest in Southeast Asia and fourth-highest in the world behind China, India and the US. With the country's total internet penetration at 64 per cent, there is also ample potential for SMEs and financial institutions to expand further – and this in turn spells hot demand for cloud computing and data centre service providers.

In 2019, Indonesia boasted five unicorns¹⁶ – start-up companies which are now valued at over US\$1 billion. Tech giants such as Amazon Web Services, Google Cloud Platform and Microsoft have all started construction of data centres in Indonesia, and their operations are slated to start between late 2020 and 2022. Chinese players in the fintech and cashless payments scene such as Alibaba and Tencent are particularly eager to tap the Indonesian consumer market, particularly in more remote areas, and hence are eyeing data centre operations in second-tier cities.

Indonesia's connectivity and infrastructure are growing from strength to strength. Until recently, Indonesia had a good international network - which included cable networks reaching as far as Hawaii - but its domestic fibre was still very weak, with incoming connections reaching metropolitan areas well, but with limited connectivity to the rest of the country, particularly the remote rural areas.

However, in January 2020, the country-wide Palapa Ring, a comprehensive cross-country network made up of undersea fibre-optic cables and land cables divided into three sections - West, East and Central - is expected to be a game-changer, providing 4G internet access across the country's 514 districts and cities. With the Palapa Ring



supporting cross- country connectivity, Indonesia is now fibre-ready to receive digital players in the market, and will be a hotbed for data centre demand.

Indonesia has enormous potential for renewable energy supply

With Indonesia's huge potential in data centre demand, it is critical to build sustainable growth amongst data centres for the long term. Policies need to support the growth of clean energy options and energy efficiency.

Indonesia's energy profile is still fossil fuel-heavy, mainly driven by coal, natural gas and palm oil. As a member of the G20, Indonesia ratified the Paris Climate Agreement and committed to reducing GHG emissions by 29 per cent in 2030 from "business as usual"¹⁷.

It also set the target for renewable energy to make up 23 per cent of its total

energy mix by 2025, and 31 per cent by 2030. However, progress over the past 5-10 years has been slow – as of 2019, new and renewable energy supply made up only 12.4 per cent of the country's total energy mix.

Lack of investment and funding are partly to blame – as of October 2019, 27 out of the 75 renewables Power Purchase Agreements (PPAs) still had not been concluded, and 5 PPAs had been terminated¹⁸.

Policies favouring traditional fuels are also slowing the switch to cleaner energy sources. For instance, under the Domestic Market Obligation (DMO) it is still mandated that 25 per cent of the country's coal output needs to be supplied to the local market, which includes supplying coal at fixed lower prices to its state- owned electricity company, Perusahaan Listrik Negara (PLN), one of the country's biggest energy purchasers. Government policies are not yet ideal for long-term sustainable data centre growth.



Indonesia nevertheless shows immense potential to become a major producer of renewable energy. It boasts the world's richest reserves of geothermal energy, as well as one of the longest coastlines in the world which can accommodate large-scale wind farms and tidal generators. Hydropower currently represents the largest source of the country's renewable energy, while geothermal, biothermal, solar and wind energy are expected to witness exponential growth in the next few years. In 2018, the country opened its first wind farm at Disrap, South Sulawesi, which is currently Southeast Asia's largest wind farm with a capacity of 75MW¹⁹.

Furthermore, research studies show that Indonesia's large land area and year-round sunshine means that, if 0.4

per cent of its land area (8,000 square km) is devoted to solar photovoltaic power plants, it could provide 100 per cent of the country's electricity demand.

Once the country puts regulations in place to boost renewable energy, it could become a rich source of clean fuel for the rest of the region and globally.

Clues that Indonesia's clean energy potential is starting to take shape

There are signs that Indonesia is moving in the right direction towards sustainable growth for data centres. From 2019, the Ministry of Energy and Mineral Resources (MEMR) launched its official roadmap to meeting the nation's

goal of renewable energy supply. Key developments also reached completion, including the country's largest solar power plant, PLTS Likupang, in September 2019²⁰. Other top-down initiatives such as the marked shift towards electric vehicles also show that sustainability and clean energy are taking a front seat.

In February 2020, news that a fresh set of clean energy regulations, including legislation to improve the investment climate in the renewable energy sector, was also awaiting government approval²¹.

Malaysia shows potential, but it is still early days

Malaysia shows strong potential for data centre growth in the longer term but, as of 2020, is several steps behind Indonesia. Nevertheless, industry experts agree that Malaysia is a competitive market for the long term.

Various reforms, particularly in the telecommunications industry, have already helped create a stronger infrastructure around which data centre operations can develop. Connectivity is also gaining ground. While its subsea cable network is less developed than Singapore's, the completion of the Malaysia-Cambodia-Thailand (MCT) subsea cable system in March 2017, and the SEA Cable Exchange-1 (SeaX-1) which connects Malaysia, Singapore and Indonesia, gives the country much improved connectivity. In June 2018, the Malaysian Communications and Multimedia Commission (MCMC) introduced the Mandatory Standard on Access Pricing (MSAP), which transformed connectivity by doubling the country's broadband speeds and reducing prices by almost half.

In September 2019, the Pakatan Harapan government introduced its five-year RM20 billion National Fibreisation and Connectivity Plan (NFCP) to enhance its broadband and network communications infrastructure. Malaysia's sustainability story is also emerging. As of 2020, Malaysia has over 6,000MW of installed hydropower capacity, which represents approximately 11 per cent of the country's electricity supply.

The government has also put forward a vision to boost hydropower generation to 20,000 MW through large-scale initiatives such as Sarawak Corridor of Renewable Energy (SCORE). Despite political challenges, Malaysia has still experienced strong interest, particularly from the tech giants.

Alibaba chose Malaysia as its first location to operate in Southeast Asia in 2017, and Microsoft and Amazon Web Services followed suit with their own investments in the market.

Some players have increased their data centre footprint by securing partnerships with local players to benefit from their local knowledge and clout and navigate the local business practices.

In December 2019, Facebook tied up with local telecommunications provider, TIME dotcom Berhad, to invest in data centres and managed services through TIME's subsidiary, AIMS Data Centre. As these countries go through teething issues, data centre operators need to be in for the long haul to see their potential realised.





