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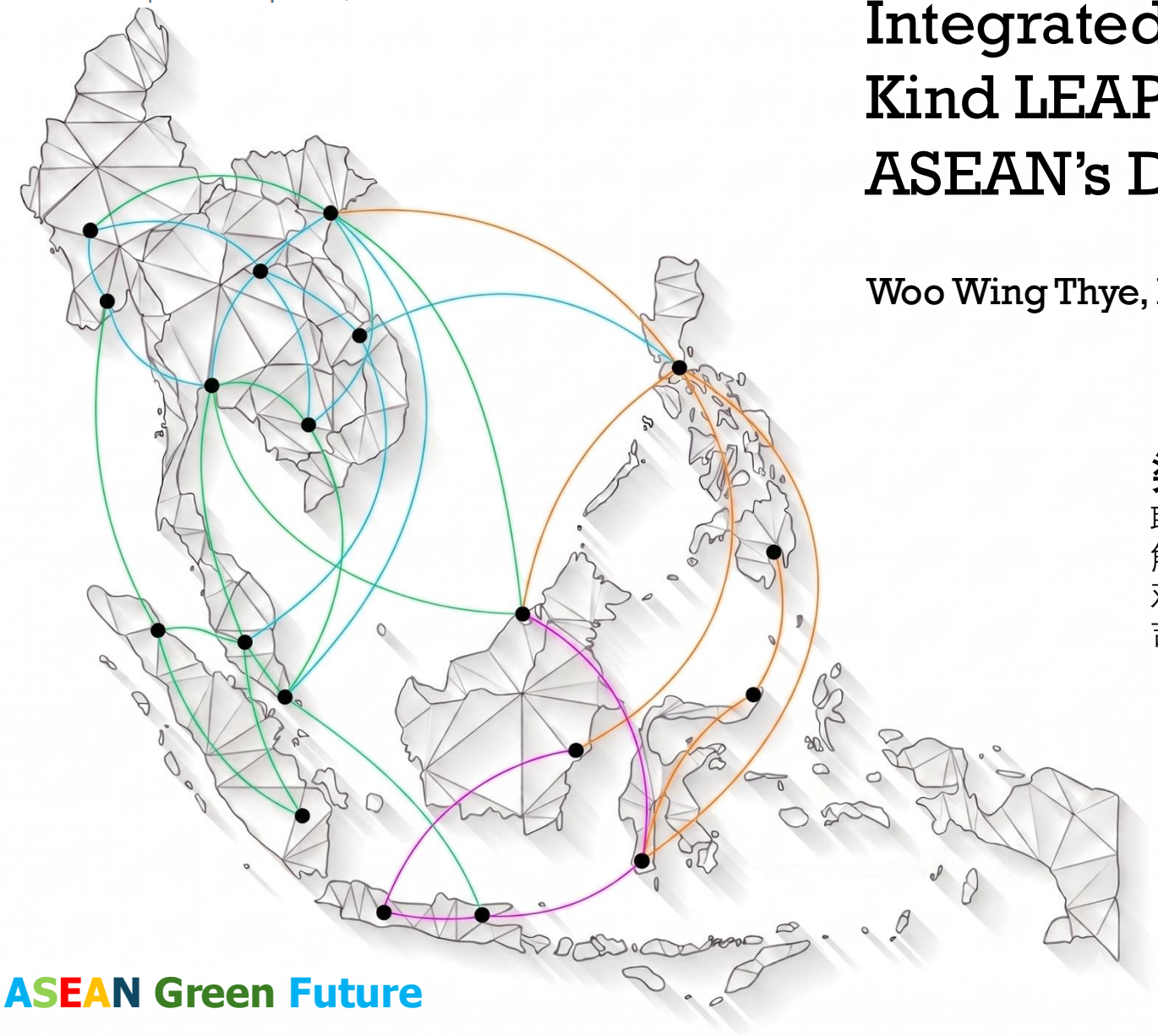

Integrated Resilience: A First-of-its-Kind LEAP-NEMO Assessment of ASEAN's Decarbonised Power Sector

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ASEAN Green Future

SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK
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ASEAN Green Future project

Countries	Partner Institutions (Self-funded participation)
Cambodia	Royal University of Phnom Penh Asian Vision Institute
Indonesia	University of Indonesia Institute for Sustainable Earth and Resources United in Diversity PT Bank Mandiri Mandiri Institute
Lao PDR	National University of Laos
Malaysia	SDSN Sunway University
Myanmar	University of Tokyo University of North Carolina WWF Myanmar
Philippines	University of the Philippines
Singapore	National Technological University
Thailand	Thailand Development Research Institute Thammasat University
Vietnam	Vietnam Initiative for Energy Transition University of Economics Ho Chi Minh City SDSN

