MUFG TRANSIT
APAC Sustainability Journey

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ESG Finance Department

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Section I: Executive Summary

APAC Energy Transition Landscape

Southeast Asia requires **~$180 billion annual investment** in clean energy as per IEA's Sustainable Development Scenario by 2030 to upkeep a trajectory compatible with the region's climate goals. Between 2016-2020, clean energy investment only stood at an average of **$30 billion/year**.

25%

Target share of renewable energy in total regional primary energy supply by 2025

35%

Target share of renewable energy in ASEAN's installed power capacity by 2025

ASEAN-EU Summit

€10 billion funding by EU member states to accelerate green transition & sustainable connectivity in ASEAN

ASEAN Power Grid

- Establish regional power grid infrastructure and transmission lines to enhance cross-border regional electricity trade
- ASEAN Interconnection Masterplan Study (AIMS) III - ongoing study to provide insights on optimizing regional electricity cooperation & increase RE penetration

ASEAN Taxonomy for Sustainable Finance

Credible and science-based Foundation Framework + Plus standard to ensure an orderly transition

ASEAN Plan of Action on Energy Cooperation Phase II: 2021 - 2025:

- Accelerating Energy Transition & Strengthening Energy Resilience through Greater Innovation & Cooperation"
- To explore more ambitious targets to enhance energy security & sustainability in line with global objectives of energy transition, SDGs & Paris Agreement

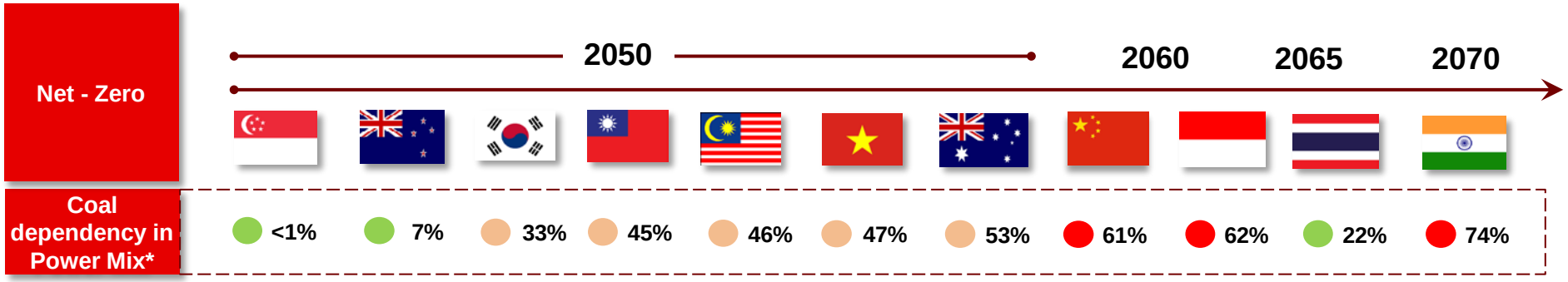
Blended Finance

- Energy Transition Mechanism (ETM), market-based approach developed by ADB, concept first launched in COP26
- Mobilize public & private sector—governments, multilateral banks, private investors, philanthropies, long-term investors to finance country-specific ETM funds seeking to retire coal assets on earlier schedule
- Expanded into an international programme, Just Energy Transition Partnership(JETP)
  - ✓ Spotlight on JETP Indonesia in 2022 amidst backdrop of COP27 & G20, domestically managed by PT SMI

Source: MUFG compiled from Argus Media, ASEAN Main portal, IEA, PwC, The Edge markets and various public sources

APAC Decarbonization Strategy

National commitments, a highly energy-correlated goal, determine the transition strategy that each APAC country deploys



Country Positioning

Centre of Decarbonization for coal-intensive, hard to abate industries

Moratoriums on new coal power plants, coal financing restrictions, technology adoption to reduce externalities of coal, coal phaseout financing scheme

✓ Indonesia, India, Malaysia, Philippines, Vietnam

Energy Excellence & Innovation

Cleaner and smarter technology e.g. Vehicle to Grid (V2G), energy storage, EV Ecosystem

✓ Australia, Malaysia, Singapore, South Korea, Thailand

Renewables, soaring to meet energy demand

Cost of solar PV and wind energy has been on the decline & a step closer to achieving grid parity, coupled with the region's sustainability agenda

✓ China, Indonesia, India, New Zealand, Philippines, Thailand, Taiwan, Vietnam

**Power Mix compiled from Bloomberg New Energy Finance (2021)*

Source: MUFG compiled from Bloomberg New Energy Finance, IEA, Wood Mackenzie Net Zero Tracker and various public sources

Transitioning Energy Sector

While aiming to achieve common goals; reduce emission, increase clean energy, improve efficiency; the approach taken is diverse according to each market's geographical location, energy dependency and industrial base

Market	Premise	Prioritize coal phase-out	Renewable Energy	Hydrogen supply chain	Others
Australia	Focus on new & innovative, clean energy technologies & energy efficiency. 'Safeguard mechanism' policy to transition away from oil and gas	✓			
China	Matured development of wind & solar as energy security & self-sustenance are the cornerstone of China's economy. Nascent green hydrogen industry to be ramped up amidst the global green technology race	✓			
Hong Kong	Exploring space of renewables especially floating solar & offshore wind to overcome land & natural resource scarcity. Tapping on zero-carbon energy & green urban industries for decarbonization	✓			
India	Leveraging geographical advantages to pursue green hydrogen hub for export supported by regulatory push for industry adoptions & renewable capacity expansion	✓			
Indonesia	Transitioning away from its historical dependence on coal through managed phaseout & exploring technologies like co-firing. Spotlight on energy transition in 2022 with ETM & JETP delivering support via blended finance	✓			
Malaysia	Adopting new energy clean-technology while keeping major energy players relevant & competitive. Vision for hydrogen and carbon capture & storage hub with spotlight on Sarawak	✓			
New Zealand	Target 100% renewable electrification by 2030. Transition to a low-carbon economy via development of energy strategy, regulatory framework for offshore renewable energy & roadmap for development & use of hydrogen				

Transitioning Energy Sector – cont'd

While aiming to achieve common goals; reduce emission, increase clean energy, improve efficiency; the approach taken is diverse according to each market's geographical location, energy dependency and industrial base

Market	Premise	Prioritize coal phase-out	Renewable Energy	Hydrogen supply chain	Others
Philippines	A test-bed for Energy Transition Mechanism with quick-win approach to roll-out solar/wind by private-sector	✓			
Singapore	4 'supply switches' due to scarcity of land & natural resources & limited options for renewable energy sources. Seek to diversify energy sources for security & reliability with hydrogen as major decarbonization pathway				
South Korea	Cleaning domestic energy mix with renewables, hydrogen and efficiency enhancement while setting to export clean technology & innovation	✓			
Taiwan	Spearheading wind technology and looking to rapidly expand LNG & renewables space while doubling down on nuclear	✓			
Thailand	Clean & smarter technology to build low-cost energy excellence. Decentralization, digitalization & electrification are key themes with a short-term focus on expanding solar capacities				
Vietnam	Consider the appropriate roles of transition fuels, modernizing grid, revising energy management regulations to curtail imbalance domestic renewables supply & distribution capacity	✓			

Section II: Market Insights

Australia Energy Transition

Centre of clean energy and innovative technologies with increasing momentum on the legislation space

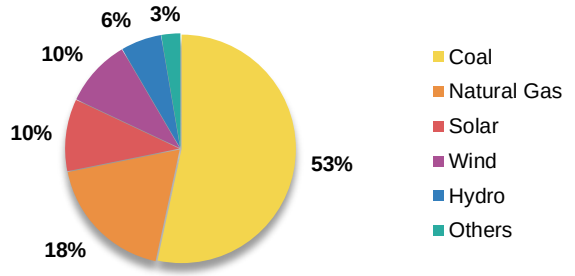
Australia's Key Targets

NDC:

43%
Emission Reduction by 2030

2050
Net Zero Target

Australia's Power Mix



Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. Climate Change Legislation:

Emissions Reduction Fund – Australia government's AUD 2.5 billion commitment for projects in carbon offset scheme

Climate Solutions Fund – AUD 2 billion for further abatement across individuals, businesses & communities

Sep 2022: **passed first climate change legislation bill in a decade** to implement Australia's net-zero commitments

- Cut emissions by >43% compared to 2005
- Developing on leading Labor party's **"safeguard mechanism"** covering ~215 industrial sites, including coal mines, LNG & manufacturing plants
- **Proposed Safeguard Mechanism Reform:** Australia's largest emitting facilities proposed to reduce GHG emissions by 4.9%/year till 2030

2. National Hydrogen Strategy:

Aims to create "clean, innovative, competitive and safe H_2 industry" as a **major global hydrogen player by 2030**

- Aim for **H_2 exports** to reach AUD 10 billion by 2040
- Plans to generate H_2 at **<AUD 2/kilo** & establish Australia's **first H_2 export hub**
- Investment of $1.4 billion in building a **national hydrogen industry**

