Unlocking ASEAN

Low Carbon Opportunities for North East Scotland Energy Supply Chain Companies

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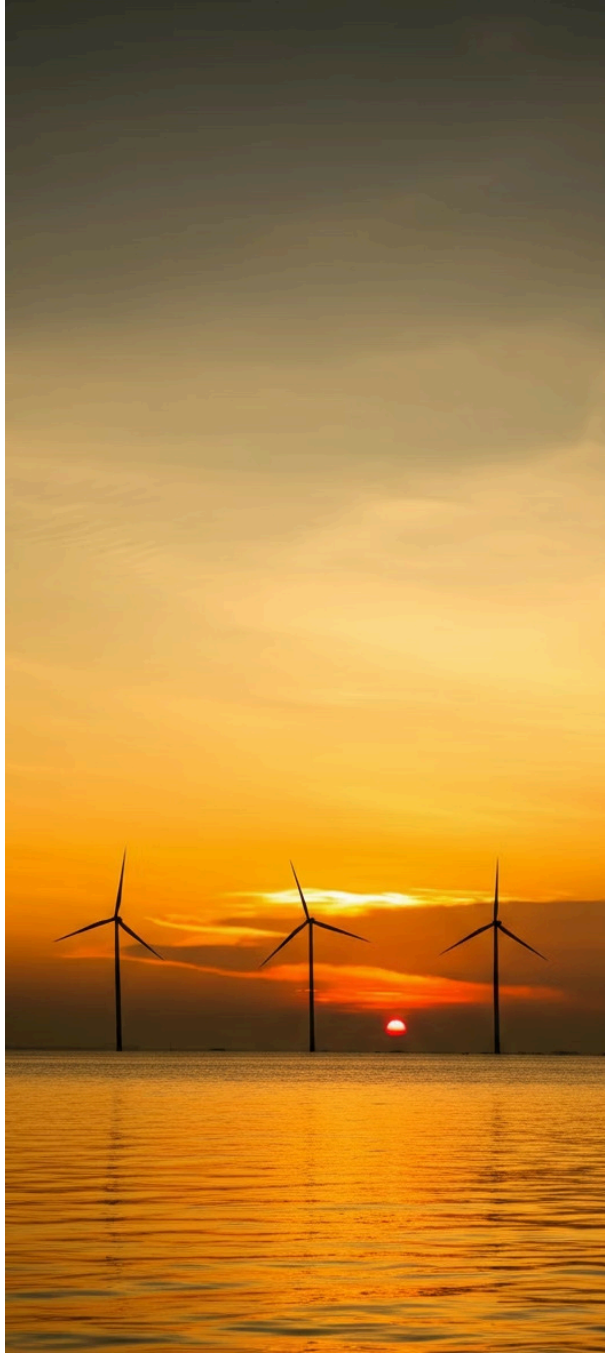
by Dr Jim Hamill



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Executive Summary

Market Opportunity

The ASEAN region represents one of the most significant low carbon energy market opportunities globally with a projected investment requirement of USD 3.7-6.7 trillion to achieve carbon neutrality by 2050. Significant opportunities exist across all low carbon sectors including offshore wind, CCUS, green hydrogen, solar energy, wave and tidal, hydropower, clean energy and decommissioning. Over 40 GW of renewable energy projects are in development.

Key Project Analysis

A Key Project Analysis highlights 20 major low carbon energy projects spanning the complete development lifecycle from early-stage feasibility studies through front-end engineering design (FEED), engineering, procurement, and construction (EPC), and operational phases.

Industry at a Critical Juncture

While ambitious targets for energy capacity have been agreed, the industry stands at a critical juncture. A detailed gap analysis reveals a complex landscape where surging demand for clean energy infrastructure encounters systematic bottlenecks across manufacturing, logistics, workforce, and technical services.

Technology Transfer Opportunities

These gaps create substantial opportunities for technology transfer and commercial partnerships with established energy hubs. Possessing world-leading capabilities and expertise, North East Scotland energy supply chain companies are uniquely equipped to help accelerate ASEAN's low carbon transition.

The ASEAN Energy Transition Context

- [ ] Regional Economic Overview
- [ ] Energy Demand Projections
- [ ] ASEAN Strategy for Carbon Neutrality
- [ ] Investment Climate and Foreign Direct Investment

Regional Economic Overview

The ASEAN region encompasses 10 member states (Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam) with a combined population of **680 million people** and a regional GDP exceeding **USD 3.2 trillion**. The region's economic growth trajectory remains robust, with average GDP growth projected at 4.7% over the next five years, driven by sustained industrialisation, urbanisation, and domestic consumption growth. Indonesia and Vietnam lead regional expansion, while Singapore serves as the financial and technology hub for Southeast Asia.

Energy Demand Projections

Energy demand across ASEAN is projected to grow substantially, with electricity consumption expected to increase by approximately **80% between 2022 and 2050**; deriving from three primary drivers - rapidly rising GDP per capita as middle classes expand across the region, population growth concentrated in urban centres, and industrialisation particularly in manufacturing-intensive sectors. The region currently accounts for approximately 7% of global energy demand but is projected to grow to 10-12% by 2050, positioning ASEAN as a critical market for global energy infrastructure development and technology deployment.

ASEAN Strategy for Carbon Neutrality

The updated 2025 Nationally Determined Contributions (NDCs) demonstrate enhanced ambition across most ASEAN countries, with notable improvements including shifts to absolute emissions targets, earlier peak emission commitments, and accelerated net-zero timelines - see Exhibit 1 below. However, significant gaps remain between current commitments and what would be required to align with the Paris Agreement's 1.5°C pathway. International support through climate finance, technology transfer, and capacity building remains crucial for the region to achieve its climate goals. With estimates suggesting that ASEAN's Strategy for Carbon Neutrality could generate USD 3 to 5.3 trillion in GDP and 66 million jobs by 2050, the region's climate transition presents significant economic potential for international company's across the supply chain.