Technical Platforms

LEAP

nemo

https://www.unsdsn.org/our-work/asean-green-future/

Scenario Design

Scenario	Interconnection	Dispatch Logic	Optimisation Goal
S1	Fixed (2026 transmission capacity)	National isolation	National self-sufficiency
S2	Policy specified (AIMS III +)	Regional cooperation	Policy-guided expansion
S3	Endogenous (optimised)	Regional integration	System-wide technical optimum
S3+	Endogenous (optimised)	Green integration	Near-zero emissions power sector benchmark

Isolation Penalty

S1: With cross-border transmission frozen at 2026 levels, countries must maintain massive redundant capacity for local self-sufficiency: **102 GW of coal and 172 GW of natural gas** still operating in 2050.

Scenarios	Total Generation (TWh)	Annual Curtailed Energy Production (TWh)	Energy Curtailment Rate (%)	Peak Curtailed Power Production (GW)
S1	3,417.69	932.81	27.29	291.54
S2	3,565.76	493.12	13.83	141.81
S3	3,547.42	49.51	1.40	17.97
S3+	3,615.51	387.74	10.72	54.06

932.81 TWh of discarded clean electricity annually—nearly a trillion kilowatt-hours

Systematic waste of decarbonisation investment

Regional Multiplier Effect: S1 vs. S3 by 2050

Scenarios	Regional Capacity (GW)	Generation (TWh)
S1 (national isolation)	1,473	3,318
S3 (regional technical optimum)	966	3,547

Dividend: Regional integration produces MORE energy with 507 GW LESS hardware

S3+: The Hydrogen Currency

Clean hydrogen as the primary regional energy currency

(218 GW generating 35% of the mix by 2050)

Structural Distinction of Hydrogen's Role in S3 and S3+

Feature	S3: Hydrogen as a Market Fuel	S3+: Hydrogen as a Structural Backbone
Grid Role	Economic fuel option to compete with gas	The explicit "glue" holding a zero-carbon grid together
System Companion	Co-exists with 679 TWh of fossil gas	Pairs with 775 TWh of firm hydro/geothermal
Network Reliance	Tied to a small 15.0 GW regional grid	Enabled by a massive 38.5 GW regional grid

The Subsea Cost Premium

Deep Maritime CAPEX Overhead

Current policy frameworks favor direct subsea HVDC cables crossing the South China Sea to high-demand hubs like Singapore. Our optimization model systematically rejects these routes based on extreme cost realities:

- → **Standard Overland Lines:** Cost-efficient deployment across mainland corridors.
- → **Deep Maritime Corridors:** Impose prohibitive engineering, laying, and maintenance premiums.

Thailand: ASEAN’s Grid Hub

Peninsula Malaysia

Capacity expands to **7.5 GW**, securing key north-to-south balancing pathways and optimized bilateral trade stability.

Cambodia Interlink

Capacity scales to **6.6 GW**, anchoring the eastern wing of mainland ASEAN's power sharing infrastructure.

The ASEAN Terminal

Thailand becomes the **"Grand Central Station"**, connecting 5 neighbors with over **16 GW** of bidirectional capacity by 2050.

Regional Power Gateways

The Sabah–Philippines Link

A strategic transmission model prioritizing realistic regional integration over political optics:

- → **Scale & Velocity:** Projected to climb to **7.1 GW** of bidirectional transit capacity by 2035.
- → **Purpose-Driven:** Specifically engineered as a renewable gateway rather than a costly vanity megaproject.

Maintaining rigid political borders and inflexible bilateral supply contracts forces the region into a **“sovereignty trap”** that leaves 50% of the grid's economic and environmental benefits on the table.

Scenario	Curtailment Rate	Grid Characteristics	System Meaning
S1	**27.29% (severe)**	Limited APG sharing	Total grid lock; massive clean energy waste due to isolation.
S2	**13.83% (high)**	Policy guided APG sharing	Policy roadmap captures half the potential value of integration.
S3	**1.40% (optimal)**	15 GW APG + natural gas	Pure economic efficiency; gas cushions the grid so no green energy is wasted.
S3+	**10.72% (moderate)**	38.5 GW APG + hydrogen	The price of near-zero emissions. Spillover energy is intentionally wasted as a byproduct of aggressive solar overbuilding.

Interconnection ≠ Automatic Greening