4 pillar approach to scale-up hydrogen policy:

1. Creating H_2 hubs
2. Assess supply chain infrastructure needs
3. Set clear regulatory frameworks & ensure development has positive influence on energy prices & security
4. Develop scheme to track & certify origins of internally traded clean H_2

3. Australia Renewable Energy Roadmap 2022:

Target 82% energy in National Electricity Market from renewable sources by 2030:

- Focus on power systems capable of **running entirely on renewable energy**
- Low-cost renewable energy tapping on below **abundant resources available** in Australia:

Solar power

Large-scale hydropower

Wind farms

New solutions & resources

Source: MUFG compiled from COAG Energy Council, IEA, Reuters, The Guardian and various public sources

Australia | Market Activity

Date	Countries / Developers	Energy Type	Project Type	Project Details
Government				
Jun-21	Australia, Japan	-	-	Partnership through technology to foster cooperation to net zero
Jul-22	Australia	Wind, Solar, Storage		NSW Government to deliver >2,500GWh new annual generation & 600MW of long-duration storage before 2025
Oct-22	Australia, Singapore	-	-	Green Economy Agreement with 17 joint initiatives including green & transition finance, working groups for electricity trade & aviation environmental cooperation
Jan-23	Australia	Wind, Hydrogen		NSW Government declared a Renewable Energy Zone under NSW Electricity Infrastructure Roadmap, for offshore wind generation & strong demand for H_2 projects
Selected Japanese Corporations				
Mar-22	Chiyoda Corp, ENEOS, Mitsubishi Corp	Hydrogen	-	Revealed to be key partners in development of a H_2 hub at Port Bonython
Apr-22	Osaka Gas, Aqua Aerem			Desert Bloom Hydrogen: combine large solar farm in central Australia with novel, modular 2 MW H_2 to create green H_2, heat & power
May-22	Sumitomo Corp, Rio Tonto			Developed 2 MW green H_2 production facility in Queensland & exploring potential of H_2 to replace gas in alumina refining process
Jun-22	Marubeni, J-Power, Glencore	CCS		Each to fund A$10 million in Glencore's CTSCo CCS Project in Queensland being long-term partners in its mining operations
Nov-22	Idemitsu Kosan	Ammonia		Joint Study for Production & Export of Green ammonia at Abbot Point Port
Mar-23	Upstream: J-Power, Sumitomo Corp, Mid-Downstream: Kawasaki Heavy Industries, Iwatani, ENEOS	Hydrogen		World's first liquid H_2 supply chain demo project, Hydrogen Energy Supply Chain ("HESC") Project to Japan at commercial scale by 2030
Selected Local Corporations				
Dec-21	Woodside Petroleum	Hydrogen	-	H2Perth is a phased development to be one of the largest facilities in the world to produce <1500 tonnes per day (tpd) of H_2 for export
Aug-22	TotalEren		MOU	Government & TotalEren to development green H_2 project – Darwin H2 Hub to produce >80,000 tonnes of H_2/annum
Oct-22	Vena Energy	Wind	-	Plans for 2 GW offshore wind project in Victoria, among largest green energy projects announced in Australia. Blue Marlin Offshore Wind Project expected to be developed over several stages
Jan-23	Neoen	Wind, Solar, Storage	-	Goyder South Stage 1 wind farm to be fully operational in 2024, on the road to become South Australia's largest renewable project

Highlighted Company

Woodside Energy:
Net zero by 2050

Australia's largest dedicated oil & gas company

- US$5 billion targeted investment in new energy products & lower-carbon services by 2030
- Developer of 4 major H_2 projects in Australia

Source: MUFG compiled from Fuel cells works, HESC, Neoen, The Straits times, Woodside, and various public sources

China Energy Transition

Mature domestic solar & wind market, looking towards transforming into a green hydrogen hub

China's Key Targets

NDC:

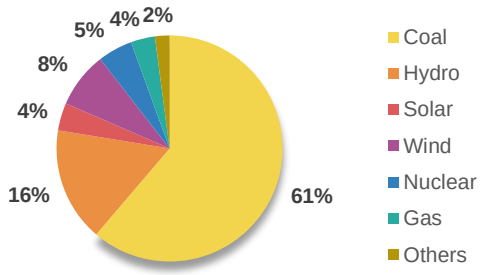
>65%
Emission Reduction by 2030

Renewable Energy Target:

33%
by 2025

2060
Net Zero Target

China's Power Mix

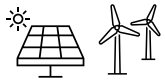


Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. 14th Five-Year Plan (FYP) on Renewable Energy Development & Modern Energy System (2021–2025):

- **1st energy-specific FYP** following President Xi Jinping's carbon neutrality pledge in 2020
- Reflects shift in 'dual control' approach from limiting energy intensity & demand to **limiting carbon intensity & emissions**
- Less focus on quantified demand-side targets, turning towards **quality & modernization** of energy consumption pattern to **overcome inadequate supply capacity & infrastructure**



- Provincial renewables target: Collectively 1263 GW wind & solar by 2025
- China captures the **largest solar market**, with ~700 GW offshore

- Hydropower generation capacity to increase by ~40 million KWh

2. Coal policy:

- In 2021, President Xi made a climate pledge at UN General Assembly to **stop construction of coal-fired power plants abroad**
- 26 plants (21 GW) were removed from the pipeline, avoiding the addition of 85 million tonnes of CO_2 per year
- Flexible retrofitting & modernization of 200 GW of coal-fired power plants locally

3. Hydrogen policy:

Target: 100,000-200,000 tonnes of annual green hydrogen production by 2025

- Target remains conservative relative to global due to China's H_2 industry considered early-stage in 14th FYP
- Provinces like Inner Mongolia set more ambitious target of 480,000 tonnes of annual green H_2 production by 2025
- Plan to overcome limited downstream application, approval process of power dispatching & production control of large-scale electrolysis plants
- Launched policy to **replace subsidies with incentives** for fuel cell vehicles

Source: MUFG compiled from BNEF, EFChina, Reuters, S&P Global, Wood Mackenzie and various public sources

China | Market Activity

Date	Countries / Developers	Energy Type	Project Type	Project Details
Selected Japanese Corporations				
Dec-19	JERA, PetroChina International Company Ltd	LNG	MOU	Discuss opportunities to cooperate in the LNG business including shipping & bunkering
Selected Local Corporations				
May-22	China Energy Investment Corporation	Hydro, LNG, Wind	-	Announced start of 11 power projects with total installed capacity of 12.4 million kW, focusing on offshore wind, large hydropower & natural gas power generation
Jan-23	State Power Investment Corporation	Wind		1st major new-energy project completed by SPIC during the 14th Five-Year Plan period, 80 wind turbines of 400 MW total capacity
Feb-23	China Huaneng Group Co., Ltd	Wind, Solar		Cooperation with provincial government for 10 clean energy projects with investment of $883.9mil to deliver annual on-grid electricity generation of >2.2 billion kWh
Mar-23	Petrochina, BP	CCUS	MOU	Build a regional CCUS cluster in Hainan province

Highlighted Company

China Petroleum & Chemical Corporation (Sinopec) :
Net zero by 2050

World's largest oil refining, gas & petrochemical conglomerate

- Launched world's biggest green hydrogen project in Inner Mongolia in Feb 2023
- Plans to offer H_2 at up to 1,000 of its service stations in the country by the end of 2025
- 1st company in China to purify by-product H_2 to 99.999% for fuel cell vehicles

Source: MUFG compiled from BNEF, Global Construction Review, Global times, Nikkei Asia, Sinopec, Xinhua net and various public sources

Hong Kong Energy Transition

Exploring renewables, zero-carbon energy & green urban industries for decarbonization

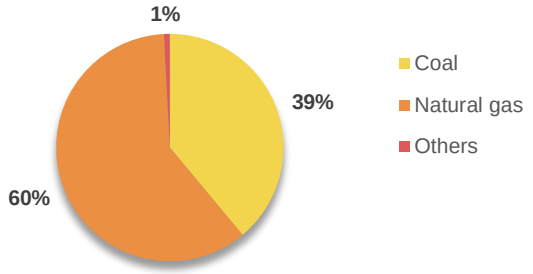
Hong Kong's Key Targets

NDC:

50%
Emission Reduction by 2035

2050
Carbon Neutrality

Hong Kong's Power Mix



Source: IEA, Electricity Generation by Source (2020)

Energy Transition Policies & Key Developments

1. Hong Kong's Climate Action Plan 2050:

- Increase RE share in electricity mix from <1% currently to 10% by 2035
  - Target 1-2% solar by 2035
  - Target 3.5-4% solar by 2035
- **Feed-in Tariff (FiT) Scheme** for solar & wind projects up to project end-life or 2033 whichever is earlier, applicable to all individuals & private sector
- Due to **limitations of land & natural resources** in HK, offshore windfarm development is preferred
- Active pilot in progress for installation of floating solar generation systems on water channels & restored landfills
  - Target 3-4% waste-to-energy by 2035
- Advance quality of waste-to-energy facilities in development e.g. Tai Po STW to enhance HK's food waste treatment capacity to ~950,000 kWh annually