Investment Climate and Foreign Direct Investment

ASEAN attracted **USD 224 billion** in FDI in 2022, with a growing share directed toward renewable energy and clean technology. Despite accounting for only 2% of global clean energy investment, the region is poised for rapid growth. While foreign ownership regulations and political risks vary, initiatives to streamline approvals are spreading in Singapore, Malaysia, and Vietnam.

Exhibit 1: National Climate Commitments and Net-Zero Targets

1

Brunei Darussalam

Net-Zero Target: 2050

NDC 3.0 (2025): Brunei has committed to reducing greenhouse gas emissions by **20% relative to Business-As-Usual (BAU) levels by 2035**, using 2015 as the baseline year. This maintains the same ambition level as its previous 2030 target but extends the timeframe. The commitment is delivered through ten strategic approaches outlined in the Brunei Darussalam National Climate Change Policy, including reducing industrial emissions, increasing forest cover, promoting electric vehicles (targeting 60% of total annual vehicle sales by 2035), and improving power management.

2

Cambodia

Net-Zero Target: Carbon neutrality by 2050

NDC 3.0 (2025): Submitted in August 2025, Cambodia's third NDC represents a major increase in ambition. The country commits to an economy-wide GHG reduction target of **55% by 2035 compared to BAU** (equivalent to approximately 73.7 $MtCO_2e$) under the conditional scenario, and **16% unconditionally** (approximately 21.7 $MtCO_2e$). This marks the first time Cambodia has specified an unconditional target, demonstrating dedicated domestic commitment.

Key sectoral targets include achieving **72% renewable energy share in installed capacity by 2035** (up to 80% with external support), 60% efficient and clean cookstove adoption by 2035, halving deforestation and expanding forest cover by 2030, and 59% GHG emissions reduction in the waste sector. The total estimated cost for implementation is USD 32.2 billion for 2026-2035.

3

Indonesia

Net-Zero Target: 2060 or sooner

Second NDC (2025): Indonesia submitted its Second Nationally Determined Contribution (SNDC) in October 2025, marking an important shift to absolute emissions targets. The plan projects that national greenhouse gas emissions will **peak by 2030**, with emissions declining to an absolute level between **1.26 and 1.49 $GtCO_2e$ by 2035**. This represents a significant methodological improvement, moving away from the previous business-as-usual baseline approach.

Under the high-growth scenario (8% annual economic growth), Indonesia's emissions are projected to be roughly 30% higher in 2035 than 2019 levels, which climate analysts note is insufficient to meet the 1.5°C pathway that would require a 21% reduction by 2035. The SNDC covers five key sectors: Energy, Industrial Processes and Product Use (IPPU), Waste, Agriculture, and Forestry & Other Land Use (FOLU).

Notably, President Prabowo Subianto has made more ambitious verbal commitments, including achieving 100% renewable energy by 2035 and phasing out coal within 15 years, though these are not yet reflected in the formal SNDC.

4

Lao PDR

Net-Zero Target: 2050

NDC 3.0 (In Development): Lao PDR kicked off the process of preparing NDC 3.0 in February 2025. In its current NDC 2.0, the country has set an **unconditional emissions reduction target of 60% by 2030** compared to a 2020 baseline scenario, with additional conditional targets covering land use, agriculture, waste, and energy. These targets serve as stepping stones toward achieving carbon neutrality by 2050.

Despite being a minor contributor to global GHG emissions, Lao PDR plans to raise its ambitions further in NDC 3.0, with financial and technical support crucial for achieving revised targets.

5

Malaysia

Net-Zero Target: 2050

NDC 3.0 (2025): Malaysia published its updated NDC 3.0 in October 2025, representing a major advancement in climate ambition. The country has committed to **peaking GHG emissions no later than 2034, with the intention to peak earlier by 2029 or 2030**. By 2035, Malaysia aims for an **economy-wide absolute emissions reduction of 15–30 $MtCO_2eq$** from the peak level.

This comprises an **unconditional reduction of up to 20 $MtCO_2eq$**, with a further **10 $MtCO_2eq$ reduction conditional** upon the provision of climate finance, technology transfer, and capacity-building support from international sources. The NDC 3.0 represents a significant shift from the previous carbon intensity target (45% reduction in carbon intensity against GDP by 2030 compared to 2005 levels) to an absolute emissions reduction target.

As ASEAN Chair for 2025, Malaysia is leading regional cooperation through initiatives such as the ASEAN Power Grid, which facilitates cross-border renewable energy trade.

6

Myanmar

Net-Zero Target: Net-zero emissions from Land Use, Land Use Change and Forestry (LULUCF) by 2040.

NDC: Myanmar is committed to contributing to an **unconditional reduction of emissions of 244.52 million tCO_2e**, and a total of **414.75 million tCO_2e** subject to international financial conditions and technical support by 2030. The country's mitigation targets mainly cover the Forestry, Electricity, and Rural Renewable Energy sectors. Myanmar envisions that by 2030, the country can achieve climate-resilience and pursue a low-carbon growth pathway to support inclusive and sustainable development.

7

Philippines

Net-Zero Target: No formal net-zero target.

NDC: The Philippines is the only Southeast Asian country without a formal net-zero target. However, the country has committed to a projected greenhouse gas emissions **reduction and avoidance of 75% by 2030** (of which 2.71% is unconditional) for the period 2020 to 2030, covering the sectors of agriculture, wastes, industry, transport, and energy.

The Philippines has set targets to increase the share of renewable energy in the power mix to **35% by 2030 and 50% by 2040**. Energy Secretary Sharon Garin has stated that the country sees no need for a net zero pledge, instead focusing on national targets and allowing the highly-privatized power sector to drive achievement of climate and energy targets.

8

Singapore

Net-Zero Target: 2050

NDC 3.0 (2025): Singapore announced its second NDC in February 2025, committing to reduce emissions to **between 45 and 50 $MtCO_2e$ by 2035**. This builds on the 2030 NDC to reduce emissions to around 60 $MtCO_2e$ by 2030 after peaking emissions earlier. The 2035 target represents a significant step forward, demonstrating a continued decline in emissions toward the net-zero by 2050 goal.

