



ASEAN's low-carbon future flows through smart grids

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About Ember

We are an independent energy think tank that aims to accelerate the clean energy transition with data and policy.

Our mission is to: **shift the world to a clean, electrified energy future.**

Our [data](#) is open, free, and easily downloadable.



Power reliability challenges vary widely across ASEAN countries

Energy not served and system average interruption duration index, 2020



Source: Ember analysis based on the estimated ENS values and SAIDI data from ASEAN Centre for Energy for 2020

ENS is estimated based on each country's average hourly load and outage data



60% reduction

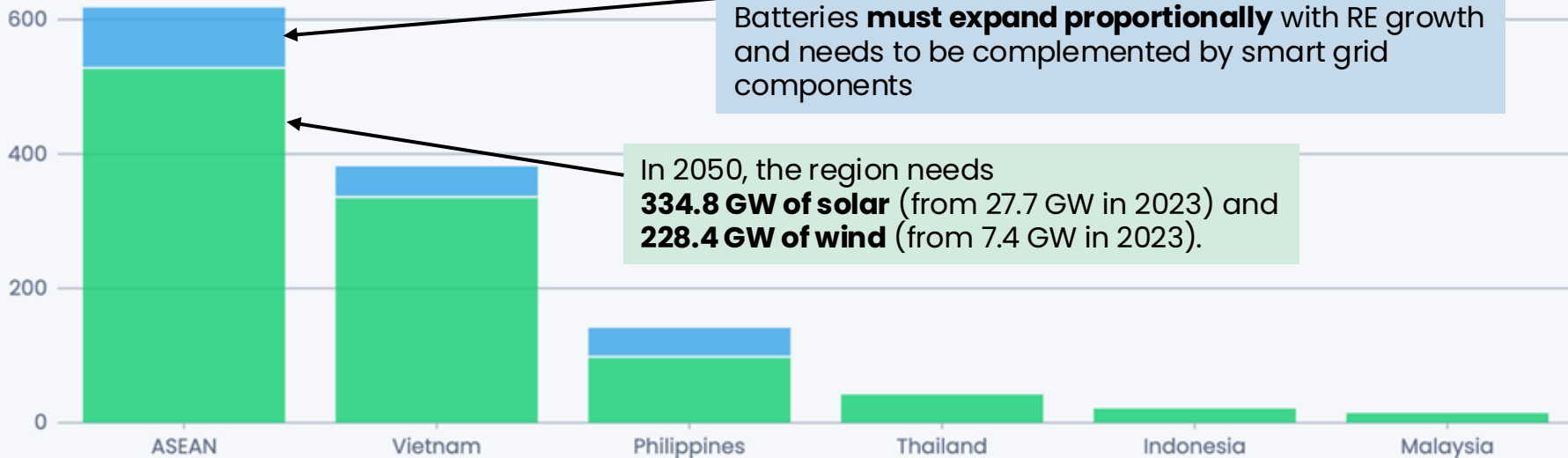
ASEAN achieved a near in outage duration and frequency across the region from 2015 to 2020

Projected renewable capacity expansion underscores strong commitment to low-carbon development led by the Philippines and Vietnam

Installed capacity per country in 2050 (GW)