2. Zero-carbon policy:

- Government actively studying development & application of hydrogen for usage as fuels in transportation sector
- HK developed its 1st locally built H_2 fuel cell application, an off-grid H_2-powered EV charger
- To trial H_2-powered double-deckers & other heavy-duty vehicles in 2023
- Consider purchasing zero-carbon electricity from mainland or abroad

3. Green industry policies:

Green transport:

- Roadmap on Popularisation of EVs published by government in 2021
- Target **zero carbon emissions** from **vehicles & transport sector** before 2050
- Cease new registration of fuel-propelled & hybrid private cars by 2035 or earlier

Buildings:

Since **buildings account for ~90% of HK's total electricity consumed**, target to reduce consumption by 30-40% for commercial & 20-30% for residential by 2050

- Energy-saving technologies like big data, AI & smart-metering
- China Light & Power's Eco-building fund scheme subsidy up to $0.5 million on matching basis for energy-saving improvement in various buildings

Source: MUFG compiled from EEB HK, GovHK, SCMP, and various public sources

Hong Kong | Market Activity

Date	Developers	Energy Type	Project Type	Project Details
Selected Japanese Corporations				
Dec-21	Mitsui OSK Lines, Royal Vopak	LNG	JV	Own & operate a floating storage & regasification unit(FSRU) for Hong Kong LNG terminal
Jul-22	Mitsubishi Power, Hong Kong Electric Company		-	Re-provision of gas turbine power generation equipment, specifically GT5, GT6, and GT7 at Lamma Power Station
Selected Local Corporations				
Sep-20	The Hong Kong University of Science & Technology, Widex Technology Development Limited	Solar	-	Launched largest solar-scale power system in HK with 8000 panels at 50 campus locations to generate up to 3 million units (kWh) of electricity/year
May-21	China Light & Power, Dairy Farm International			Installed system of 2000 solar panels in Tseung Kwan O to generate 1 million kWh of energy
Mar-23	Hong Kong Electric Company	Wind	MOU	Develop an offshore wind farm southwest of Lamma Island, Hong Kong, with capacity of 150MW

Highlighted Company

Hong Kong Electric Company:
Carbon neutral by 2050

One of HK's main electricity generating companies

- 2019-2023 Development Plan invested HK$ 16.2 billion in power generation projects, majority towards replacing coal-fired with gas-fired units
- Commissioned HK's 1st commercial-scale wind turbine, Lamma Winds to support government's carbon-neutral goals

Source: MUFG compiled from HK Electric, HKUST, MHI, NS Energy, S&P Global and various public sources

India Energy Transition

Renewable energy powerhouse with green hydrogen hub as national vision

India's Key Targets

NDC:

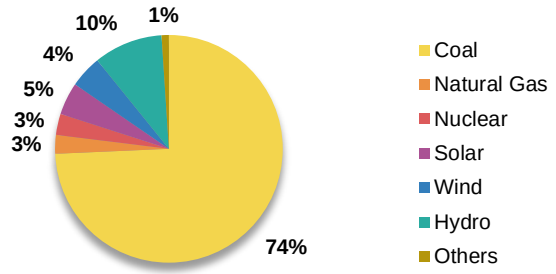
45%
Emission Reduction by 2030

Renewable Energy Target:

50%
by 2030

2070
Net Zero Target

India's Power Mix



Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. National Electricity Plan (NEP) 2022:

Addition of renewables' capacity:

Solar by 333GW

Wind by 134GW

Renewable Purchase Obligations (RPOs):

43.3% of electricity **legally mandated to be produced from RE sources** by 2030

Energy Storage Obligation (ESO), Jul 2022:

specifies % of total energy consumed from solar and/or wind via energy storage:
2023-24: **1%** 2029-30: **4%**

2. National Hydrogen Mission, 2021:

1. Transform India into global hub for both production & export of green H_2
2. Core aim - Produce **5 million tonnes of Green Hydrogen by 2030**
3. Centered around H_2 technologies manufacturing via incentives e.g. Production-linked incentive scheme for electrolyser production
4. Demand creation in specific areas e.g. mandates for use of green H_2 in industry segments & its demonstration in transport applications

USD 2.3bn **Incentive plan** announced in Jan 2023to support this green H_2 production capacity by **reducing its production cost by a fifth** over the next 5 years

3. Coal transition policy:

- Glasgow Climate Pact COP26: India signed commitment to phase down coal
- Import of coal for thermal power generation to end by 2024
- However, **no moratorium on coal power development** or clear governmental action on decreasing coal capacity

Strategic Interventions for Green Hydrogen Transition (SIGHT) program:

Low-carbon steel | Mobility | Shipping | Decentralised energy & storage solutions

Green Hydrogen Policy, Feb 2022:

Promote green H_2/ammonia using renewables in electrolysis:

>1,000GW solar energy potential can be generated on 0.5% of landmass owing to abundant sunlight in India

Source: MUFG compiled from Climate action tracker, India times, and various public sources

India | Market Activity

Date	Developers	Energy Type	Project Type	Project Details
Selected Japanese Corporations				
Jun-19	Mitsui & Co.	Solar	Investment	Invested $14mil to acquire 49% stake in 16MW solar project (Marvel Solren Private Limited) owned by Mahindra Susten
Mar-21	Orix Corporation	Wind	Acquisition	Acquire ~20% of Greenko Energy Holdings shares at $980m which holds India's 2nd largest solar portfolio
Aug-21	Mitsui & Co.	-	Investment	Invest INR300mil ($4.1mil) in biomass supply chain management company - Punjap Renewable Energy System
Mar-22	IHI, Adani, Kowa	Ammonia co-firing	MOU	Study feasibility on a modification to achieve 20% liquid ammonia co-firing & thereafter up to 100% mono-firing at Adani Power Mundra Coal Fired Power Plant
Oct-22	MHI, NTPC	Hydrogen co-firing		Test feasibility for H_2 co-firing blended with natural gas in MHI-701D gas turbines installed at NTPC Auraiya gas power plant in Uttar Pradesh
Selected Local Corporations				
Sep-21	Tata Power	-	-	Plan to raise $500-750 million for Tata Power Renewables Energy, its subsidiary
Jan-22	Adani, Posco	Hydrogen	-	To cover green H_2 steel manufacturing, announced set up of green H_2/solar modules business
Feb-22	Reliance Industries Limited		-	USD 75 billion investment plan for 100GW renewable energy plant & green H_2 eco-system
	Adani, Ballard Power Systems		MOU	Explore possibility of joint investment in field of commercialization of H_2 fuel cells in India
Dec-22	Cummins, Maire Tecnimont		-	Cummins will provide technology to build proton exchange membrane (PEM) electrolyzer to produce green H_2
	NTPC	Hydrogen, Ammonia	-	5 GW capacity in green H_2 & ammonia business, 3 pilots on H_2 business: - Leh green H_2 filling station, solar plants & running H_2-based fuel cell buses to start by Aug 2023. - Blend green H_2 & natural gas at Kawas plant in Gujarat - Madhya Pradesh project - combination of H_2 & carbon capture

Highlighted Company

Reliance Industries Limited :
Net zero by 2035

Large Indian multinational conglomerate

- Produce 100GW renewable energy by 2030
- 1-1-1 vision: bring down cost of H_2 to <$1 per 1 kg in 1 decade

- $75 billion plan to add production of generation plants, solar panels, electrolyzers for clean H_2 & rechargeable batteries for India's H_2 hub

Source: MUFG compiled from Ballard, Business Standard News, India Times, Jera, Mitsui & Co, Orix, Tata Power and various public sources

Indonesia Energy Transition

Reducing historical dependence on coal coupled with blended finance and development of renewable energy

Indonesia's Key Targets

NDC:

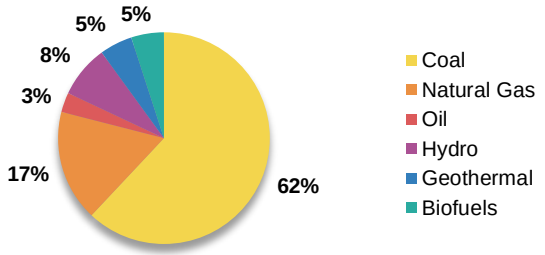
31.89 – 43.2%
Emission Reduction by 2030

Renewable Energy Target:

23%
by 2025

2065
Net Zero Target

Indonesia's Power Mix



Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. New Electricity Business Plan (RUPTL) 2021-2030:

21GW Additional installed capacity of renewable energy by 2030 focusing on hydro, solar & geothermal

51.6%

Majority of NEW power generation projects to be developed are **renewable energy projects**

64.8%

Allocated bigger share to private sector IPPs in developing new RE generation capacity to catalyze more private financing