ATTITUDES TOWARDS MORE SUSTAINABLE DATA CENTRES

Online survey assesses attitudes towards sustainable growth of data centres

Between May-July 2020, Eco-Business and Digital Realty conducted a joint online survey to gauge the sentiment in Southeast Asia towards the sustainable

growth of data centres in light of global disruptions. The survey featured 208 respondents in Indonesia, Malaysia, and Singapore from industries including services, construction, engineering, architecture, and real estate. Full details of the survey are available in Appendix 1 of the white paper.

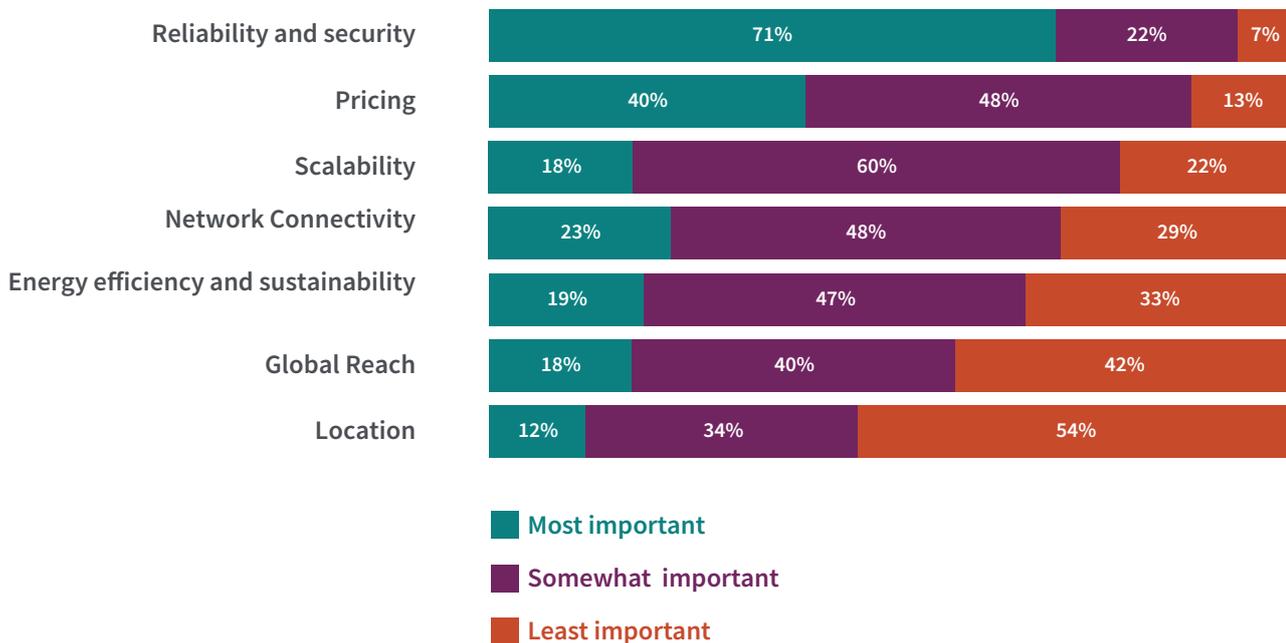
One of the key findings highlighted by the survey was the major impact of

Covid-19 on digital transformation (see Fig 8). Seventy-three per cent of respondents stated that their organisation will be extremely or significantly impacted by digital transformation because of Covid-19.

This underscores the huge role that digital technology plays in the modern economy and the enormous role played by data centre services in these countries.

Figure 9: Survey highlights - Important factors when choosing a third-party data centre provider

If you are choosing a 3rd party data centre provider, which of the factors below would you consider to be most important?

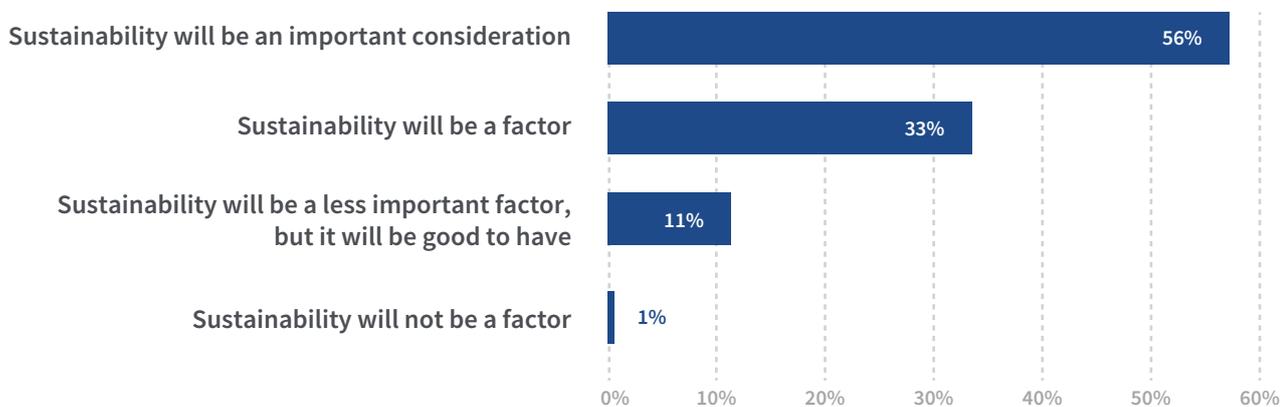


Source: Eco-Business/Digital Realty online survey “Sustainable Growth of Data Centres in light of Global Disruptions”, May 2020-July-2020; 208 respondents

* Respondents were asked to rank the factors above in order of importance. Ranks 1 and 2 were considered “Most important”, ranks 3, 4, 5 were considered “Somewhat important” and ranks 6 and 7 were considered “Least important”

Figure 10: Survey highlights - Importance of sustainability in the next five years

Looking ahead to the NEXT FIVE YEARS, how much of a priority do you think SUSTAINABILITY will be when choosing 3rd party Data Centres?