Singapore's NDC is an economy-wide absolute GHG emissions reduction target covering key sectors including Energy, Industrial Processes and Product Use, Agriculture, Land Use, Land-Use Change and Forestry (LULUCF), and Waste. Singapore has also been actively signing Article 6.2 implementation agreements with multiple countries to facilitate carbon credit trading, with nine agreements executed as of September 2025.

9

Thailand

Net-Zero Target: Carbon neutrality by 2050; Net-zero GHG emissions by 2065.

NDC 3.0 (2025): Thailand's Cabinet approved NDC 3.0 in November 2025, marking a significant acceleration of climate ambition. The updated commitment sets a target to reduce net greenhouse gas emissions to **no more than 152 million tons of CO_2 equivalent ($MtCO_2eq$) by 2035**, representing a **47% reduction from the 2019 baseline**.

Crucially, Thailand has **accelerated its path to Net Zero by 15 years, shifting the target from 2065 to 2050**. This ambitious revision aligns Thailand with global standards including the European Union, Japan, and Vietnam. The plan targets emission reductions across five main sectors, with implementation relying on 70% domestic capacity and 30% support from international technical and financial resources. Thailand aims to attract approximately THB230 billion (about USD 6.7 billion) in foreign investment to help reduce emissions by 32.8 $MtCO_2eq$ under the Paris Agreement framework.

10

Vietnam

Net-Zero Target: 2050

NDC (Updated 2022, NDC 3.0 in Development): Vietnam's updated NDC from 2022 commits to an **unconditional emission reduction target of 15.8%** and a **conditional target of 43.5% by 2030** compared to the business-as-usual scenario with a 2014 base year. These targets represent increased ambition compared to the previous NDC, which had targets of 9% and 27% reduction respectively.

Under the National Climate Change Strategy, Vietnam aims to set a cap on total emissions of 185 $MtCO_2e$ in 2050. Vietnam is currently developing NDC 3.0 for the 2026-2035 period, which will focus on measures that fully reflect the country's climate change response needs. The 2025 update of Power Development Plan 8 (PDP8) strengthens coal phase-out commitments, scales up solar and offshore wind, and sets long-term renewable capacity targets of 65–70% by 2050.

11

Timor-Leste

Net-Zero Target: Timor-Leste has not announced a specific net-zero target date but is working toward low-carbon development.

NDC (Updated 2022): Timor-Leste submitted its revised and enhanced NDC covering the period 2022-2030. As a Least Developed Country and small island developing state, the NDC focuses on climate-safe transition and reducing the potential for climate change impacts to disrupt the country's development ambitions. The NDC includes commitments to scale up investment in renewable energy systems to reduce diesel consumption and improve the resilience of rural communities.

Key initiatives include developing a climate change law (committed for 2023-24), formulating a National Climate Change Strategy and Action Plan, accelerating land tenure reform over the 2021-2025 period, and introducing a low carbon development strategy. Timor-Leste has also been receiving support through projects like the UNDP-led initiative targeting enhanced resilience to climate change impacts for national and sub-national institutions and communities.

ASEAN Energy Transition Challenges

- [ ] A Critical Juncture
- [ ] Key Barriers

A Crtical Juncture

The renewable energy sector in the ASEAN region stands at a critical juncture, with significant supply chain constraints confronting ambitious targets of tripling capacity by 2030.

- The imperative for rapid renewable energy deployment in the region is clear. However, gaps in investment, infrastructure, policy frameworks, and technical capacity will need to be addressed before regional and national targets can be achieved.
- The gap analysis shown below reveals a complex landscape where surging demand for clean energy infrastructure encounters systematic bottlenecks across manufacturing, logistics, workforce, and technical services combined with fundamental challenges in equipment procurement, skilled labour availability, grid integration capacity, and specialised service provision.
- These gaps create substantial opportunities for technology transfer and commercial partnerships with established energy hubs possessing world-leading capabilities in floating offshore wind, subsea engineering, and decommissioning expertise.
- Successful energy tranisition in the region will depend on unprecedented levels of capital mobilisation, estimated at $180 billion annually, alongside policy reforms that create enabling environments for private investment, regional grid integration that leverages complementary resources across borders, and technology innovation spanning mature solutions like solar and wind to emerging technologies including green hydrogen, CCUS, and marine energy.

Exhibit 2: Key Barriers to ASEAN Energy Transition

As market demand and climate imperatives increase pressure for rapid action the barriers listed below will hinder ASEAN's ability to scale up low carbon energy quickly and cost-effectively.

Import Dependency

Key equipment such as wind turbines, floating wind platforms, transformers, and advanced batteries must be imported

Long Procurement Lead Times

Supply chain bottlenecks, especially for transformers and offshore wind components

Insufficient Manufacturing Capacity

Advanced technologies like floating wind, subsea systems, large-scale batteries, and hydrogen infrastructure

Limited Skilled Workforce

Shortages of engineers, offshore technicians, grid operators, and O&M specialists, with significant migration to higher-income countries

Fragmented Logistics and Port Infrastructure

Very few ports able to handle offshore wind and heavy equipment needs

Weak Service and Maintenance Networks

Particularly for operations & maintenance, decommissioning, and specialised engineering services

Grid Integration Challenges

Transmission congestion, poor grid flexibility, lack of interconnections, and underdeveloped market frameworks

Lack of Unified Technical Standards

Inconsistent quality assurance for renewable energy equipment, resulting in reduced investor confidence

Limited R&D Capacity

In renewables, grid management, and new energy technologies like hydrogen and next-gen storage

Policy and Regulatory Uncertainty

Unclear decommissioning obligations, local content requirements misaligned with capabilities, and slow permitting processes

Under-Investment in Infrastructure

Transmission systems, test facilities, and regional supply chain coordination remain inadequate relative to ambitious targets

North East Scotland's Unique Competitive Position

North East Scotland's energy supply chain companies are uniquely equipped to help accelerate ASEAN's low carbon transition. Our world class blend of advanced technology, supply chain depth, global experience, and collaborative models are essential for rapidly closing ASEAN's renewable energy gap, building resilient clean energy systems for the future.