Biomass co-firing rate for existing coal-fired power plants("PLTU"s) raised to 10-20% in future with plans to make **biomass co-firing mandatory** for PLN & IPPs

Convert older diesel power plants to ~660MW of solar/battery storage power plants

PLN's national plan for smart grid, EV and rooftop solar

2. New Presidential Decree, Sep 2022:

Phase out the operation of existing coal-fired steam power plants ("PLTU"s) by 2050

Prohibit development of new PLTUs

Better pricing system for geothermal, hydro & solar power to encourage investment

3. Premise for Transition Finance

Energy Transition Mechanism (ETM)

- MOU between INA & state-owned infrastructure funding company PT Sarana Multi Infrastruktur (SMI), which was appointed as country platform manager for ETM
- MOU between ADB, Indonesian government & Cirebon Electric Power for refinancing USD250-300 million deal to pay for PLTU Cirebon 1 plant's early retirement 10-15 years before end of useful life

Just Energy Transition Partnership (JETP)

- Led by USA & Japan on behalf of G7 & International Partnership Group
- USD20 billion package(USD10 billion in public funding + USD10 billion from private sector investors)
- Help fund Indonesia's shift to renewable energy from coal

Source: MUFG compiled from Argus Media, ASEAN Main portal, PwC, The Edge markets and various public sources

Indonesia | Market Activity

Date	Countries / Developers	Energy Type	Project Type	Project Details
Government				
Jan-22	Indonesia, Japan	-	MoC	Regular discussions to support creation of roadmaps, develop & deploy technologies for realistic energy transitions
Mar-23	Indonesia, Japan		MOU	Japan to provide $500 million financing support to facilitate its decarbonization & net-zero ambition
	Indonesia, Singapore			Establish institutional cooperation framework to facilitate investment for developing RE in Indonesia's manufacturing industry & a cross-border electricity trade project
Selected Japanese Corporations				
Jan-22	Marubeni	Geothermal	-	Commercial operation of Rantau Dedap Geothermal Power Generation project
	Chiyoda Corp, PT Pertamina	CCUS	MOU	Jointly study & develop application for CCUS technology
Feb-22	MHI, Institut Teknologi Bandung	Decarbonization		5-year extension of collaboration to develop ammonia-H_2 cofiring gas turbine system & combustion technologies
Apr-22	Osaka Gas, JGC Holdings, Inpex	LNG	JSA	Feasibility of clean natural gas project involving production of bio-methane from palm oil mill effluent
Sep-22	IHI Corporation, PT Pembangkitan Jawa-Bali (PJB) – PLN Subsidiary	Ammonia co-firing	MOU	R&D of H_2/ammonia as fuel to replace coal (co-firing) for steam power plants
	Mitsubishi Corporation, JOGMEC, JGC, ESSA PT Panca Amara Utama	Ammonia		Measurement of GHG Emissions at PAU Ammonia plant serves as export to Japan funded by Mitsubishi Corp.
Oct-22	IHI, PLN	Ammonia co-firing		Co-fired ammonia with PLN NP at No. 1 Boiler of gas-fired Gresik Steam Power Plant
Nov-22	JBIC, PT Pertamina	Hydrogen		Promote collaboration between Pertamina & Japanese companies in sectors such as RE, H_2/ammonia value chain, CCS, green mobility
	Marubeni, Cirebon Electric Power	Coal phase-out	ETM	Cooperation to reduce operational term of Cirebon 1 Coal-Fired Power Plant through ETM led by ADB
Mar-23	MHI, PLN	Co-firing	MOU	Technical studies related to co-firing of less carbon-intensive fuels at power plants owned & operated by PLN Nusantara Power
Selected Local Corporations				
Sep-22	PT Pertamina Geothermal Energy (PGE)	Geothermal/ Hydrogen	-	Green H_2 pilot project to be carried out in Lampung Province by 2023 to generate up to 100 kg/day of green H_2
Nov-22	PT Pertamina, ExxonMobil	CCS	-	$2.5bn agreement to further assess development of regional CCS hub in Indonesia announced by the US at G20

Highlighted Company

PT PLN:
Net zero by 2060

Large state-owned electric utility company

- Early coal plant retirement of 10GW collectively as 50% of its installed capacity in 2020 came from coal-fired plants
- Smart grid roadmap for 2021-2025: digitalization of power plants
- Convert existing 5,200 units of small-scale diesel power plants into RE & gas-fired power plants

Source: MUFG compiled from AGGPM, Antara, Argus Media, Grow your business, JGC, Marubeni, MHI, NEXI, Pertamina, Setkab, The Straits Times, Voi and various public sources

Malaysia Energy Transition

Leveraging on clean energy technology with vision to become a carbon capture & storage and hydrogen hub

Malaysia's Key Targets

NDC:

45%

Emission Reduction by 2030

Renewable Energy Target:

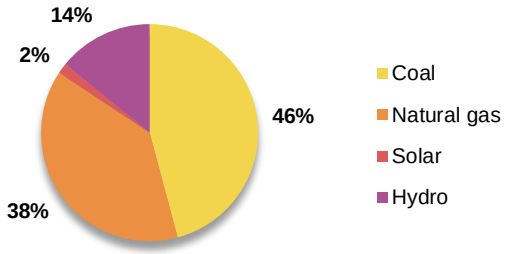
40%

by 2035

2050

Net Zero Target

Malaysia's Power Mix



Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. National Energy Policy 2022-2040, Low Carbon Nation Aspiration 2040:

- Increase use of urban public transport by 50%
- Boost EV use by 38%
- Develop alternative fuel standards for heavy vehicles through B30 fuels mixing
- Increase use of LNG for marine transport by 25%
- Reduce coal in installed capacity from 31.4% to 18.6%
- Reduce energy consumption in industries/businesses by 11% & 10% in homes

3. Malaysia Renewable Energy Roadmap (MyRER), 2021:

- New Capacity Target (NCT) scenario aims for much higher RE capacity target to align with further decarbonization of Malaysia's electricity sector
- Aligned with capacity development plan of Planning & Implementation Committee for Electricity Supply & Tariff (JPPPET 2020) for Malaysia as official commitment by Government in achieving RE target

2035 RE Targets:

- Solar: 7,280MW
- Hydro: 9,281MW
- Bioenergy: 1,404MW
- New solutions & resources

2. Policies related to Hydrogen:

Hydrogen Economy & Technology Roadmap:

- Optimizing H_2 production pathways across green, blue & grey H_2
- Various initiatives by Sarawak State Government include using public buses that operate on H_2 fuel cells & fuel cell light rail transit system by 2024

CCS landscape:

- ~46 trillion cubic feet of potential carbon storage capacity identified across 16 of Malaysia's depleted fields
- 60% storage capacity allocated to Malaysia (for **Petronas & partners**), 40% made available to other users

Sarawak is well-poised to be a major green hydrogen producer & supplier in the region by 2028:

- National vision to transform into a H_2 hub, transitioning from **blue to green hydrogen** with low-cost technology
- Potential for both **domestic** & **export production**
- H2biscus project – jointly developed by Sarawak Energy with large Korean players Chemical to study commercial potential of producing green H_2 & ammonia for local use + export to South Korea, targeting to **achieve commercial production by end 2027**

Source: MUFG compiled from Baker McKenzie, Danajamin, Energy Watch, IHS Market, Ketsa Malaysia, MDPI, MIDA, MUFG, Petronas, Pinsent Masons, S&P, SEDA and various public sources

Malaysia | Market Activity

Date	Developers	Energy Type	Project Type	Project Details
Selected Japanese Corporations				
Feb-21	JERA, Petronas	Hydrogen	MOU	Study producing & shipping green ammonia & H_2 to Japan for co-firing at thermal power plants
Dec-21	Shizen Energy Inc	Solar	-	Long-term PPA to install rooftop solar power array with minimum capacity 2.2 MW for Malaysia's Top Glove Corporation Bhd
Feb-22	IHI Corporation, Petronas, Tenaga National subsidiaries	Ammonia co-firing	-	Feasibility studies on application of ammonia co-firing technology to Tenaga's coal-fired power plants & evaluate technology & economic performance throughout supply chain
Mar-22	ENEOS, Petronas	-	JFSA	Advance studies for a commercial H_2 production & conversion project in Kerteh, Terengganu
Jun-22	Sumitomo Corp	Hydrogen	-	Develop Sarawak's first H_2 plant
Aug-22	JGC, Japex, K line	CCS	MOU	Joint study to capture & transport CO_2 from Petronas LNG complex located in Sarawak & overseas as future possibility
Sep-22	JBIC, Petronas	-		Expand & enhance bilateral cooperation between Petronas & Japanese companies including value chain development of H_2 & ammonia, RE, CCS & green mobility
Oct-22	JX Nippon, JGC, Petronas	-		Joint collaboration study which aims to study potential of CCS development
Dec-22	JX Nippon, Petronas	CCS, Gas	Agreement	Collaborate in developing joint proposal to monetise gas potential within Bujang, Inas, Guling, Sepat & Tujoh (BIGST) fields
	IHI, Gentari	Ammonia	MOU	Evaluate feasibility of leveraging solar resources of Malaysia to produce & sell green ammonia derived from renewables
Selected Local Corporations				
Jan-22	Petronas, Sarawak Shell Berhad	CCS	JSCA	Integrated CCS Area Development Plan study to support decarbonisation ambitions of both parties within selected locations offshore Sarawak
Aug-22	Petronas, Korean consortium	CCS		Develop cross-border CCS project with SK Energy, SK Earthon, Samsung Engineering, Samsung Heavy Industries, Lotte Chemical & GS Energy
Sep-22	Petronas, METI	-	MoC	Enhance cooperation between Petronas & Japan in development & utilisation of energy sources & technologies as well as LNG, including emergency measures