Source: Eco-Business/Digital Realty online survey “Sustainable Growth of Data Centres in light of Global Disruptions”, May 2020-July-2020; 208 respondents

Survey also illustrates sustainability's crucial role in future

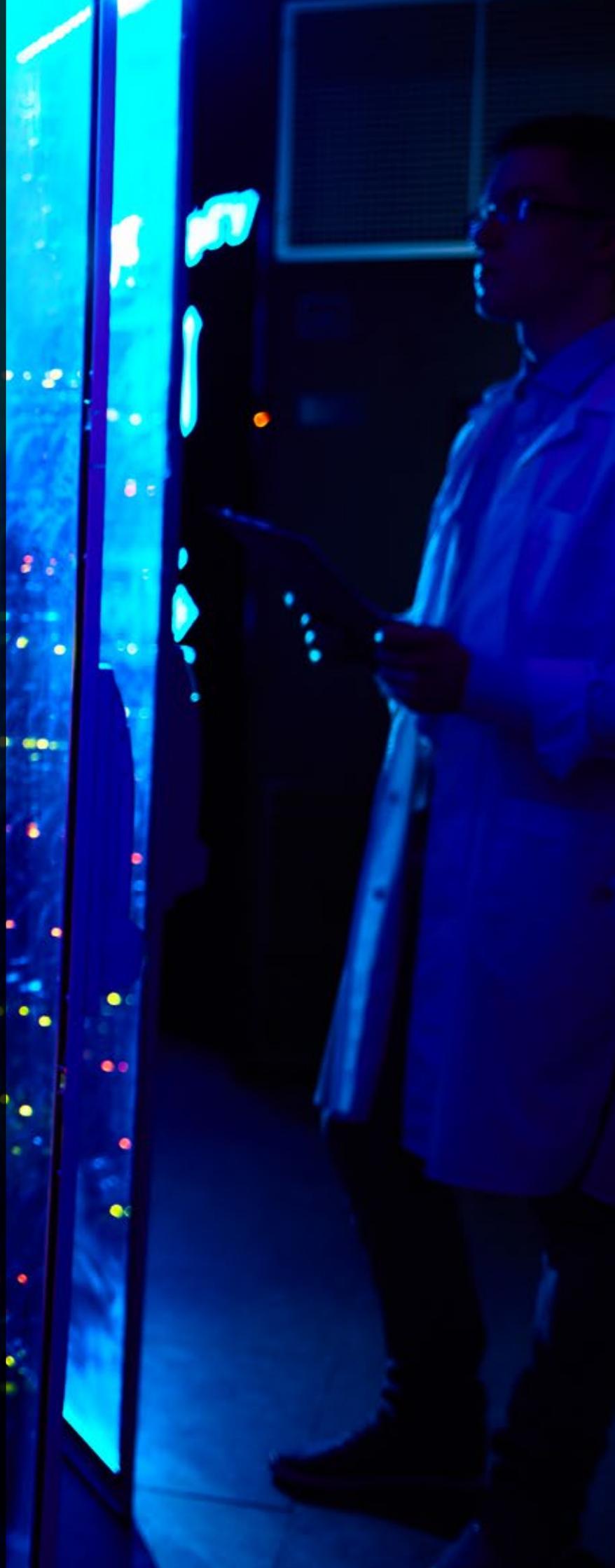
Another conclusion from the survey was that sustainability is already a fairly important factor when doing business with data centres and will play a critical role in driving the industry forward in the future. All parties will need to work together and incorporate sustainable business practices to succeed.

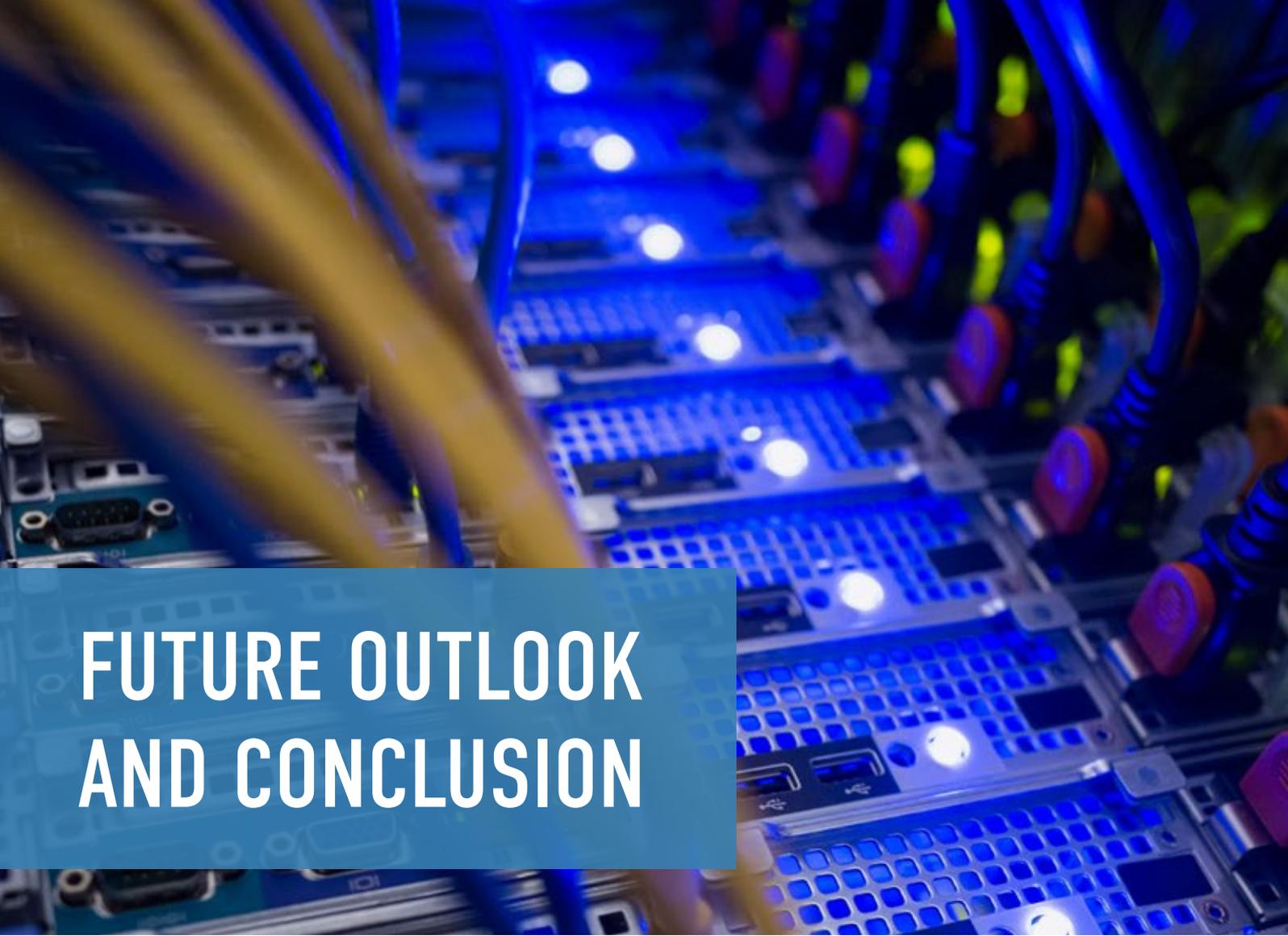
The survey results show that “Energy efficiency and sustainability” are considered “most important” or “somewhat important” by 56 per cent of respondents when choosing a third-party data centre provider (Figure 10).

