ASIA CLEAN ENERGY FORUM 2026

Beyond Transition: Building Secure, Resilient, Inclusive, and Intelligent Energy Systems

8–11 June | ADB Headquarters, Metro Manila, Philippines

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ADB

Session 3: Investing in sustainable digital infrastructure

Benchmarks and standards for sustainable data center operations

Presented by: Jay Lee

11 June 2026 | 11.00–11.30 a.m. (GMT+8)

In cooperation with

analysys mason

Introduction

Jay Lee
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Singapore

analysys mason

- >12 years of TMT strategy consulting experience with Analysys Mason
- >20 data centre projects across the APAC region

Agenda

- **Global benchmarks: what sustainable DC standards now focus on**
- Emerging ASEAN markets: how they compare with global practice
- Beyond standards: practical levers to improve DC sustainability

Global standards are converging around a few core metrics – led by PUE and renewable energy as the main mandatory measures today

Common approaches

Power usage efficiency (PUE)

Increasingly mandatory, including some for existing DCs, with the average between 1.2 – 1.4

Renewable energy % / Renewable Energy Factor (REF)

Emerging as mandatory requirement in some markets – but mostly applicable to new DCs

Elaborated further in following slides

Certifications

Referencing sustainability-related certification is common but most do so only on a voluntary basis

Other relevant approaches

Water usage efficiency (WUE)

Still uncommon or introduced as guidelines

Grid allocation & support

Ireland and Korea require DCs to obtain on-site power generation / grid support

Electronic waste and other circularity metrics

Uncommon across benchmarks but suggested by the ASEAN guide and EU WEEE Directive

GHG emission metrics

Uncommon across benchmarks but suggested by the ASEAN guide

Not relevant approaches

Waste heat utilisation / energy reuse factor (ERF)

Limited relevance for ASEAN given tropical climate

Legend:

- Approaches that are mandated by ≥30% of markets
- Approaches that are only seen in certain markets / are mostly voluntary

Source: Analysys Mason

PUE standards are becoming increasingly mandatory, including some for existing DCs, with the average ranging between 1.2 – 1.4

Comparison of PUE related standards across countries

Legend: Voluntary Mandatory

Country	New DCs PUE	Existing DCs PUE	National level PUE
	1.20 After July 2026	1.30 By July 2030	–
	1.1-1.3 Depending on climate by 2031	1.2-1.4 Depending on climate by 2031	–
	1.25 DC-CFA2 applications		–
	1.2-1.25 Lower PUE for national hub		1.50
	1.30 2029 onwards		1.40 By 2030
	1.3-1.4 Design PUE 1.3, Operational PUE 1.4 in 3 years	1.50 Operational PUE by 2030	–
	1.40 For DCs used by govt only	1.50 For DCs used by govt only	–
	1.40 From 2027 at 50% utilisation	1.35-1.45 Depends on climate by 2035; at 50% utilisation	–
	–	–	–
	–	–	–
	–	–	–

Source: press search, government websites

Renewable energy requirements support a shift away from carbon-based energy and are emerging as mandatory standards in some markets

Comparison of renewable energy standards across countries

Legend: Voluntary Mandatory

Country	Applicability	Additionality requirement?	% of renewable energy
	All DCs		100% 2027 onwards
	All DCs		100% By 2030
	New DCs with MIC[1] ≥ 1 MVA	✓ Must be via new projects	80%
	New DCs at national computing hub nodes		80%
	All DCs		80% By 2031
	New DCs under DC-CFA2		50%
	All DCs		
	All DCs		
	–		
	–		
	–		

[1] Maximum import capacity (MIC)
Source: press search, government websites

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- **Emerging ASEAN markets: how they compare with global practice**
- Beyond standards: practical levers to improve DC sustainability

Where ASEAN stands today – key emerging markets still mostly lag global best practice in managing DC sustainability

Overview of DC supply and presence of sustainable DC standards among select SEA markets

Country	Live DC supply (MW)	Common approaches			Other relevant approaches	Maturity of standards
		PUE	Renewable energy	Certifications		
Global benchmarks	N/A	Averaging ≤1.2-1.4	REF ≥50% but mostly applicable only to new DCs	Mostly used as reference and not a requirement apart from SG (KPI-based) and EU (process-based via ISO standards)	• WUE: ≤2.0 m^3 /MWh (based on SG given similar climate to other SEA markets) • Grid access related • E-waste / circularity • GHG emissions	
	1,288	• Hyperscale ≤1.4 • Colocation ≤1.6-1.7	Indirectly considered as part of the certification (e.g. GBI) scoring – not specifically tracked / regulated otherwise	Malaysia's Green Building Index (GBI) certification	• WUE ≤2.2 m^3 /MWh • GHG emissions (Requires declaration of annual carbon emissions relative to IT equipment energy demand + indirectly considered as part of GBI scoring under carbon emission reduction)	
	138	≤1.3	–	–	Requires water management plan	
	390	–	–	ISO 50001		
	75	New DCs ≤1.4	–	–		
	110	Standards in development following the National Connectivity Plan 2026				