Highlighted Company

Petronas:
Net Zero by 2050

Malaysia's government owned oil & gas integrated company

- Produce **blue hydrogen by 2024, green hydrogen at USD2/kg by 2025**
- Aims to establish Malaysia as CCS regional hub: **Kasawari Integrated Offshore High Contaminant** project with potential to be one of the **largest CCS projects in the world**
- New clean energy entity, **GENTARI,** established for **renewable energy, H_2 & green mobility solutions**

Source: MUFG compiled from Energy voice, JBIC, Petronas, The Edge and various public sources

New Zealand Energy Transition

Development of renewable energy via a broad energy strategy and greater regulations at play

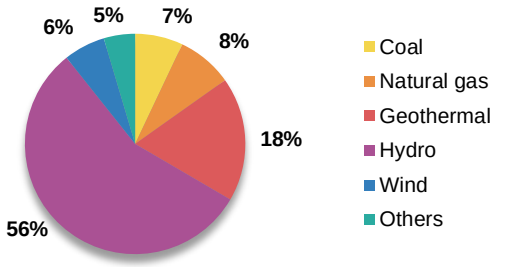
New Zealand's Key Targets

NDC:

50%
Emission Reduction by 2030

2050
Net Zero Target

New Zealand's Power Mix



Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. New Zealand Emissions Reduction Plan:

Target: 90% of electricity generated from renewable sources by 2025

Government's NZ Battery project of NZD 4 bn:

- Since most electricity is generated via hydropower, this project investigates **RE generation storage technologies**
- E.g. Lake Onslow project pumped hydro scheme to **tackle fluctuating storage capacity** of hydropower lakes
- Overcome NZ's **"dry year" scenario** when demand is high

Leverage on green storage fuels:

Hydrogen | Biofuels | Flexible geothermal generation | Flow batteries

- NZD 650m injection in Government Investment in Decarbonising Industry (GIDI) fund for fuel-switching & adoption of decarbonising technologies
- New Zealand Green Investment Finance Limited, a NZD400 million fund to accelerate low-emissions investment

2. New Zealand Energy Strategy 2011-2021:

- Diverse resource development
- Environmental responsibility
- Achieving efficient use of energy
- Promoting energy security & affordability

3. Hydrogen strategy:

2019: Published Green Paper titled 'A vision for H_2 in New Zealand', looks at scope of NZ's H_2 potential to frame discussions for national strategy

2023: Target to develop regulatory roadmap for H_2

4. Regulatory Reforms for Energy transition:

Electricity Authority adopted new "benefit-based" transmission pricing methodology to assist transition to low-emissions economy

- Developing proposed regulatory framework for offshore wind farm development & licensing
- To enforce legislation by late 2024

Source: MUFG compiled from MBIE, Ministry for the Environment, PwC, The Conversation and various public sources

New Zealand | Market Activity

Date	Countries / Developers	Energy Type	Project Type	Project Details
Government				
Oct-18	New Zealand, Japan	Hydrogen	MoC	Exchange of information to enhance H_2 development in respective energy & transport sectors to achieve transition to low-emissions economy
Jul-21	New Zealand, Singapore		Arrangement	Chart standards & certifications to scale-up respective hydrogen economies, establish supply chains for low-carbon hydrogen & its derivatives, strengthen networks & partnerships
Selected Japanese Corporations				
Sep-21	Mitsui & Co.	Hydrogen	Investment	Strategic investor in Hiringa Refuelling New Zealand Limited ("HRNZ") to develop network of green H_2 refueling stations for fuel cell powered heavy vehicles in NZ
Jun-22	Obayashi Corporation, Tuaropaki Trust		JV	Build a pioneering green H_2 supply chain in NZ, including construction & operation of NZ's first megawatt-class green H_2 production facility through local joint venture Halcyon Power Ltd.
Nov-22	Mitsui & Co., Meridian Energy, Woodside	Hydrogen, Ammonia	-	Develop large-scale H_2 & ammonia facility in Southland called Southern Green Hydrogen (SGH), focused on NZ's export market
Selected Local Corporations				
Oct-22	Meridian Energy	Wind, Solar, BESS	-	Develop 7 new large-scale renewable generation projects into operation around Aotearoa by 2030 including Harapaki wind farm
Jan-23	TotalEnergies	BESS	-	NZ's first Big Battery Project of 200MWh & Solar Farm
Feb-23	Contact Energy, Lighthouse bp	Solar	-	Develop one of the largest solar farms in NZ, Kōwhai Park, with ~300,000 solar panels

Highlighted Company

Mercury:
Net zero by 2050

New Zealand's major retailer of electricity generation

- 100% of electricity generated is renewable
- Powers ~18% of NZ's needs via wind, geothermal & hydro
- **Largest project owner** in New Zealand, of 695 MW in total
- Emerged as **NZ's largest wind generator** in 2022 – in addition, Mercury NZ Ltd is in the making of a 204 MW Turitea Wind Farm, **NZ's largest wind facility** ready by 2023

Source: MUFG compiled from Fuel cells works, HESC, The Straits times, Woodside, and various public sources

Philippines Energy Transition

Quick-win strategy to roll-out solar & wind energy while acting as test-bed for Energy Transition Mechanism

Philippines' Key Targets

NDC:

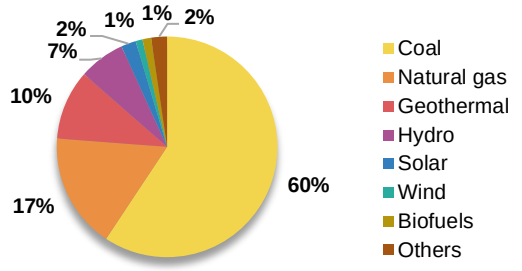
2.71 – 72.29%
Emission Reduction by 2030

Renewable Energy Target:

35%
by 2030

N.A
Net Zero Target

Philippines' Power Mix



Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. Philippines Energy Plan 2020-2040:

- Philippine Offshore Wind Roadmap Project: identify high potential areas with 5 GW Wind Energy Service Contracts (WESC) awarded thus far
- Nov 2022: DOE issued 40 offshore wind service contracts with potential capacity of 30,000 MW

- National Renewable Energy Program (NREP): **aspirational solar target** of 1528 MW
- **Increased net-metering limit** for renewables to 1 MW

- Oct 2020: moratorium on developing new coal plants

2. Renewable Energy market policies:

- Oct 2022: Department of Justice (DOJ) revised constitution for **foreigners to own 100% of renewable energy projects** from previous restriction of 40%. Includes exploration, development & utilization of following resources:

Solar | Wind | Hydropower | Ocean/tidal energy

- Renewable Energy Portfolio Standards: Government announced **an increase on minimum amount of RE supplied** to distribution utilities, investors & direct buyers/end-users from 1 to 2.5%
- Other RE policy mechanisms e.g. RE portfolio standards, net metering, green energy option/auction programs & renewable energy market (REM) trading system

3. Premise for Transition Finance

Energy Transition Mechanism (ETM):

- COP26: government working with ADB and some private sector partners in developing this ETM:
  - ✓ Pilot project in Mindanao to rehabilitate & expand Agus-Pulangi hydropower plants to enable **early retirement of coal-fired plants**, maximizing their generation capacity to a combined 1,001 MW
  - ✓ ADB is conducting a feasibility study on financial aspects & economic value estimation of these plants

Source: MUFG compiled from ADB, ASEAN Briefing, DOE PH, IRENA Coalition, Power Philippines, PV Magazine, Trade.gov and various public sources