This proportion is still lower than other factors such as Reliability and Stability, Pricing, Scalability and Network connectivity (considered to be “most important” or “somewhat important” by 93 per cent, 88 per cent, 78 per cent and 71 per cent respectively), but nevertheless still reveals that it is a major consideration. Furthermore, 93 per cent of respondents shared that Sustainability will be “a factor” or “an important consideration”, when choosing third-party data centre providers in the next five years.

From the same findings, it is also interesting to note how scaleability is an important factor among respondents, indicating the need for data centres to respond to this demand through further expansion.

As the need for scaleability will encourage data centres to expand, all parties will at the same time need to be prepared to address the growing significance of sustainability in their future strategies.





FUTURE OUTLOOK AND CONCLUSION

Data centre outlook positive, supported by accelerated digitalisation trend

The post-Covid-19 outlook will be one of exponential growth for the data centre industry in the region, with strong overall demand expected as consumers appreciate the crucial role they play in long-term sustainable growth.

During the crisis, countries and businesses which had robust IT infrastructure fared better than those who did not. Organisations who had invested in an experienced, knowledgeable third-party data centre providers would have fared better than those with limited IT support.

During the crisis, two local telecommunication providers, Starhub²² and M1²³,

experienced a breakdown in their broadband services for one day, disrupting a huge number of households and businesses. The Infocomm Media Development Authority (IMDA) announced investigations into the outage, highlighting how much we rely on a stable and robust online and data system to go about our lives.

Industry experts unanimously agree that Covid-19 has resulted in an acceleration of digital transformation. Eco-Business's survey had 52 per cent and 21.2 per cent of respondents expecting Covid-19 will "significantly impact" or "extremely impact" digital transformation within their organisation, respectively.

A study by consulting firm McKinsey also aptly summed up that "the world has experienced five years of consumer and business digital adoption in the short span of eight weeks since

Covid-19 forced a switch to remote working"²⁴.

Governments are also supporting the digitalisation efforts of companies. In Singapore, its Deputy Prime Minister has announced that over S\$500 million will be set aside to support businesses in digital transformation.

In May 2020, IMDA created the SG Digital Office (SGO)²⁵, an agency aimed at increasing the adoption of digital practices in the community. In June 2020, 1,000 "Digital Ambassadors" were also recruited to help owners and tenants of hawker centres, coffee shops and wet markets to switch to e-payments and adopt SGQR codes.

With work-from-home, virtual meetings, online guided tours, and remote factory testing, the post-Covid workplace is about embedding digital applications to increase both cost and efficiency.

Figure 11: Recommendations for sustainable growth of data centre industry in Southeast Asia

Solution	Recommendation
Data Centres	<ul style="list-style-type: none"> • Invest in the best technologies and implement airflow management best practices to ensure the maximum level of energy efficiency. Dedicate funding and planning resources to evaluate and adopt new technologies. • Evaluate AI technologies that can help identify inefficiencies and lower energy usage. • Work with suppliers to encourage the development of new, more efficient technologies suited to tropical environments. • Engage with electric utilities and governments to advance the development of new sources of renewable energy.
Governments	<ul style="list-style-type: none"> • Engage with the data centre industry to understand what support it will need to grow sustainably in the long-term. • Provide regulatory stability and a clear long-term plan so data centre developers and operators can plan and invest accordingly. • Consider revisions to current legislation to become more favourable to the industry's continued responsible growth. • Facilitate engagement across stakeholder groups that play a role in reducing the impact data centres have on the environment (e.g. electric utilities, data centre operators, renewable/hydrogen energy developers). • Provide incentives for data centres to innovate and become more efficient and remove barriers to this type of innovation.
All parties	<ul style="list-style-type: none"> • Communicate openly about opportunities and challenges and encourage an environment which leverages on everyone's different strengths. • Acknowledge the urgency of sustainable growth, and that all parties cooperating and sharing knowledge will benefit everyone in the long-term. • Maximise opportunities for long-term sustainable growth by uniting to share expertise across the region.

Source: Eco-Business

Sustainability will be high on the corporate agenda

Sustainability is increasingly become a higher priority across the Southeast Asian region and globally, with consumers and regulators alike becoming increasingly climate conscious.

All industries, including the forerunners of digitalisation such as technology,

banking, and finance — key industries relying heavily on data centre service providers — are setting more ambitious sustainability targets. The Eco-Business survey showed that almost half of respondents said their company had made sustainability a strategic business issue and part of the company leadership's mandate.

Big names that have made climate pledges this year include Google, which said last month that it had erased its

carbon legacy using high-quality carbon offsets, and Facebook has set the goal to reach net zero emission in its company's value chain by 2030. This corporate movement towards net zero emissions will undoubtedly drive efforts to increase the sustainability performance of data centres. When it comes to choosing a third-party data centre provider, the Eco-Business survey revealed that 79 per cent of respondents said that sustainability is a factor or an important consideration — and this percentage

increases by a further 10 percentage points when respondents were asked how important sustainability will be in the next five years when choosing a third-party data centre.

Companies who show leadership in terms of sustainable growth practices will be able to support their tenants and will capture the most demand in the long term. The Eco-Business survey also showed that almost 10 per cent of respondents had already switched to greener data centres. This trend is expected to continue in the future.