Guidelines / targets Incentive requirements Regulation

Increasing maturity

Source: Analysys Mason, press search, government portals

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- **Beyond standards: practical levers to improve DC sustainability**

DC sustainability is being driven by two critical levers: (1) efficiency and (2) decarbonisation

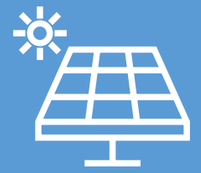
1

Cooling systems

Air cooling vs liquid cooling approaches

Improves internal efficiency of the facility with resulting implications for power / water usage

2



Decarbonisation approaches

Direct renewable supply, enabling infrastructures, accounting mechanisms, post-emissions generation

Reduces reliance on carbon-based energy and the resulting emissions

1 Traditional cooling forces a trade-off between energy and water, but new specialised coolant-based systems help alleviate this…

Data centres typically use air or water cooling, with water being a superior heat transfer medium

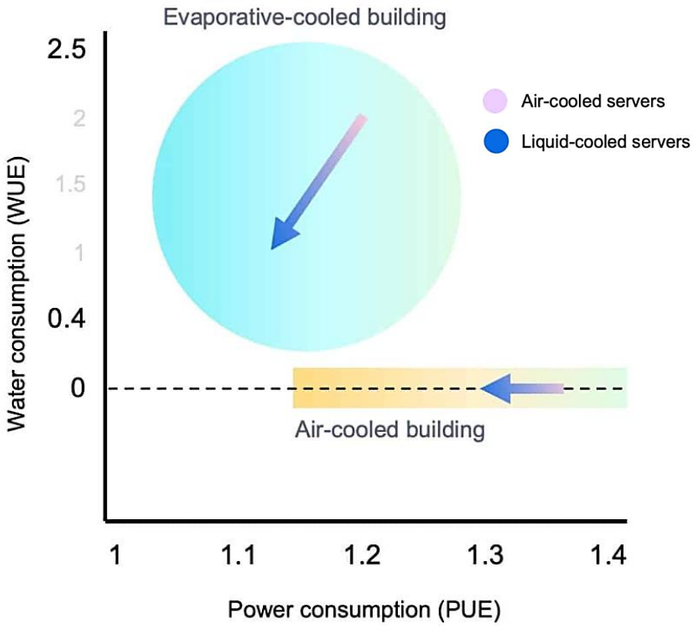
Cooling is a key sustainability driver, contributing 30–40% of total energy use in DCs

- DCs traditionally use two types of cooling methods: water vs. air cooling
- Water cooling uses water to absorb and remove heat from IT equipment
- Air cooling relies on air circulation to expel hot air and has been the standard data centre cooling approach

Water has thermal conductivity ~20–25 times greater than air

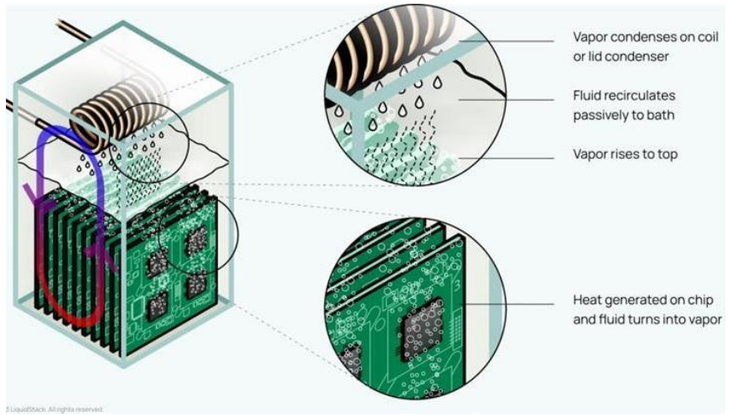
However, this has created a trade-off: water cooling improves energy efficiency but increases water use

Illustrative relationship between WUE and PUE



More recently, new coolant-based systems have emerged that reduce the water vs. power efficiency trade-off

Illustrative workings of coolant-based systems



Property	Water	Coolant (Dielectric liquid)
Heat transfer ability	✓✓✓ very high	✓✓ moderate
Electrical conductivity	✖ conducts electricity	✓non-conducive

Source: press search, Equinix, LiquidStack

1 …with advanced liquid cooling technologies optimising both PUE and WUE, but typically requiring higher upfront capex