Exhibit 3: Core Competitive Strengths

World-Leading Floating Offshore Wind Expertise

World-class expertise and industrial capacity in floating offshore wind, with proven commercial deployment

Unmatched Subsea Engineering Capability

The North East is the global centre for subsea engineering, with 75% of the world's subsea capability, giving it the technical depth to address ASEAN's subsea and deepwater challenges

End-to-End Decommissioning Excellence

The region offers integrated, cost-effective decommissioning services, with Europe's largest and most advanced port facilities and decades of experience dismantling offshore assets

Integrated Supply Chain and Port Infrastructure

With more than 700 specialist suppliers, sophisticated logistics support, and modern ports like Aberdeen Harbour, the region delivers full project lifecycle solutions at industrial scale

Successful Technology Transfer and Training Models

North East Scotland companies have helped other regions (e.g. Taiwan) build local skills, clusters, and technology adoption, offering scalable models for ASEAN workforce and supply chain upskilling

Proven Innovation and R&D Track Record

The region leads in cost reduction, mooring systems, floating foundation design, and supply chain efficiency, helping accelerate the commercialisation of next-generation renewables

Experience with Regulatory and Policy Frameworks

Scottish companies have navigated complex consenting, safety, and local content regulations—this knowhow helps ASEAN countries design effective policy frameworks and avoid implementation pitfalls

Project Management and Operational Best Practices

Decades of delivering large, complex offshore wind, oil & gas, and infrastructure projects equip North East Scotland firms with the skills to manage risk, quality, cost, and local content

Established Global Export and Partnership Networks

Many companies already export technology and services to Asia and are experienced in JV, licensing, and partnership approaches suitable for building regional capability

ASEAN Opportunity Analysis By Country

Indonesia	Malaysia	Vietnam
Singapore	Thailand	Philippines
Brunei	Cambodia, Laos & Myanmar	Corss-Cutting Opportunities

Exhibit 4: Country Screening

1

Indonesia

Offshore Decommissioning represents the most immediate and substantial opportunity, with **630+ offshore platforms** requiring decommissioning work, of which 107 are no longer in use. With 85% of the region's 1,750+ platforms located in Indonesia and Malaysia, the decommissioning market is valued at **$100 billion through 2030**. North East Scotland's North Sea decommissioning expertise is highly sought after, particularly for "rig-to-reef" conversion projects.

CCUS Hub Development positions Indonesia as an aspiring international carbon storage hub, targeting facilities that could store CO2 from Japan, South Korea, China, Taiwan, and Singapore. Indonesia possesses **69 gigatonnes of CO2 storage capacity** in saline aquifers and 10.14 Gt in depleted petroleum reservoirs. Aberdeen's Acorn CCS project experience is directly transferable to Indonesian hub initiatives.

Green Hydrogen & Ammonia Production opportunities are substantial, with Indonesia having **7.8 million tonnes per year of ammonia production capacity** and being the region's largest ammonia exporter. The transition from high-carbon to low-carbon hydrogen production creates demand for electrolyzer equipment, renewable energy integration, and engineering services.

Offshore Wind Supply Chain includes foundation and tower manufacturing capabilities that can be scaled to meet the **42 GW renewable energy expansion** target. North East Scotland companies can provide subsea cable expertise, installation vessel support, and turbine component manufacturing.

2

Malaysia

CCUS Leadership is evident through Malaysia's ambitious **three-hub strategy targeting 15-80 Mtpa storage capacity by 2050**. The Kasawari, Lang Lebah, and BIGST projects create opportunities for engineering consultancy (FEED), EPC services, and operations & maintenance contracts. The CCUS Act 2025 provides regulatory clarity for foreign investment.

Offshore Decommissioning market comprises **300+ platforms, with 40% over 30 years old**. PETRONAS plans to invest **$2 billion in decommissioning** over the coming decade, including plugging 153 wells and abandoning 37 offshore facilities. Scottish expertise in well abandonment, platform dismantling, and environmental restoration is highly valued.

Offshore Wind Corridor includes the **Malaysia-Singapore-Vietnam project delivering 2,000 MW by 2034**, with 700 MW for domestic consumption and 1,300 MW for export. This requires subsea cable infrastructure, offshore substations, and grid reinforcement expertise where Scottish companies excel.

Green Hydrogen Hub Development in Sarawak targets **240,000 tonnes annual production capacity**. Opportunities span electrolyzer supply, hydrogen storage infrastructure, and integration with offshore wind for green hydrogen production.

Floating Solar through the **2 GW Large Scale Solar (LSS) programme** and reservoir-based installations creates demand for floating platform technology, where Scottish marine engineering expertise can be adapted.

3

Vietnam

Offshore Wind Dominance presents exceptional opportunities with a **72 GW pipeline by 2050**, including 6 GW targeted by 2030. Vietnam's offshore wind potential is world-class due to high wind speeds and favorable seabed conditions. Scottish companies can provide:

- **Floating wind technology** for deep-water applications
- **Subsea cables** for the Vietnam-Malaysia-Singapore interconnector
- **Port infrastructure development** in Vung Tau and southern ports for foundation and tower manufacturing
- **O&M services** and blade/nacelle component supply

Supply Chain Localization opportunities exist as Vietnam lacks WTG OEM manufacturing facilities and requires **consistent project pipeline support**. North East Scotland's ScotWind expertise is directly applicable to Vietnam's development trajectory.

Grid Infrastructure Expansion to accommodate renewable integration requires **subsea cable systems**—Vietnam plans at least **10 new subsea cable systems by 2030** with 350 Tbps capacity. Scottish subsea engineering and installation expertise is critical for cross-border power transmission.