Across the supply chain, pre-competitive open dialogue and communication between different parties will be crucial in helping to achieve the respective corporate sustainability goals of different businesses. Players able to communicate and understand each other will be able to support one another in achieving their respective targets.

Companies will also benefit if they dedicate more resources and expand their sustainability teams, so that they have more manpower to achieve increasingly ambitious sustainability targets.

Call to action

As Covid-19 has emphasised, data centres are today the silent pillars of our modern society as they sit at the heart of digital transformation and are essential in ensuring business continuity and supporting the economy.

However, the industry is far from attaining the level of sustainable growth that it needs. When experts were asked about what is needed to achieve this, there were several calls to action, and three core messages emerged:

- Data centres need to urgently embrace the efficient technologies that are available
- Governments need to support data centre operators with adequate legislation and incentives
- The regional data centre community needs to collaborate more intimately to share best practices and raise the sustainability standards of data centres

Data centres - investigate new technologies

The data centre industry remains conservative and continues to prefer tried-and-tested approaches rather than accept new processes and technologies. This needs to change to avoid major challenges in not only meeting the anticipated growth in data demand, but also in ensuring energy efficiency can be achieved on a significant scale. Certain data centre players are taking the lead in adopting modern technologies, but many of the potential solutions have shown minimal uptake so far.

This attitude needs to shift with more urgency to ensure the industry develops sustainably for the long term. AI is a crucial technology that data centres must themselves use to mitigate climate change.

Align policies to support sustainable industry growth

Data centres face continuing challenges with the current legislation. As such, to help data centres achieve sustainable growth, government policies could lend greater support to data centres. The lifting of the moratorium in Singapore would support the industry, yet it is also important to communicate what is needed to meet the country's sustainability and economic goals. Industry leaders across academia and research are also calling for greater subsidies and support.

There are pockets of interest and huge talent in the market but more funds and test bedding would provide an even more nurturing environment, as well as ensure that Singapore remains competitive and continues to benefit from the expected growth in data demand.

Community collaboration

The industry consensus is also that collaboration and sharing of expertise is much lower in Southeast Asia than other regions such as the Nordic countries, where all members jointly recognise

their role in building sustainable growth, and are able to achieve major milestones through collaborating openly and extensively.

As Joshua Au, Head, Data Centres, IT Shared Services (ITSS) at A*STAR, observes: "In order for us to achieve some of these goals, it has to be four parties talking together. Industry, academia, government and customers must contribute something different to the table."

Particularly in Southeast Asia, with the rapid rate of digitalisation and rising data demand, there is incredibly low awareness among end-users about the necessity to support sustainable growth of data centres. Simon Young, international business development director for RED emphasises: "People need to know what their data is costing the planet". Users need to be educated on the impact of their data usage so that they can also play their part in managing their carbon footprint.

As Grant Muller, Head of Telstra Energy at Telstra Corp, aptly summarises: "Data centres have become part of wider society, and it has a potential to be a force for great good and great change, but that potential needs to be realised." The attainment of zero emission data centres to power our future economies is a vision that requires all stakeholders to play their part. 🌱

APPENDIX 1: Detailed summary of Online Survey

Which country are you based in?

Indonesia	18%
Malaysia	23%
Singapore	59%

What type of organisation do you work for?

Multinational/international corporation or large state-owned enterprise	42%
Small or medium enterprise	34%
Non-profit, intergovernmental or multilateral organisation	11%
Government agency	4%
Education sector	9%

Which of the following best describes your job title?

CEO, CFO, COO, CIO, President, Managing Director, Country Manager, Owner	19%
Vice President, General Manager	5%
Director	16%
Regional manager	10%
Manager	18%
Technical, Engineer, Executive, Officer, Reporter	19%
Consultant, Academic, Lecturer	14%

Which industry are you from?

Agriculture	5%
Automotive	0%
Banking, finance, insurance	10%
Construction, engineering, architecture, real estate	11%
Consumer goods	1%
Education	8%
Energy	10%
Government or other public sector	4%
Healthcare	0%
Information technology or telecommunications	9%
Manufacturing	4%
Media	4%
Non-profit, NGO, intergovernmental or multilateral organisation	8%
Services, including consulting	21%
Transport or logistics	3%
Utilities / Waste / Water	2%

How much do you think Covid-19 will impact digital transformation (digital transformation is the process of using new digital technologies to meet changing business and market needs) within your organisation?

Extremely impacted	21%
Significantly impacted	52%
Fairly impacted	22%
Very little	4%
Not at all	1%

Does your company run its IT in-house, or use cloud services/computing?