Philippines | Market Activity

Date	Developers	Energy Type	Project Type	Project Details
Selected Japanese Corporations				
May-21	Mitsui & Co.	Solar	JV	Mitsui & Global Business Power to jointly develop a 115 MW mega solar farm project
Sep-21	JERA	-	Acquisition	JERA acquires ~27% outstanding shares of Aboitiz Power (USD 158 million) to decarbonize its local & overseas businesses
Oct-21	JGC Philippines	Solar	-	JGC awarded EPC contract for Mega Solar Power Plant, Aboitiz Power's first solar power plant project in region of Luzon
Oct-22	Kyuden	-		Investment in PetroGreen Energy Corp - a renewable energy developer
Feb-23	JERA, Aboitiz Power	Ammonia co-firing	MOU	Joint study of ammonia co-firing in coal-fired power plants which Aboitiz Power has been investing
	Kawasaki Heavy Industries	Renewable Energy		MOU with Amber Kinetics, IKS & Aboitiz to build cooperative partnership entailing solutions for transition to RE
Mar-23	Shizen Energy	Wind		Jointly develop up to 96 MW onshore wind power generation with Ganubis Renewable Energy Consortium
Selected Local Corporations				
Jul-21	San Miguel Corporation	Solar	-	Constructed 31 BESS facilities (1,000 MW) in Philippines to alleviate domestic electricity grid issues
Feb-22	AC Energy			Carried out 40MW pilot BESS project at 120MW solar PV power plant in Laguna
Sep-22	New Sky Energy, Inc.	Waste to energy	JV	Philippines city officials approve first large-scale waste-to-energy plant
Oct-22	Aboitiz Power	Wind		Subsidiary, Aboitiz Renewables Inc acquired 60% stake in a 90 MW onshore wind project in Camarines Sur in the group's first try at wind power generation
Nov-22	ACEN	-	ETM	Completion of world's first market-based Energy Transition Mechanism (ETM) transaction, enabling early retirement of 246 MW SLTEC coal plant & its transition to cleaner technology
	Solar Philippines	Solar	-	Plan to develop world's largest solar farm
	Altenergy, Shell	Wind	-	Forged partnership to jointly explore & develop country's offshore wind energy potential to boost Philippines' RE target

Highlighted Company

Ayala Group:

Largest & oldest conglomerate in the Philippines

- **1st ETM deal in the world**
- Target: **100% renewables generation by 2025** for ACEN, the listed energy platform of Ayala Group
- Nov 2022: South Luzon Thermal Energy Corporation (SLTEC) coal plant's operating life was cut from 50 years to half
- Avoid/reduce up to 50 million metric tons of carbon emissions

Source: MUFG compiled from JERA, JGC, Kawasaki, Kyuden, Nikkei Asia, Philstar and various public sources

Singapore Energy Transition

Energy diversity & security, frontrunner of clean energy technology with hydrogen as major decarbonization pathway

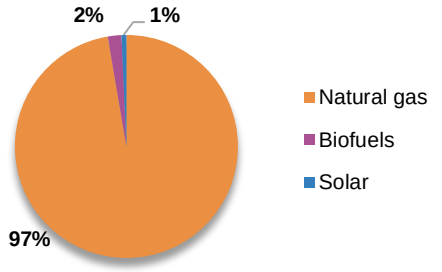
Singapore's Key Targets

NDC:

60 $MtCO_2e$
Emission Reduction by 2030

2050
Net Zero Target

Singapore's Power Mix



Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. Singapore Energy Transition, 4 supply switches:

Natural Gas:
- Dominant power generation fuel
- Seek to improve plant efficiency
- Develop H_2-ready gas turbines

Regional power grid:
- **Energy source diversification** purposes &
- **Import low-carbon electricity** from offshore e.g. Laos PDR-Thailand-Malaysia-Singapore Power Integration Project

Solar Energy:
- 500 MWp of solar installed
- Deploy >200 MW of **energy storage systems (ESS)** beyond 2025

Low-carbon alternatives:
- Energy Market Authority(EMA) actively investing in R&D through Low-Carbon Energy Research Funding Initiative to improve technical and economic viability of implementing technologies e.g. H_2 & CCUS

2. National Hydrogen Strategy, Oct 2022:

50% of power needs fulfilled by hydrogen **by 2050**
- H_2 to act as major decarbonization pathway: low-carbon H_2 identified as focus area
- Preliminary steps: build on existing infrastructure, become technology hub for breakthrough H_2 solutions to achieve commercial adoption
- Capacity building: additional S$129 million set aside for low-carbon energy research to handle/utilize H_2 with its carriers safely & at scale

3. Singapore Green Plan, 2030:

- Increase capacity of solar power generation facilities to **>2 GWp by 2030**
- Target Renewable Energy shares to reach **15% by 2030**

4. Energy efficiency & excellence strategy:

- Embark on economy-wide energy conversation
- Energy efficiency efforts to manage total & peak electricity demand
- Transform grid using new technologies & storage capabilities e.g. EMA's power grid digital twin to enhance Singapore's grid resilience & reliability
- Singapore positioning itself to capture growing global demand for sustainable energy solutions:
  - ✓ Establishing itself as technology frontrunner
  - ✓ Becoming test-bed & living lab for innovative solutions

Source: MUFG compiled from CNA, EMA, MTI, SIEW, UNFCCC and various public sources

Singapore | Market Activity

Date	Countries / Developers	Energy Type	Project Type	Project Details
Government				
Jan-22	Singapore, Malaysia	-	MOU	Framework of Cooperation (FoC) on Green Economy to decarbonise industries while seizing opportunities covering next-generation mobility, low-carbon solutions & carbon credits
Selected Japanese Corporations				
Feb-20	Mitsui O.S.K Lines ("MOL"), Namura Shipbuilding	Hydrogen	-	Construction of very large gas carriers ("VLGCs") to transport LPG & ammonia
Oct-21	Chiyoda Corp, Mitsubishi Corp, Sembcorp		MOU	Explore supply chain commercialisation of decarbonised H_2 into Singapore utilising Chiyoda's H_2 storage & transportation technology
Dec-21	Osaka Gas, Woodside		-	Study feasibility of long-term, stable supply chain of sustainable liquid H_2 from Western Australia to Singapore & potentially Japan.
Aug-22	Mitsubishi Power, Keppel Infrastructure, Jurong Engineering		-	Singapore is expected to get its 1st hydrogen-ready power plant, Keppel Sakra Cogen Plant by the first half of 2026
	MHI, Keppel New Energy	Ammonia	MOU	Conduct feasibility study on development of ammonia direct combustion GTCC power plant in Singapore
Oct-22	IHI, Sembcorp			Collaborate on an integrated green ammonia supply chain, both upstream & downstream
	JBIC, Sembcorp	Hydrogen, Ammonia		JBIC to support green H_2 & ammonia projects developed by Sembcorp & Japanese companies
	ITOCHU, EDF, Tuas Power			Cooperation in fields of green H_2 & ammonia
Selected Local Corporations				
Oct-21	Sembcorp, Sunseap	Solar	-	Export energy from solar energy plants (8GW) from Indonesia to Singapore
May-22	Sembcorp			Singapore's 1st solar farm with an integrated rainwater harvesting system officially opened in Tuas
Sep-22	Keppel Infrastructure	CCUS	MOU	Air Liquide, Chevron & PetroChina consortium to evaluate & advance development of large-scale CCUS solutions & integrated infrastructure in Singapore.

Highlighted Companies

Sembcorp:
Net zero by 2050

Leading energy & urban development company

- 3300 MW of renewable energy capacity comprising solar, wind & energy storage globally
- Entered strategic partnerships with Japanese government & various corporations to progress hydrogen & other decarbonisation initiatives

JTC:

Government agency championing sustainable industrial development

- Dec 2022: launched tender to install solar panels on 60ha of temporary vacant land & rooftops on the backdrop of Sun Cable's collapse
- Boost total solar energy capacity on Jurong Island from 12.3 to 103.2 megawatt-peak (MWp)

Source: MUFG compiled from City Energy, MHI, Sembcorp, The Edge, The Straits Times and various public sources

South Korea Energy Transition

Centre of development for renewables and hydrogen while exporting its clean energy technology and innovation

South Korea's Key Targets

NDC:

40%

Emission Reduction by 2030

Renewable Energy Target:

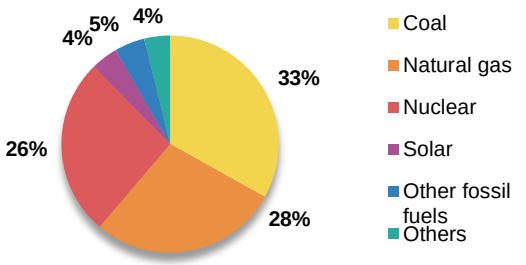
22%

by 2030

2050

Net Zero Target

South Korea's Power Mix



Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. Green New Deal:

Introduced as **73.4 trillion won Covid-19 recovery package** in July 2020 to strengthen green economy

- Promote low-carbon decentralized economy via **green transition of infrastructure**
  - ✓ Install RE equipment & high-performance insulation in 225,000 public rental housings
  - ✓ Build smart grid for more **efficient energy management** with outreach of 5 million apartments
  - ✓ Promote distributed energy production & eco-friendly vehicles by expanding supply of electric/ H_2 vehicles
- Innovation in green industries
  - ✓ Create ~215 billion won worth of public-private joint funds to grow green businesses
  - ✓ Harnessing digitalisation to foster energy transition e.g. smart working/low-carbon industrial complexes