Green Hydrogen Integration with offshore wind creates opportunities for hydrogen production facilities, storage infrastructure, and ammonia conversion for export markets.

4

Singapore

Regional Energy Hub Strategy positions Singapore as a **trading, financing, and certification center** for low-carbon hydrogen and renewable energy. Scottish companies can establish regional headquarters to serve the broader ASEAN market.

Hydrogen Infrastructure Development includes hydrogen-ready power plants capable of supplying **up to 50% of Singapore's electricity by 2050**. Opportunities include:

- Combined Cycle Gas Turbine (CCGT) retrofitting for hydrogen blending
- Hydrogen import, storage, and conversion infrastructure
- Maritime bunkering solutions for hydrogen and ammonia

Electricity Import Projects targeting **6 GW of low-carbon imports by 2035** (one-third of energy demand) require interconnection infrastructure, subsea cables, and energy management systems.

Floating Solar including the operational **60 MW Tengeh Reservoir project** demonstrates technology viability. Scottish marine and offshore engineering expertise can support regional floating solar expansion.

5

Thailand

Floating Solar Leadership with the **world's largest hybrid solar-hydropower project (45 MW)** operational since 2021 and plans for **2,725 MW capacity** through 16 projects by 2037. Scottish companies can provide floating platform engineering, hybrid system integration, and O&M services.

CCUS Development through the **Arthit field project targeting 700,000-1 million tonnes CO2/year** creates opportunities for carbon capture technology, subsea CO2 pipelines, and storage facility engineering.

Offshore Wind Development potential includes **13 GW of electricity generation capacity**, with several projects including the 260 MW Hanuman Wind Power Project. Scottish floating wind and installation expertise is applicable.

Decommissioning Framework through **Decomm 2.0 initiative** with **450 offshore platforms** creates opportunities for regulatory compliance services, engineering consultancy, and platform removal expertise.

Grid Modernization to integrate variable renewables requires energy storage systems, smart grid technology, and transmission reinforcement—areas where Scottish engineering companies have proven capabilities.

6

Philippines

Massive Offshore Wind Pipeline of **52-67 GW of service contracts**, with Department of Energy projections of **19-50 GW by 2050**. The Philippines has **178 GW of technical offshore wind potential**, making it one of ASEAN's most attractive markets. Opportunities include:

- **Shipbuilding and fabrication** leveraging existing capabilities
- **Steel production** for foundations and towers
- **Transmission cables** utilizing the Philippines' critical minerals reserves
- **Floating wind technology** for deep-water deployment

Supply Chain Development is nascent, creating early-mover advantages for Scottish companies to establish manufacturing partnerships, technology transfer agreements, and training programs.

Floating Solar projects including the **610.5 MW Laguna Lake development** and typhoon-resistant technology testing offer opportunities for floating platform engineering and resilience design.

Grid Integration Services to connect offshore wind capacity require subsea cable installation, offshore substations, and grid reinforcement expertise.

7

Brunei

Solar Energy Development through the **30 MW Solar PV Plant** (first large-scale project) and targets of **30% renewable energy by 2035**. While a smaller market, Brunei offers:

- **Solar project EPC services** for utility-scale developments
- **Energy storage systems** for grid stability
- **Capacity building and training** programs leveraging Scottish expertise

Renewable Energy Framework Development as Brunei is still establishing regulatory frameworks creates opportunities for advisory services and policy support.

8

Cambodia, Laos & Myanmar

Hydropower Integration with **100% renewable energy potential** achievable through hydropower and non-hydro renewables. Opportunities include:

- **Hybrid floating solar-hydro systems** on existing reservoirs
- **Energy storage systems** (16.1 GW capacity needed by 2050)
- **Grid interconnection infrastructure** for power export to Thailand and Vietnam
- **Mini-grid and off-grid solutions** for rural electrification

Supply Chain Entry Point as these smaller markets offer less competition and potential for technology demonstration projects that can scale regionally.

Cross-Cutting Opportunities Across ASEAN

Subsea Cable and Grid Infrastructure: The **ASEAN Power Grid initiative** envisions interconnecting all 10 countries by 2045. Scottish subsea engineering expertise is critical for **18+ planned interconnectors**, including some of the world's longest subsea cables.

Energy Storage Systems: The **$3.32 billion ASEAN energy storage market** (growing at 6.78% CAGR through 2033) requires battery integration, pumped hydro storage, and grid-scale storage solutions where Scottish engineering companies can contribute.

Transferable Skills: Over **90% of North East Scotland's oil and gas workforce have transferable skills** for adjacent energy sectors. This expertise in project management, subsea operations, offshore logistics, and safety management is highly valued across ASEAN's energy transition projects.

Partnership Models: Joint ventures with local companies are required in Malaysia and Thailand, while Singapore offers a strategic regional hub strategy for serving the broader ASEAN market. Scottish companies should leverage **Scottish Enterprise support**, **UK Export Finance facilities** (£10 billion clean energy commitment), and the **UK-ASEAN Green Transition Fund**.

North East Scotland companies possess unique competitive advantages in **floating wind technology**, **subsea engineering**, **decommissioning expertise**, and **CCUS project delivery** that directly address ASEAN's most critical supply chain gaps in its **$200+ billion annual energy transition investment** opportunity through through 2030.

Exhibit 5: Opportunity Analysis By Sector

Offshore Wind	CCUS	Green Hydrogen
Solar	Marine Energy	Hydropower
Clean Fuels	Decommissioning	

Offshore Wind Energy

Offshore wind represents ASEAN's single largest renewable energy opportunity, with over **40 GW of planned capacity** across Vietnam, Philippines, Malaysia, Thailand, and Indonesia. Current operational capacity remains minimal (approximately 2 GW), indicating massive growth potential. Vietnam's offshore wind pipeline alone comprises 72 GW of projects, making it one of the world's largest untapped offshore wind markets. The Philippines government has awarded 65 GW of offshore wind sites in two licensing rounds, while Malaysia's new offshore wind policies complement onshore expansion plans.