Comparison of select cooling methods used in data centres

Unfavourable → *Favourable*

	Air cooling		Liquid cooling		
	Air-cooled chillers	**Water-cooled chillers**	**Rear-Door Heat Exchanger (RDHx)**	**Direct-to-Chip (DTC) / Direct Liquid Cooling (DLC)**	**Immersion cooling**
PUE	1.5–2.0	1.2–1.5	1.25–1.35	1.1-1.2	<1.1
Water usage					
Max. rack density supported	~20kW/rack	~20kW/rack	~50kW/rack	~50kW/rack	>100kW/rack
Indicative cooling capex per MW	USD1–3 million	USD2–4 million	USD4–5 million	USD5–6 million	USD6–7 million[1]

Low water usage due to use of specialised coolants

[1] Based on single phase immersion cooling as two-phase liquid immersion cooling's technology is still not as mature

Source: Analysys Mason, press search

2 Solar dominates renewable adoption with green finance supporting early progress; concessional climate finance could help unlock further scale-up

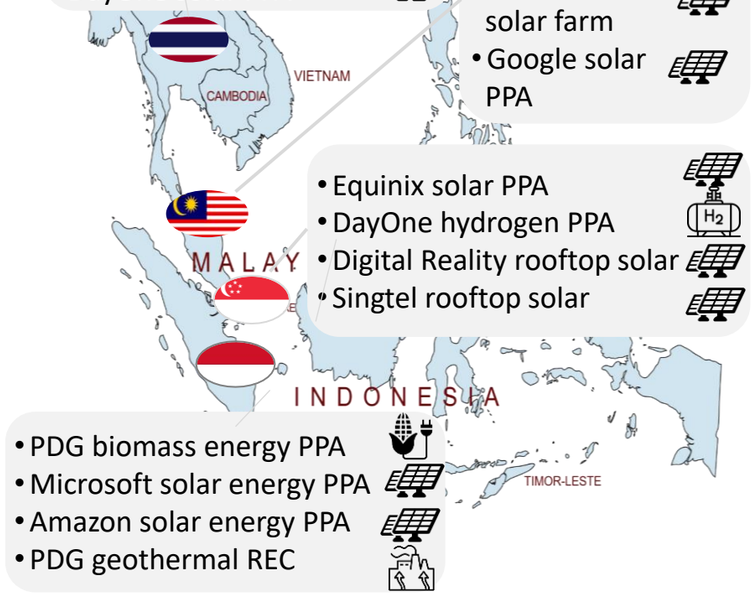
Solar energy is the most common renewable used for DCs in the region, with only a small no. of non-solar projects

Green finance is already being used for DCs in the region, highlighting the appetite to tap onto such financing instruments

Concessional climate finance can unlock the next phase in further renewable adoption including use of alternatives to solar

Key renewables used in regional DCs

- SUPERNAP on site solar farm
- ETIX rooftop solar
- True IDC rooftop solar
- DayOne solar PPA
- Bridge DC solar PPA
- YTL on site solar farm
- Google solar PPA
- Equinix solar PPA
- DayOne hydrogen PPA
- Digital Reality rooftop solar
- Singtel rooftop solar
- PDG biomass energy PPA
- Microsoft solar energy PPA
- Amazon solar energy PPA
- PDG geothermal REC



Examples of DCs that have received green loans

Developing Telecoms

Digital Edge secures US$665m green loan for Indonesia AI data centre

Digital Edge announced on Monday it's secured a US$665 million green loan to support development of the first phase of its planned 500MW...

17 Mar 2026

BT The Business Times

DayOne raises RM15 billion in green financing to develop Johor data centres

The sum sets a record for sustainable data centre funding in Malaysia Read more at The Business Times.

11 Jun 2025

kaohoon international

BGRIM and Digital Edge Secure Record-Breaking $880 Million Green Loan to Strengthen Thailand's Digital Infrastructure

BGRIM and Digital Edge Secure Record-Breaking $880 Million Green Loan to Strengthen Thailand's Digital Infrastructure.

3 weeks ago

Renewable energy challenges for DCs and mitigation via concessional finance instruments

High upfront capex (e.g., large scale onsite solar, storage, grid upgrades)	Below-market loans reduce cost of capital
First-of-kind / non-standard solutions (e.g. hydrogen, fuel cells) → technology + structuring risk	First-loss capital absorbs downside risk and improves risk return profile
Intermittency + need for firm power (storage, dispatchable capacity) → revenue uncertainty	Minimum revenue support help to de-risk revenue streams
Emerging market risk (FX, policy, offtake risk) for select SEA markets	Risk-sharing instruments (guarantees, political risk insurance) transfer political + credit risk

Source: press search

Summary and key takeaways

Observations	Potential actions to consider
Global standards in managing DC sustainability are converging, but focused on a few metrics (e.g. PUE, renewable use)	Emerging ASEAN markets to consider introducing some DC sustainability requirements to manage DC growth
Approaches in emerging ASEAN markets remain fragmented and lag global best practice	
Real progress depends on operational decisions and not standards alone (e.g. cooling systems, use of renewable energy)	Financiers (e.g. development banks) to actively use concessional climate finance tools to support adoption of sustainability-related levers at DCs

Thank you