2. 10th Basic Plan for Electricity Supply and Demand (2022-2036):

Target: increase share of electricity from renewable sources from 7.5% in 2021 to 30.6% in 2036

Shut down 26 coal plants by 2036

Increase share of **nuclear energy** in power mix from 27.4% in 2021 to 34.6% by 2036 to **support coal phase-out to <15%**

3. Renewable Portfolio Standards (RPS):

- Primary driver of renewables' installation in Korea as replacement of feed-in tariff program
- **Large-scale power generators** to procure 12.5% of electricity from renewable sources (2022) - annual governmental mandate to be **raised to 25% by 2030**

4. National Hydrogen Roadmap:

Scale up hydrogen demand in transportation, power generation & industrial sectors

- High-mobility ecosystem
  - Produce 30,000 H_2 commercial vehicles by 2030
  - Build 70 liquid H_2-refuelling stations by 2030
- Distribution infrastructure for clean hydrogen
  - Establish H_2 power generation bidding market by end 2023
  - Introduce clean H_2 certification system by 2024
- Target to build world's largest liquid H_2 plant
- Secure core technologies across entire H_2 value chain e.g. water electrolysis, liquid H_2 carriers, trailers, H_2 turbines

Source: MUFG compiled from Argus Media, BNEF, IEA and various public sources

South Korea | Market Activity

Date	Countries / Developers	Energy Type	Project Type	Project Details
Selected Japanese Corporations				
Jul-22	Itochu Corporation, Lotte Chemical	Hydrogen	MOU	Collaboration in H_2 & ammonia business areas, seek to secure competitive decarbonized fuels through joint procurement & optimization of logistics
Oct-22	Sumitomo Corp, Lotte Chemical			Jointly explore business development opportunities related to H_2 & ammonia e.g. joint investments in Australia, Chile, establishment of value chains & development of ammonia storage terminals in Japan/ Korea
Feb-23	Mitsubishi Corporation, Lotte Chemical, RWE	Ammonia	-	Formed strategic alliance to jointly develop stable large-scale clean ammonia (green & blue) supply chains in Asia, Europe & the US
Selected Local Corporations				
Jul-21	Lotte Chemical	Hydrogen	-	Investing 4.4 trillion won ($3.8 billion) in H_2 projects by 2030, build 50 liquid H_2 charging stations by 2025 & increase number of H_2 fueling stations to 200 by 2030
Jun-22	LG Energy Solution			Plans to build H_2 plant in South Korea to produce 50,000 tonnes of H_2 annually by 2Q 2024.
	Lotte Chemical, Air Liquide Korea, SK Gas		JV	Build a H_2 fuel cell power plant in Ulsan
Aug-22	Korea Gas Corp, Matrix Service Co.		MOU	Support South Korea's development of a H_2 economy as it transforms itself from a natural gas supplier to H_2 platform operator
Sep-22	Samsung Electronics	-	-	Invest 7 trillion won in green initiatives & lobby South Korea's clean energy push including spending on CCS & boost product energy efficiency
	POSCO, Greenko	-	MOU	Cooperation in green H_2/ammonia business, where Greenko could contribute by supplying green power

Highlighted Companies

LOTTE Chemical:
Net zero by 2040

Korea's leading chemical company

- Target: invest 6 trillion won ($4.3 billion) by 2030 to produce 1.2 million tons of clean H_2 a year
- Achieve annual revenue of 5 trillion won ($3.6 billion) from its H_2 & ammonia business

POSCO:
Net zero by 2050

Large Asian steel company

- Establish 5 million-ton H_2 production system by 2050
- Aim to expand production of blue & green H_2 by 2026
- Developed **world's first steel product** for H_2 fuel cell separators

Source: MUFG compiled from Argus Media, ITOCHU, LG, Posco and various public sources

Taiwan Energy Transition

Wind energy at the crux of its renewables' expansion strategy supported by LNG

Taiwan's Key Targets

NDC:

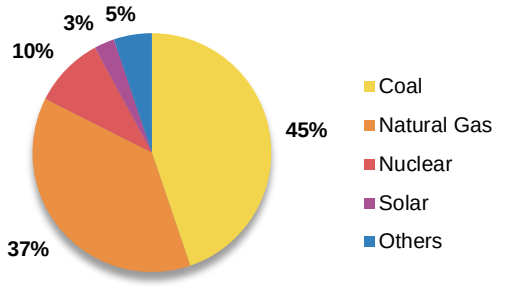
23 – 25%
Emission Reduction by 2030

Renewable Energy Target:

22%
by 2025

2050
Net Zero Target

Taiwan's Power Mix



Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. Energy Transition Promotion Scheme, Ministry of Economic Affairs(MOEA):

Wind Energy:
- "Thousand Wind Turbines" Project Target: 5.6 GW by 2025
- Offshore wind capacity target: 10GW by 2035

Solar installation:
20GW by 2025 (8GW rooftop solar, 12GW on the ground)

LNG earmarked as transition fuel:
- Gradually increase required storage capacity & security stockpile of natural gas till 2027
- Convert coal-fired boilers to natural gas-fired boilers

Decommissioning of coal:
No new coal-fired power plants to be built from 2025

Nuclear power:
Phase-out by 2025

Feed-in-tariffs:
- Reviewed FIT rates in 2022 for renewables
- Priced higher FITs for small-scale hydro & geothermal

2. 5+2 Industrial Innovation Policy (Tsai Ing-Wen administration):

- Revive Taiwan's **technological expertise** as early powerhouse in **solar cell & LED manufacturing**
- **Export solar panels** for stable renewable energy supply in the region through manufacturing sites abroad
- Circular economy: foster large-scale energy resource recycling centers, promote international cooperation, establish cross-sector cooperation platforms
- Build **dedicated research institute** for Green Energy in Tainan, falling under supervision of both MOEA & Ministry of Science & Technology

Source: MUFG compiled from MOEA, TWTPO and various public sources

Taiwan | Market Activity

Date	Developers	Energy Type	Project Type	Project Details
Selected Japanese Corporations				
Feb-20	Marubeni Corporation	Solar	Acquisition	Acquired Chenya Energy Co., Ltd, a local solar project developer with 270 MW solar generation facilities
Mar-22	Mitsui O.S.K. Lines ("MOL"), Toho Gas, Hokuriku Electric Power Company	Wind		Agreed to acquire a 25% stake in Formosa I International Investment (128 MW) from Macquarie's Green Investment Group to participate in Taiwan's offshore wind power business
NA	JERA		-	Formosa I,II,III Offshore Wind IPP Project (I in operation, II under construction, III in bidding process)
Nov-22	Mitsubishi Heavy Industries, Taiwan Power Company (TPC)	Ammonia co-firing	MOU	Conduct study on introducing ammonia co-firing at Linkou Thermal Power Plant in New Taipei
Selected Local Corporations				
Oct-21	Cathay Life Insurance Co	Solar	JV	JV with Solar Master Energy Co Ltd & San Ching Engineering Co to invest in ground mounted solar (100 MW) with aim to double its solar energy investments to >NT 20 billion (USD 716.8 million)/400 MW by 2025
Apr-22	Hon Hai Precision Industry Co., Ltd	-	-	Plans to purchase 70,000 MWh of renewable energy by 2030
Sep-22	Taiwan Semiconductor Manufacturing Company (TSMC)			Pledges to use 100% renewable energy by 2050. Purchased 1,200 MW wind farm from Wpd AG, engaged in renewable energy PPA & certification purchases

Highlighted Company

Taiwan Power Company (Taipower) :
Net zero by 2050

State-owned electric power company

Target: Helps to implement the government's energy transition strategy

- Vision of "non-nuclear homeland" and 20% renewables in power mix by 2025

Source: MUFG compiled from Mitsubishi Power, Nikkei Asia, Offshore Wind, Taipei times and various public sources

Thailand Energy Transition

Three-pronged approach: decentralization, digitalization, electrification adopting a bio-circular green economy model for clean energy excellence

Thailand's Key Targets

NDC:

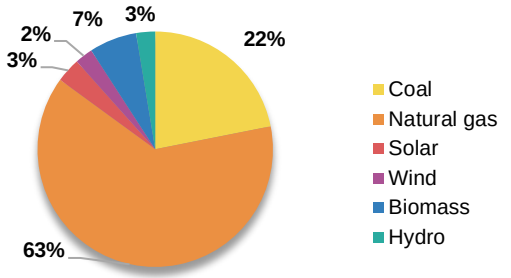
30%
Emission Reduction by 2030

Renewable Energy Target:

30%
by 2037

2065
Net Zero Target

Thailand's Power Mix



Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. Power Development Plan (PDP), and Alternative Energy Development Plan(AEDP):

Target: Increase proportion of **renewable & alternative energy** in the form of **electricity, heat & biofuels** by 30% in 2037

Target: **8,740 MW by 2037**
- Solar booster program: 5 GW new solar projects/year till 2030

Oct 2022: Energy Regulatory Commission introduced 25-year Feed-In-Tariffs of THB 2.1679/kWh for solar & THB 2.8331/kWh for solar + storage