The technological profile of ASEAN's offshore pipeline diverges significantly from global trends. Approximately **60% of the planned ASEAN offshore capacity** targets floating foundations rather than bottom-fixed structures. This concentration on floating technology stems from several factors: Vietnam's offshore sites experience average water depths of 60-100 metres, Thailand's development zones reach 200+ metre depths, and Philippines' typhoon-prone waters require advanced mooring systems. This technological requirement perfectly aligns with Scottish floating wind expertise, where Hywind Scotland (the world's first commercial floating wind farm) pioneered the technology in 2017 and Hywind Tampen now operates as the world's largest floating offshore wind farm.

Key Offshore Wind Projects

1

Vietnam-Malaysia-Singapore Offshore Wind Corridor Phase 1

2,000 MW (700 MW Malaysia domestic, 1,300 MW export to Singapore) capacity planned with 2034 completion date. Cabinet approval in May 2025 triggers FEED contracts expected in 2025-2026, with major procurement opportunities for subsea cables, foundation engineering, and installation services.

2

Philippines Floating Offshore Wind Northern Luzon

2,000 MW development in Ilocos Norte province with 133 turbines (15-20 MW each) planned for 2030 completion. Developers Buhawind Energy, PetroGreen, and Copenhagen Energy have received government approval, with significant procurement windows opening 2025-2027.

3

Vietnam's Bac Lieu Offshore Wind Phase 3

141 MW capacity with investment certificate awarded September 2025 under Nexif Ratch Energy. Construction starting early 2027 presents opportunities for turbine supply, balance of plant, grid connection, and foundation engineering across 26 planned turbines.

Offshore Wind Supply Chain Requirements

Foundation Systems

Floating wind platforms require specialised engineering for local water conditions and typhoon resilience. Scottish companies including Smulders (foundation jackets), JDR Cables (inter-array systems), and Tekmar (cable protection) possess required capabilities.

Subsea Cable Systems

Vietnam-Malaysia-Singapore corridor alone requiring approximately 600 km of high-voltage submarine cables. JDR Cables' expertise in North Sea cable systems translates directly to ASEAN requirements.

Installation Vessels

Heavy-lift capacity suitable for floating platform deployment and foundation installation in deeper water. Scottish supply chain companies with vessel management experience can provide significant value.

Grid Integration

Vietnam experienced 40% solar curtailment in 2022. This gap creates substantial opportunities for Scottish companies specialising in grid integration technology, smart transmission systems, and energy storage solutions.

Scottish Capability Match: VERY HIGH

Carbon Capture, Utilisation, and Storage (CCUS)

Malaysia's landmark **CCUS Act 2025**, recently enacted, establishes the region's most comprehensive regulatory framework for carbon capture and storage. This legislation creates economic incentives for CCUS deployment, carbon storage rights allocation, and a pathway for storage site monetisation. The market opportunity spans multiple industrial sectors: power generation (coal-fired plants representing primary capture targets), cement production, steel manufacturing, petrochemicals, and oil refining.

Indonesia has initiated **15+ CCUS projects** scheduled to begin by 2026, establishing CCS regulatory frameworks through Presidential Regulation No. 14 of 2024 and linking CCS outputs to Carbon Economic Value (CEV) trading under Presidential Regulation No. 98 of 2021. These regulations broaden CCUS application beyond oil and gas into industrial sectors, creating substantial monetisation opportunities through carbon credit mechanisms.

The cost structure for regional CCUS deployment averages USD 63 per ton of CO2, with capture technology representing 70% of total costs. This cost profile presents opportunities for technology providers offering efficient capture systems, particularly for point-source industrial emitters concentrated in specific geographic clusters.

Key CCUS Projects

Malaysia CCUS Storage Hubs

Multiple offshore sites including the Kasawari field with estimated 2-3 billion USD investment across multiple hubs through 2030. Petronas leads development with international partners.

Indonesia Cilegon Industrial Cluster

50+ MTPA of point-source emissions from integrated steel, chemical, and power generation facilities. USD 3-5 billion investment spans 2025-2030, with feasibility studies underway and FEED contracts expected 2025-2027.

Scottish Capability Match: VERY HIGH - North East Scotland's CCUS expertise, stemming from the Peterhead carbon capture project, combines with subsea engineering excellence to position Scottish companies as ideal CCUS infrastructure providers.

Green Hydrogen

Green hydrogen represents ASEAN's strategic energy technology for achieving long-term decarbonisation in hard-to-abate sectors including shipping, aviation, and heavy industry. Multiple national strategies position hydrogen development within broader energy transition frameworks, with phased deployment spanning grey hydrogen (present), blue hydrogen (2026-2030 transition), and green hydrogen (post-2030 scaling).

ASEAN's hydrogen strategy emphasises cluster development models concentrating production, storage, and export infrastructure in regions with abundant renewable energy and port access. Malaysia's Sarawak state, Vietnam's Mekong region, and Indonesia's eastern provinces target hydrogen hub development with export agreements to Japan, South Korea, and potentially European partners.

Key Green Hydrogen Projects

01

H2biscus and H2ornbill (Sarawak, Malaysia)

Combined 240 ktpa capacity by 2030 and USD 4.2 billion investment. These projects combine hydropower and solar resources with electrolyser technology to produce green hydrogen for export markets. Development timelines progress 2025-2030 with phased capacity additions.

02

Indonesia's Hydrogen Clusters

Batam-Bintan cluster (25-100 ktpa potential), Ulubelu cluster (25-100 ktpa potential), and northern Sulawesi initiatives. These clusters leverage renewable resources with government support for port and transport infrastructure development. Initial development timelines target 2027 commencement.

03

Vietnam's Hydrogen Strategy

Projects including Dong Gio Linh and other initiatives target 60+ ktpa capacity by 2030, focused initially on blue hydrogen (steam methane reformation with CCS) transitioning to green as electrolyser costs decline.