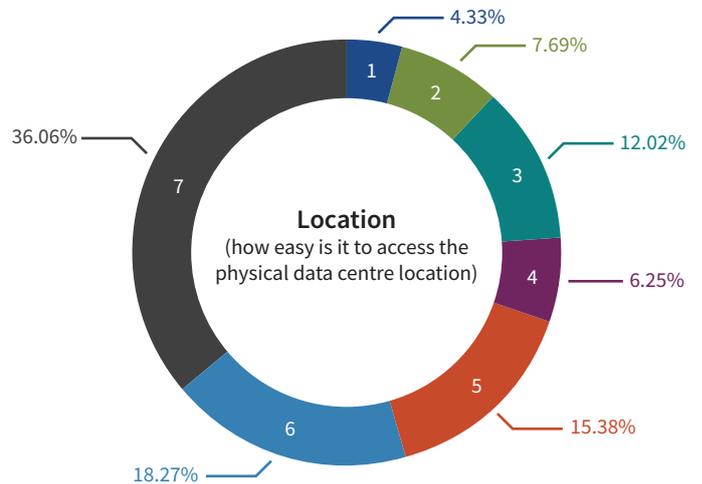
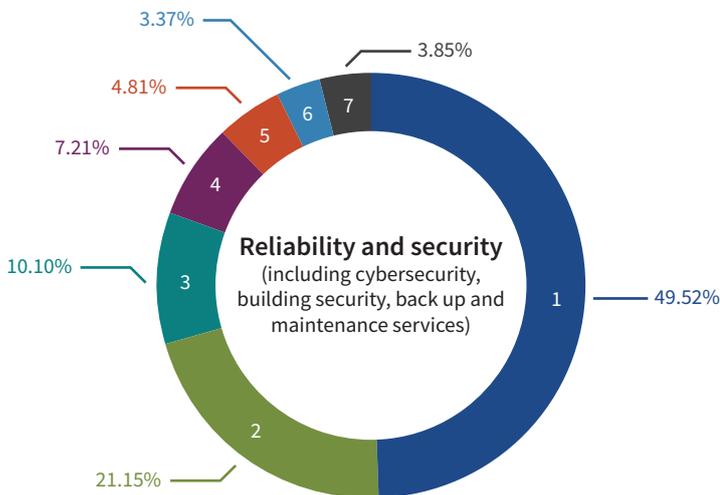
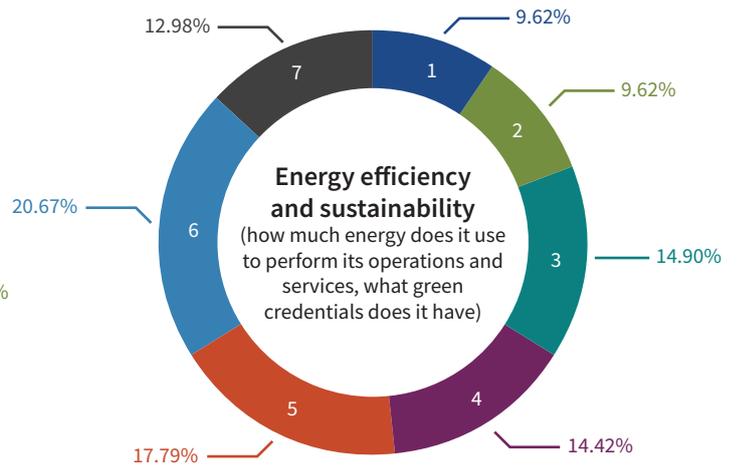
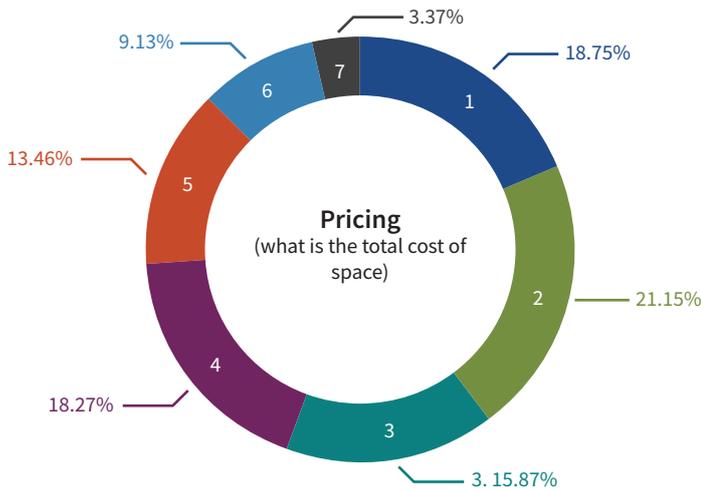
Indonesia	26%
Malaysia	23%
Singapore	51%

Does your company use 3rd party Data Centre providers?

Yes - 100%	14%
Yes - partially	28%
No	28%
Don't know/prefer not to answer	29%

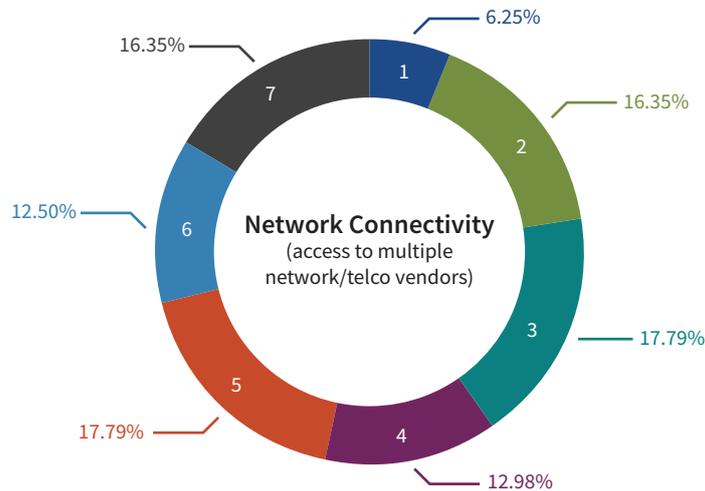
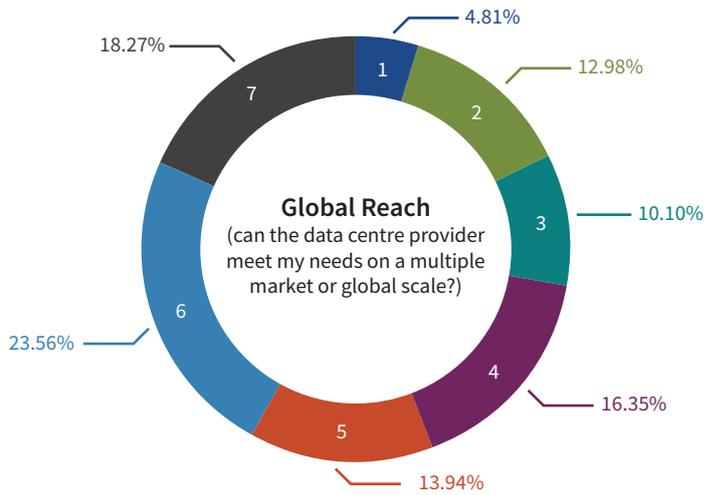
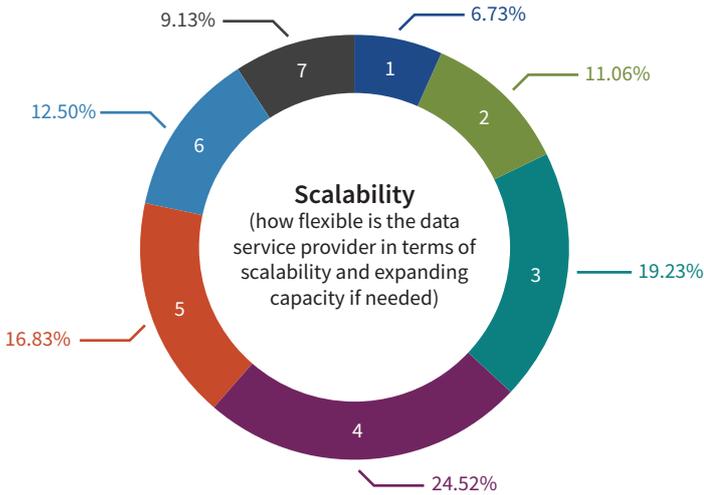
APPENDIX 1: Detailed summary of Online Survey continued

If you were choosing a 3rd party data centre provider, which of the factors below would you consider to be most important? (Please rank in priority order where 1 is the most important and 7 is the least important)?