Top five countries in ASEAN by installed capacity

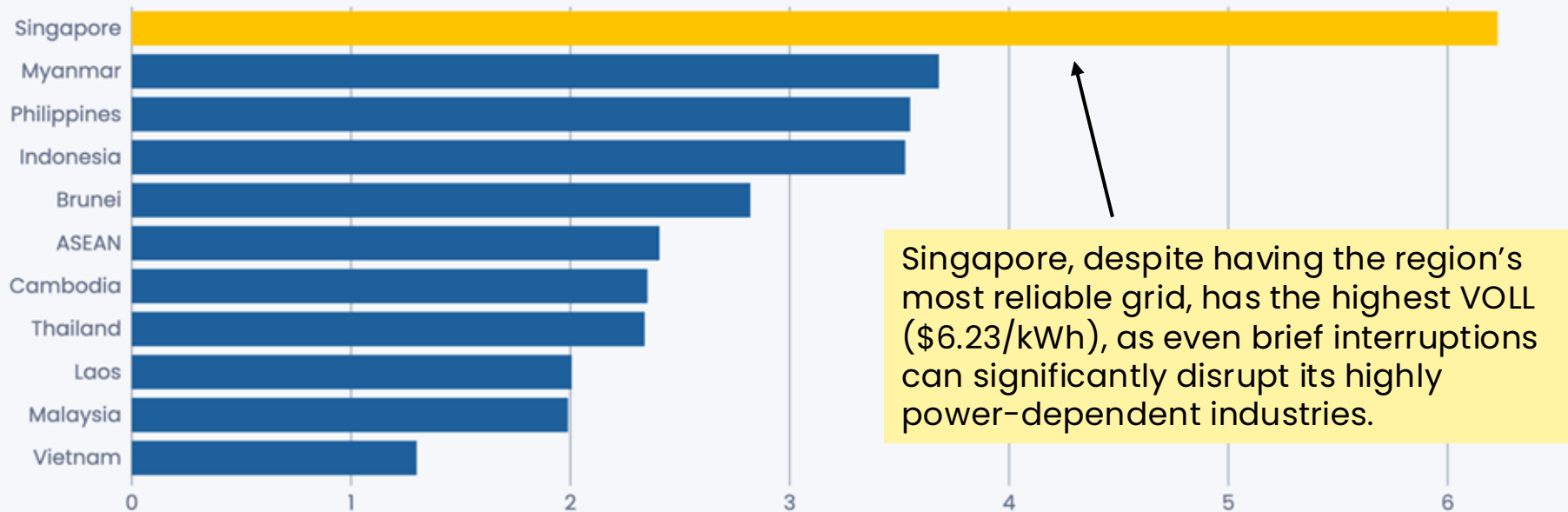
Solar and wind Battery



Source: ASEAN Centre for Energy
8th ASEAN Energy Outlook (ASEAN Target Scenario, ATS)

Outage costs weigh heavily on Myanmar, Indonesia, and the Philippines — while Singapore suffers high costs even with small disruptions

Average value of loss load (VOLL) for 2015 to 2020 (\$/kWh)



Singapore, despite having the region's most reliable grid, has the highest VOLL (\$6.23/kWh), as even brief interruptions can significantly disrupt its highly power-dependent industries.

Source: Ember analysis based on ACE's SAIDI and ASEAN Secretariat's gross value added data for 2015–2020

VOLL represents the economic cost incur when electricity supply is unavailable; Estimated values assume proportionality between economic activity and electricity use, without accounting for differences between short and prolonged outages or interruptions during peak and off-peak periods

By 2040, unaddressed power outages could translate into nearly \$2.3 billion in annual GDP losses across ASEAN

Cost of power outage, billion of US dollars

Shaded area = predicted years

Top five countries in ASEAN by cost of power outages



Source: Ember analysis based on ACE's SAIDI, Asia Development Bank's projected gross domestic product, and ASEAN Energy Outlook's projected electricity generation data

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Note: These estimates are indicative benchmarks, not precise forecasts, since impacts vary by sector, timing and duration.

ASEAN countries view grid modernisation as...