Scottish Capability Match: MEDIUM-HIGH

Solar Energy

Solar energy represents ASEAN's fastest-growing renewable technology, with total capacity projected to expand from **124.6 GW (2025) to 178.1 GW (2030)**, representing 7.4% compound annual growth rate. Vietnam leads regional solar deployment with 18.4 GW capacity, followed by Thailand (3.6 GW) and Malaysia (1.8 GW). Cost competitiveness has improved dramatically, with levelised cost of electricity (LCOE) ranging from USD 64-246/MWh across the region, now cheaper than coal in Vietnam and approaching parity with conventional generation across most ASEAN countries.

Solar deployment concentrates in utility-scale projects (increasingly through competitive auctions), commercial and industrial rooftop systems, and emerging floating solar on hydropower reservoirs. The last category represents particular growth opportunity, with existing floating solar projects in Malaysia (50 MW) and Thailand (24 MW) demonstrating viability and grid integration benefits through hybrid operation with hydropower generation.

Scottish Capability Match: MEDIUM - North East Scotland's expertise lies in balance of plant engineering, grid integration technology, hybrid solar+storage system design, and smart grid solutions rather than solar component manufacturing.

Marine Energy (Wave and Tidal)

Marine energy represents an emerging opportunity sector with nascent commercial development in ASEAN. Despite the region's substantial marine resource potential (particularly in straits with high tidal flows and coastal areas with significant wave resources), technology deployment remains limited, creating first-mover opportunities for advanced technology providers.

Southeast Asia's first commercial tidal energy project, the **Capul Island Tidal Energy Plant** in the Philippines' Northern Samar province, achieved deployment in late 2025 with 1 MW capacity expandable across multiple island locations. The project employs Inyanga Marine's HydroWing tidal technology integrated with solar and battery storage for microgrid operation serving isolated communities. This pilot demonstrates emerging market viability for marine energy in ASEAN's island geographies and represents a proving ground for technology developers and supply chain companies.

Thailand's Gulf of Thailand presents substantial tidal potential, with feasibility assessments ongoing for Pak Phra Strait and other locations. The Thai government's clean energy roadmap includes marine energy development as a strategic technology for 2030+ deployment as offshore wind and hydropower capacity reach saturation points.

Scottish Capability Match: HIGH - North East Scotland possesses world-leading marine energy technology expertise through decades of wave and tidal energy research and development.

Hydropower and Pumped Storage

Hydropower represents ASEAN's largest renewable energy source with 208.79 billion kWh generation (2025) and 3.56% projected annual growth through 2029. However, hydropower development faces increasing environmental and social opposition, with dam construction slowing across the region due to indigenous rights concerns, ecosystem impact, and transboundary water governance complexities. Despite these constraints, significant untapped potential remains, particularly in pumped-storage hydropower (PSH) and hybrid systems combining hydropower with solar and wind generation.

Indonesia's Power Development Plan projects hydropower expansion from current capacity to 72 GW by 2070, while Vietnam targets 29.35 GW by 2030 and Philippines plans 800 MW Laguna pumped storage facility. These large capacity targets face implementation challenges but represent substantial engineering and construction opportunities.

An emerging opportunity involves floating solar on hydropower reservoir surfaces, capturing renewable generation benefits while reducing water evaporation and managing algae growth. Existing projects in Malaysia (50 MW) and Thailand (24 MW) demonstrate technical feasibility and operational benefits.

Scottish Capability Match: MEDIUM - Scottish companies' expertise lies in pumped-storage technology optimisation, hybrid solar-hydro system design, and environmental management frameworks.

Clean Fuels: Sustainable Aviation Fuel (SAF)

- [ ] Sustainable aviation fuel (SAF) represents a critical decarbonisation pathway for aviation, with ICAO projections indicating SAF potential to achieve 40-60% of aviation emissions reduction by 2050. Southeast Asia accounts for approximately 8% of global jet fuel demand, with Singapore emerging as the regional SAF production and distribution hub.
- [ ] Singapore's Neste refinery operates the world's largest SAF production facility with **1 million tonnes annual capacity**, supplying regional and international airlines including Singapore Airlines, SilkAir, and major international carriers. The facility uses waste oils and advanced feedstocks through HEFA (hydroprocessed esters and fatty acids) technology, establishing the regional benchmark for SAF production quality and scale.
- [ ] ASEAN countries are implementing SAF mandates beginning 2027, with Malaysia, Thailand, and Indonesia establishing blending requirements (typically 1-5% SAF by volume). Vietnam is developing regulatory frameworks for SAF adoption. These mandates create demand certainty for SAF production scaling and feedstock development.
- [ ] Southeast Asia possesses substantial feedstock potential for SAF production, including agricultural residues, waste oils from food processing, and potential energy crop cultivation on under-utilised land. Estimated feedstock availability ranges from 500 ktpa to 2 Mtpa depending on sustainable land-use assumptions.

Scottish Capability Match: MEDIUM

Decommissioning: The Optimal Opportunity

Decommissioning represents North East Scotland's single strongest market opportunity in ASEAN, with over **USD 100 billion** in identified investment requirements across **2,600 offshore platforms, 35,000 wells**, and 55,000 kilometres of pipeline requiring remediation and removal through 2040. This market dwarfs ASEAN's renewable energy investment needs and aligns perfectly with Scottish supply chain capabilities developed through 50+ years of North Sea oil and gas operations.

Approximately 200 offshore fields are projected to cease production by 2030 across Southeast Asia, triggering decommissioning obligations for platform operators. Indonesia (450 platforms, 75% over 20 years old) faces the most urgent decommissioning timeline, with SKK Migas developing strategic plans for accelerated platform removal starting 2025. Malaysia operates over 85% of Southeast Asia's 1,750+ platforms, with significant age-related decommissioning liabilities concentrated on Petronas operations. Thailand faces complex multi-stakeholder decommissioning negotiations on mature fields (Erawan, Bongkot).