APPENDIX 1: Detailed summary of Online Survey continued

If you were choosing a 3rd party data centre provider, which of the factors below would you consider to be most important? (Please rank in priority order where 1 is the most important and 7 is the least important)?



APPENDIX 1: Detailed summary of Online Survey continued

How much of a priority would SUSTAINABILITY be in choosing a 3rd party Data Centre? (sustainability is defined as being energy and resource efficient in areas such as energy, water waste and carbon emissions)

Sustainability is an important consideration	39%
Sustainability is a factor	40%
Sustainability is not a factor, but it is good to have	21%
Sustainability is not a factor	0%

Looking ahead to the NEXT FIVE YEARS, how much of a priority do you think SUSTAINABILITY will be when choosing 3rd party Data Centres? (Please choose one)

Sustainability will be an important consideration	56%
Sustainability will be a factor	33%
Sustainability will not be a factor, but it will be good to have	11%
Sustainability will not be a factor	0%

Which of the following best describes the sustainability measures that your company has taken in the past year? (Please choose all that apply)

We have encouraged employees to incorporate more sustainable practices in the day-to-day running of the office (eg no longer using disposable plastics, opting for recycling paper, switching lights off, switch computers off, limit the size of emails)	75%
We have encouraged work from home and telecommuting practices to avoid unnecessary travel and transport usage	58%
We have made Sustainability a strategic business issue and part of the company leadership's mandate	49%
We have started setting Sustainability goals and tracking our environmental footprint	38%
We have invested in new technologies to reduce the carbon footprint generated in producing our product/service	34%
We have switched to greener data centre providers	8%

To what extent do you think your company is taking action to reduce its carbon footprint in terms of IT Infrastructure?

Less than it should	37%
Adequate action	52%
More than others	11%

To what extent do you think your company is taking action to reduce its carbon footprint in terms of data storage infrastructure?

Less than it should	44%
Adequate action	47%
More than others	10%

Are you involved in supplying and building data centres for your company?

Yes	19%
No	81%

APPENDIX 1: Detailed summary of Online Survey continued

Which of the following areas of data centre supply and planning do you consider to be most important in making data centres more energy efficient? (please rank in priority order where 1 is the most important and 6 is the least important)

	1	2	3	4	5	6
Building and construction materials	16.13%	9.68%	12.90%	16.13%	9.68%	35.48%
Electrical infrastructure (including lighting, power cables)	9.68%	19.35%	32.26%	22.58%	16.13%	0.00%
IT infrastructure (including servers, storage, network)	32.26%	12.90%	19.35%	6.45%	19.35%	9.68%
Fuel generators (UPS, batteries)	16.13%	19.35%	6.45%	29.03%	22.58%	6.45%
Cooling infrastructure and technology	25.81%	32.26%	16.13%	6.45%	9.68%	9.68%
Building monitoring systems	0.00%	6.45%	12.90%	19.35%	22.58%	38.71%

Which of the following areas in the supply chain do you think will be impacted by Covid-19?

Building and construction materials	87%
Electrical infrastructure (including lighting, power cables)	52%
IT infrastructure (including servers, storage, network)	55%
Fuel generators (UPS, batteries)	48%
Cooling infrastructure and technology	48%
Building monitoring systems	23%

In your view, what are the biggest challenges in making Data Centres more sustainable?

Lack of environmental awareness	71%
Lack of collaboration from relevant stakeholders	61%
Lack of investment	65%

Looking ahead, how is your ORGANISATION'S data usage going to change in the NEXT FIVE YEARS?

There will be minimal/no change in my organisation's data usage habits	8%
I expect my organisation's data usage to REDUCE	2%
I expect my organisation's data usage to INCREASE SLIGHTLY (below 33%)	14%
I expect my organisation's data usage to INCREASE MODERATELY (between 34-66%)	36%
I expect my organisation's data usage to INCREASE SIGNIFICANTLY (between 67-100%)	28%
I expect my organisation's data usage to INCREASE VERY SIGNIFICANTLY (more than 100%)	13%

Looking ahead, how is your PERSONAL data usage going to change in the NEXT FIVE YEARS?

There will be minimal/no change in my personal data usage habits	8%
I expect my personal data usage to REDUCE	4%
I expect my personal data usage to INCREASE SLIGHTLY (below 33%)	29%
I expect my personal data usage to INCREASE MODERATELY (between 34-66%)	31%
I expect my personal data usage to INCREASE SIGNIFICANTLY (between 67-100%)	18%
I expect my personal data usage to INCREASE VERY SIGNIFICANTLY (more than 100%)	10%

APPENDIX 1: Detailed summary of Online Survey continued

In light of digital transformation, especially during crises such as Covid-19, which of the following actions do you think will ensure the Data Centre industry continues to move forward in a way that achieves sustainability goals in the long term future? (Please rate each response between 1-5 (1=Strongly Disagree, 5=Strongly Agree))

	STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEITHER AGREE NOR DISAGREE	SOMEWHAT AGREE	STRONGLY AGREE
Carbon credit systems for new Data Centres	2.19%	9.84%	20.77%	45.90%	21.31%
Financial incentives to improve the efficient running of Data Centres	3.28%	5.46%	10.93%	47.54%	32.79%
Government mandates to regulate carbon emissions	1.64%	3.28%	10.93%	34.43%	49.73%
Government subsidies to support new initiatives	2.73%	3.83%	13.11%	37.16%	43.17%
Greater collaborative opportunities for industry players to work together	1.64%	4.37%	11.48%	42.08%	40.44%
Greater usage of industry certifications such as the BCA Green Mark or SS 564	1.64%	7.10%	25.14%	38.25%	27.87%
Improving access to renewable energy in my region	2.73%	2.19%	9.29%	33.33%	52.46%
Increased government funding on research and development	2.73%	5.46%	15.30%	36.61%	39.89%
Defined strategic plan from my executive management	3.28%	3.28%	16.39%	42.08%	34.97%
Penalties for inefficient running of existing Data Centres	3.28%	13.11%	25.68%	33.88%	24.04%
Putting a moratorium on the building of new Data Centres	6.56%	15.85%	37.16%	26.23%	14.21%