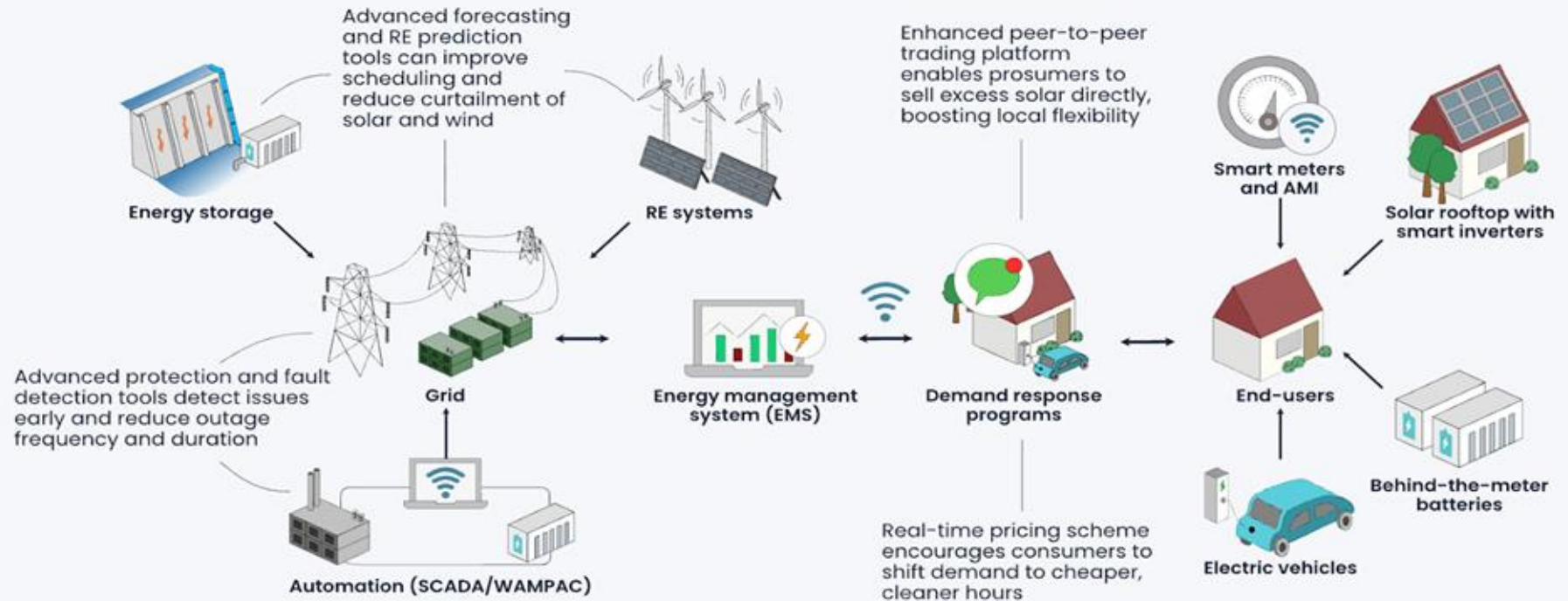
Grid flexibility



**Consumer
empowerment**



Smart grids are set of technologies that enables **bidirectional information flow** between consumers and generators in real-time.



ASEAN requires \$4 to 10.7 billion in smart grid investments under different pathways to avoid costly power disruption

Investment cost, billions of US dollars

Top five countries in ASEAN by investment cost

■ Distribution modernisation ■ Rapid RE expansion ■ Cross border integration



Source: Ember analysis through benchmarking international smart grid investments from Norouzi et al. (2023), China's State Grid Corporation, and India's Revamped Distribution Sector Scheme (RDSS) budget

Around **\$4 billion** would fund essential upgrades like smart meters and automated controls, while **\$10.7 billion** would enable a fully optimised, digitalised, and interconnected system that maximises clean energy potential.

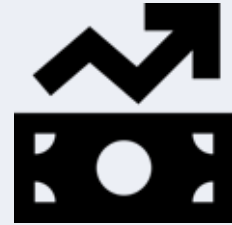
Smart grid deployment hinges on the **right mix of financing and policy innovation**



Green bonds



**Multilateral
Development Banks
support**



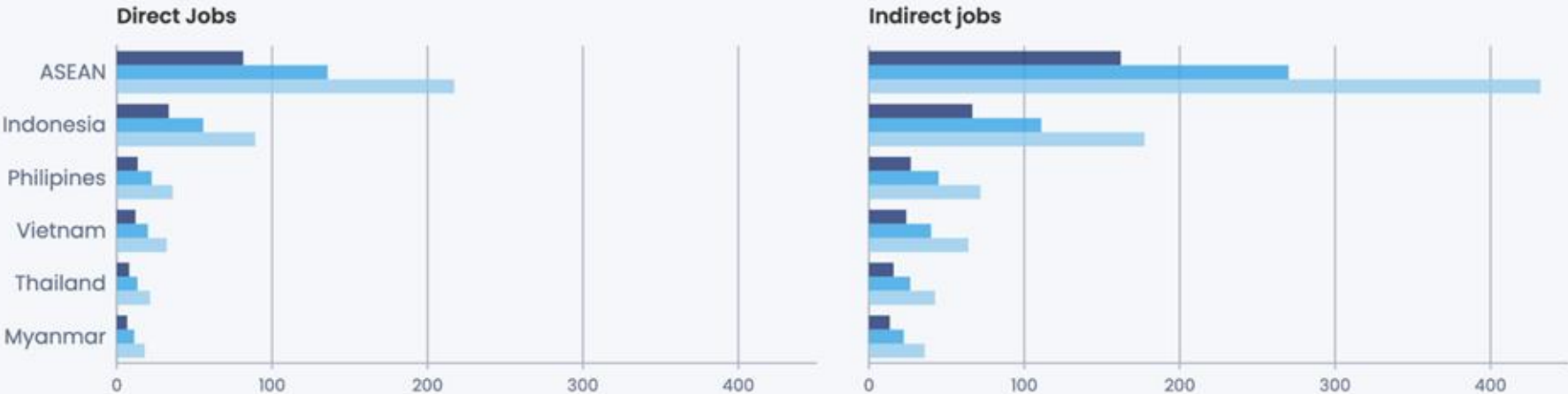
**Performance-based
schemes**

Investment in smart grid infrastructure could create 243,000 to 649,000 new jobs for the ASEAN region

Number of new direct and indirect jobs, thousands

Top five countries in ASEAN by number of new direct and indirect jobs

Distribution Modernization Rapid RE Expansion Cross border Integration



Source: Ember analysis through benchmarking job creation from International Labour Organization's Senegal study

Direct jobs refer to employment created within the project itself (e.g., engineers, technicians, and workers engaged in installing and operating smart grid infrastructure).

Indirect jobs refer to employment generated along the project's supply chain (e.g., suppliers of electrical equipment, transport and logistics providers)

A background network diagram consisting of a series of interconnected nodes and lines. The nodes are represented by small circles, some in light blue and some in light green. The lines connecting them are thin and light blue. The overall shape is irregular, with more nodes and connections on the right side.

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