Target: **2,780 MW by 2037**
- Additional biomass/biogas power plants to be constructed reaching combined generation of 106.9 MW
- THB 265m to support farming of energy crops in 2023-2024
- Thailand is major producer of **rice, sugar cane & cassava**

Target: **1,485 MW by 2037**
- More investment opportunities in wind expected following EGAT
- Build necessary transmission lines for small power producers
- Wind Energy Holding (WEH), Thailand's largest wind power developer & operator aims to double its generation capacity to 1,500 MW within 5 years

2. 20-year Smart Grid master plan:

- EGAT, Metropolitan Electricity Authority (MEA) & Provincial Electricity Authority (PEA) have been piloting technologies like smart metering, energy storage systems
- Decarbonization of power supply factoring in cost-optimization constraints

3. Electricity market:

Liberalization of electricity market
- Shifting from enhanced singer buyer model to open market
- New RE Quota Regulations, Sep 2022:
  - ✓ Government started accepting bids from Nov 2022 to purchase power generated from RE sources between 2024-2030
  - ✓ **Foreign participation of up to 49%** allowed for such bids

Sandboxes for decarbonization:
- Collaboration between startups & leading Thai corporations like PTT
- Energy Regulatory Commission launched regulatory sandboxes to encourage P2P electricity trading

Source: MUFG compiled from Bangkok Post, EGAT, LTDS, Trade.gov and various public sources

Thailand | Market Activity

Date	Countries / Developers	Energy Type	Project Type	Project Details
Government				
Jan-22	Thailand, Japan	-	MOU	METI & Ministry of Energy to conduct regular discussions & operation of joint projects on support for energy transition roadmap development
Jun-22	Thailand, Switzerland	Carbon credits	-	Bilateral carbon offsetting agreement to carry out projects in Thailand to reduce CO_2 emissions
Selected Japanese Corporations				
Feb-22	Shizen Energy, Constant Energy	Solar	-	Long-term PPA for 1,169 kWp solar rooftop operation - one of the largest project finance agreements for a C&I (Commercial & Industrial) project in Thailand
Apr-22	Inpex Corporation, JGC Holdings Corporation, PTT Exploration & Production Public Company Limited	CCS	MOU	Study potential development of CCS solutions for industries including oil & gas, hard-to-abate & power generation
Sep-22	Mitsubishi Corporation, Chiyoda, EGAT	-		Exchange information & ideas relating to clean energy development & related technologies such as CCUS
Nov-22	MHI, EGAT	CCS, Hydrogen		Study & exchange information relating to clean power generation, H_2, CCUS technologies
Dec-22	JERA, EGCO	Ammonia co-firing		Assessing feasibility of ammonia co-firing at coal-fired power plant in which EGCO Group owns 50% shares
Selected Local Corporations				
Sep-22	PTT Oil and Retail Business Plc, Toyota Motor Corporation. Bangkok Industrial Gas Co	Hydrogen	-	PTT Plc co-launched Thailand's first H_2 filling station in Pattaya to serve trucks and buses to help government fight global warming
Nov-22	Sungrow, Provincial Electricity Authority of Thailand (PEA)		MOU	Diversified & profound cooperation space in energy storage, green H_2, green bonds & blockchains

Highlighted Companies

PTT Exploration and Production:
Net zero by 2050

Large national petroleum exploration and production company

- Renewable Energy: plans to increase electricity generation to 4.3 GW by 2025 & 8 GW by 2030
- Featured development to be the **first in Thailand to reduce GHG emissions via CCS technology**
- Massive Carbon Removal forest project to absorb >2 $MMTCO_2$ by 2050

Electricity Generating Authority of Thailand:
Net zero by 2050

State-owned enterprise for electricity generation

- Triple S Strategy for energy transition announced in Aug 2022:
  1. Source transformation: upgrade power generation & transmission with advanced innovations/technologies e.g. BESS, energy management systems
  2. CO_2 sink co-creation
  3. Support measures mechanism: energy-saving initiatives for the public

Source: MUFG compiled from AGGPM, Argus Media, Grow your business, JGC, Marubeni, Pertamina, Setkab, The Straits Times, Voi and various public sources

Vietnam Energy Transition

Striking a balance between fossil fuels and renewables amidst ongoing challenges of national grid capacity

Vietnam's Key Targets

NDC:

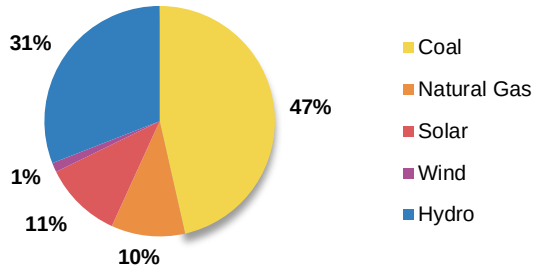
15.8 – 43.5%
Emission Reduction by 2030

Renewable Energy Target:

33%
by 2030

2050
Net Zero Target

Vietnam's Power Mix



Source: Power Mix, Bloomberg New Energy Finance (2021)

Energy Transition Policies & Key Developments

1. Power Development Plan VIII (PDP8) - to be finalized early 2023

- Further development of wind power following PDPVII's approval of 188 projects
- 2030 onshore wind power capacity target: 21,480 MW
- 2030 offshore wind power capacity target: 7,000 MW

- LNG as Vietnam's **baseload fuel** driving both economic expansion & phased energy transition
- Addition of 5 new LNG projects with total capacity of 6,600 MW in the North

- Prohibit development of new coal-fired power plants by 2030 & LNG plants by 2035

- Phase out the operation of existing coal-fired thermal power plants by 2050

2. Renewable Energy policy landscape:

- **High fixed feed-in-tariffs (FITs)** proven successful incentives-wise till 2021 from financial standpoint
- Excess boom in solar(and wind)
- Outstripped/strained capacity of national grid
- Cost-ineffective

- Urgent push to expand & modernize Vietnam's power grid/transmission infrastructure
- Strive to improve grid flexibility with batteries & energy storage systems
- Alleviate grid bottlenecks by taking the opportunity to mainstream automation & digitalization

3. Premise for Transition Finance

Just Energy Transition Partnership (JETP), Nov 2022:

- Led by USA & Japan on behalf of G7 and International Partnership Group
- US$15.5 bn package(US$7.75 bn in public funding + US$7.75 bn from private sector investors)
- Help fund Vietnam's shift to renewable energy from coal

Source: MUFG compiled from Argus Media, China dialogue, EVN, Nishimura & Asahi, UNDP, World Bank and various public sources

Vietnam | Market Activity

Date	Countries / Developers	Energy Type	Project Type	Project Details
Government				
Nov-21	Vietnam, Japan	-	MOU	Joint statement for cooperation in energy transition towards carbon neutrality e.g. supported Japanese companies in promoting investment in energy projects
Oct-22	Vietnam, Singapore			Development & financing of renewable energy, deployment of low-carbon technologies/solutions(H_2, ammonia, energy storage systems, smart grids related infrastructure, energy efficiency)
Selected Japanese Corporations				
Sep-21	Mitsubishi Corporation	Wind	JV	1st cross-border electricity interchange from wind power generation - 600MW project to deliver electricity to Vietnam from Laos
Oct-21	Osaka Gas, Sojitz	Solar		Formed SOL Energy to do rooftop solar projects in industrial & commercial areas
Dec-21	Marubeni, Ajinomoto Vietnam Co., Ltd.		-	Corporate PPA to supply electricity generated by a rooftop solar PV system
Feb-22	JERA, ExxonMobil	LNG	-	4.5 GW power plant & LNG import facilities to handle 6 million tonnes/year of LNG, potentially generating one of the largest outputs in SEA from 2026
Selected Local Corporations				
Mar-22	The Green Solutions, Black & Veatch	Hydrogen	MOU	Target to produce 180,000 tonnes of green ammonia & 30,000 tonnes of green H_2/ year to advance production & supply in Vietnam to support regional decarbonization efforts
Jun-22	TGS Green Hydrogen		-	To build Vietnam's 1st H_2 plant worth US$840 million, expected to generate ~24,000 tons of H_2 & 150,000 tons of ammonia annually

Highlighted Companies

Vietnam Electricity(EVN):

Large state-owned electricity company

- Full capacity & advantages in **offshore wind power development & renewable energy projects**
- Expertise & human resources in designing, manufacturing & operating sea-based works to engage in supply chain development of offshore wind power projects

Petrovietnam:

Large state-owned oil & gas enterprise

- Electricity buyer for the state
- Following draft PDPVIII, EVN to explore technologies like **smart grids, storage systems, power grid upgrading**
- Proposed mechanism by Vietnam Initiative for the Energy Transition for EVN to individually negotiate rates for each RE project especially for those who missed the FITs

Source: MUFG compiled from Energy Voice, Mitsubishi Corp, Osaka Gas, The Straits Times and various public sources

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