Note: figures above may not sum up to 100% due to rounding

APPENDIX 2: Research sources

Source	Name of Publication/ website
BBC	www.bbc.com
Building Construction Authority	www.bca.gov.sg
Business Times	www.businesstimes.com.sg
Channel News Asia	www.channelnewsasia.com
Cushman & Wakefield	The Cushman & Wakefield Data Centre Competitiveness Index (2019)
Data Center Dynamics	www.datacenterdynamics.com
e27	https://e27.co/
Energy Management Authority	www.ema.gov.sg
Institute for Essential Services Reform	Indonesia Clean Energy Outlook 2020 Report
McKinsey & Company	www.mckinsey.com
Meteorological Service Singapore	www.weather.gov.sg
Mina News	https://en.minanews.net/
National Environment Agency	www.nea.gov.sg
Singapore Power PowerGrid (PPG)	www.spgroup.com.sg https://www.ema.gov.sg/SP_PowerGrid_Ltd(Gas)
Solar Energy Research Institute of Singapore (SERIS)	Update of the Solar Photovoltaic (PV) Roadmap for Singapore (March 2020)
Statista	www.statista.com
The Jakarta Post	www.thejakartapost.com
The Straits Times	www.straitstimes.com
Uptime Institute	www.uptimeinstitute.com

FOOTNOTES

¹According to Statista, the average monthly net wage of an Indonesia working in the Infocomm sector stood at US\$295 in August 2019

²[https://www.straitstimes.com/singapore/environment/solar-energy-to-meet-4-of-singapores-energy-demand-by-2030-up-from-less-than-1#:~:text=By%202030%2C%20Singapore%20wants%20to,gigawatt%2Dpeak%20\(GWp\).&text=were%20some%20challenges.-,Currently%2C%20solar%20energy%20contributes%20less%20than%201%20per,to%20Singapore's%20total%20energy%20mix.](https://www.straitstimes.com/singapore/environment/solar-energy-to-meet-4-of-singapores-energy-demand-by-2030-up-from-less-than-1#:~:text=By%202030%2C%20Singapore%20wants%20to,gigawatt%2Dpeak%20(GWp).&text=were%20some%20challenges.-,Currently%2C%20solar%20energy%20contributes%20less%20than%201%20per,to%20Singapore's%20total%20energy%20mix.)

³<https://www.nea.gov.sg/our-services/climate-change-energy-efficiency/energy-efficiency/industrial-sector/mandatory-energy-management-practices-for-existing-industrial-facilities>

⁴<https://www.datacenterdynamics.com/en/analysis/reducing-carbon-footprint-singapore/>

⁵<https://www.spglobal.com/platts/en/market-insights/latest-news/electric-power/042020-asia-may-draw-lessons-from-singapores-swift-move-on-hydrogen>

⁶<https://www.straitstimes.com/business/companies-markets/use-of-hydrogen-to-power-data-centres-in-singapore-being-studied-by>

⁷Eco-Business/Digital Realty online survey “Sustainable Growth of Data Centres in light of Global Disruptions”, May 2020-July-2020; 208 respondents

⁸<https://www.channelnewsasia.com/news/singapore/nus-engineers-invent-air-con-reduce-electricity-12731506>

⁹<http://coolestdc.com/>

¹⁰<https://www.businesstimes.com.sg/companies-markets/nus-keppel-and-slng-tie-up-to-develop-better-cooling-technology-for-data-centres>

¹¹<https://www.smartnation.gov.sg/why-Smart-Nation/NationalAIStrategy>

¹²<https://e27.co/how-the-singapore-govts-energytech-firm-is-improving-energy-efficiency-20190717/>

¹³<https://deepmind.com/blog/article/deepmind-ai-reduces-google-data-centre-cooling-bill-40>

¹⁴<https://www.straitstimes.com/tech/internet-data-traffic-spikes-in-spore-as-more-work-from-home>

¹⁵<https://www.bbc.com/news/business-52376022>

¹⁶<https://www.thejakartapost.com/news/2019/10/08/ovo-becomes-indonesias-fifth-unicorn-startup-rudiantara-says.html>

¹⁷<https://www.thejakartapost.com/news/2015/09/02/indonesia-cut-emission-29-percent-2030.html>

¹⁸Indonesia Clean Energy Outlook 2020 Report, Institute of Essential Services Reform, December 2019

¹⁹<https://www.thejakartapost.com/news/2018/07/02/jokowi-inaugurates-first-indonesian-wind-farm-in-sulawesi.html>

²⁰<https://en.minanews.net/plts-likupang-the-largest-solar-panel-in-indonesia/>

²¹<https://www.thejakartapost.com/news/2020/03/02/new-regulation-on-pricing-of-renewable-energy-awaits-presidents-approval.html>

²²<https://www.channelnewsasia.com/news/singapore/imda-starhub-circuit-breaker-internet-disruption-covid-19-12646554>

²³<https://www.businesstimes.com.sg/companies-markets/outage-outage-as-m1-netlink-fibre-issues-add-to-lockdown-pain>

²⁴<https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-covid-19-recovery-will-be-digital-a-plan-for-the-first-90-days>

²⁵https://www.sdo.gov.sg/?utm_medium=sem&utm_source=google&utm_campaign=sg-digital&utm_content=sg-digital-office

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About Digital Realty

Digital Realty supports the data centre colocation and interconnection strategies of more than 2,300 firms across secure, network-rich portfolio of data centres located throughout North America, Europe, Asia and Australia. Digital Realty's clients include domestic and international companies of all sizes, ranging from financial services, cloud and information technology services, to manufacturing, energy, gaming, life sciences and consumer products.

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