Decommissioning: Regulatory Frameworks

Malaysia

Established the region's most developed decommissioning regulatory framework through decades of oil and gas experience, successfully executing the Baram-8 rig-to-reef (RTR) conversion in the South China Sea. This project pioneered alternative decommissioning approaches combining partial platform removal with in-situ infrastructure conversion to artificial reef status.

Indonesia

Decommissioning regulatory framework is rapidly developing, with Presidential Regulation No. 14 of 2024 providing legal foundation and SKK Migas implementing strategic decommissioning acceleration. Financial obligations total approximately USD 40-50 billion for Indonesian operations.

Thailand

Decommissioning market involves complex multi-stakeholder negotiations on mature fields with estimated liabilities of USD 3 billion (Erawan) and USD 1 billion (Bongkot) combining among multiple operators (PTTEP, Chevron, Total, Mitsui). Dispute resolution processes ongoing through 2025 with likely implementation 2025-2030.

Decommissioning: Technical Requirements

Platform decommissioning requires specialised heavy-lift vessels capable of removing 1,000+ ton jackets and topsides in tropical sea states with typhoon-induced constraints. Supporting infrastructure includes subsea cutting systems (scotch cutters and mechanical cutting tools), well intervention equipment for subsea well plugging, hazardous materials management systems, and waste processing facilities meeting regional environmental standards.

Scottish Capability Match: VERY HIGH - Decommissioning represents the optimal market entry opportunity for North East Scotland energy companies, combining proven track record with large commercial scale and limited regional competition.

ASEAN Low Carbon Energy Projects and Contract Opportunities

- Overview of Projects
- Exhibit 6: 20 Key ASEAN Low Carbon Energy Projects (from FEED to EPC)
- Exhibit 7: Near-Term Contracting Opportunities (2025-2027)
  - [ ] Tier 1: Imminent Contract Awards (Q4 2025 - Q2 2026)
  - [ ] Tier 2: Early-Stage Major Opportunities (2026-2027)
  - [ ] Tier 3: Strategic Multi-Billion Dollar Opportunities (2026-2028)

Overview of Projects

Exhibit 6 below lists **20 major low carbon energy projects** across ASEAN countries, representing over **$80 billion in total capital investment**. The projects span the complete development lifecycle from early-stage feasibility studies through front-end engineering design (FEED), engineering, procurement, and construction (EPC), and operational phases. The projects are distributed across offshore wind, solar with battery storage, geothermal, carbon capture and storage, hydrogen, grid infrastructure, and emerging marine energy technologies.

By Technology

Offshore wind projects dominate the portfolio with 4 major developments representing approximately $25-30 billion in investment, followed by solar and battery storage systems ($15-20 billion), geothermal ($2.4 billion), carbon capture and storage ($4-5 billion), and grid infrastructure including subsea cables ($3-5 billion).

By Country

Vietnam leads with 2 major offshore wind projects totaling 9.5 GW capacity and over $18 billion investment. The Philippines follows with the GEA-4 auction program delivering 10.2 GW across 123 projects valued at $15-20 billion. Malaysia hosts multiple projects including the ACWA Power partnership ($10 billion), Sarawak-Singapore cable ($2-3 billion), and CCS developments ($3-4 billion). Thailand's Gulf Energy solar-plus-storage portfolio represents $820 million in near-term investment. Indonesia features significant geothermal ($2.4 billion) and LNG-with-CCS projects ($20+ billion).

Development Stage

Currently, 7 projects are in FEED or planning stages, 3 are in EPC or under construction, 3 are in pre-FEED development, 2 are operational with expansion plans, 2 are in tender stages, and 3 have recently completed major milestones (auction awards, conditional approvals, or partnership agreements).

Exhibit 6: Key ASEAN Low Carbon Energy Projects (2025-2032)

1

ASEAN Wind Power Corridor Phase 1

- Location: Vietnam/Malaysia/Singapore
- Technology: Offshore Wind + Subsea Cables
- CAPEX Value: $2+ billion (Phase 1)
- Startup Date: 2034 (Phase 1)
- Project Status: FEED/Early Development
- Key Stakeholders: Malaysian Ministry of Energy, Sarawak Energy, Singapore EMA, Vietnam MOIT
- Procurement Timeline: Cabinet approved May 2025; Cable procurement Q1-Q4 2026
- Initiation of Contract: May 2025 (Cabinet approval); Q1 2026 (Cable contracts)
- Opportunities for NE Scotland: Subsea cable installation, offshore substations, HVDC systems, project management, grid integration

2

Can Gio Offshore Wind Farm

- Location: Vietnam
- Technology: Offshore Wind
- CAPEX Value: Multi-billion (est. $8-12B)
- Startup Date: 2030-2032 (est.)
- Project Status: Pre-FEED/Development
- Key Stakeholders: Vietnam Ministry of Industry & Trade, Can Gio authorities, International developers
- Procurement Timeline: Developer selection process ongoing; FID expected 2026
- Initiation of Contract: 2025-2026 (Developer selection)
- Opportunities for NE Scotland: Turbine supply, foundations (fixed/floating), subsea cables, installation vessels, O&M

3

PetroVietnam-CIP Offshore Wind Portfolio

- Location: Vietnam
- Technology: Offshore Wind
- CAPEX Value: $10.5 billion
- Startup Date: 2028-2030 (estimated)
- Project Status: Development/Pre-FEED
- Key Stakeholders: PetroVietnam, Copenhagen Infrastructure Partners (CIP), EVN
- Procurement Timeline: Investment secured; EPC contractors selection in progress
- Initiation of Contract: 2024 (investment); 2025-2026 (EPC)
- Opportunities for NE Scotland: Floating wind expertise, dynamic cables, mooring systems, installation, commissioning, O&M

4

San Miguel Bay Offshore Wind Farm

- Location: Philippines
- Technology: Offshore Wind
- CAPEX Value: $2-3 billion (estimated)
- Startup Date: 2030+ (estimated)
- Project Status: Pre-FEED/Planning
- Key Stakeholders: Philippines DOE, San Miguel Corporation, developers
- Procurement Timeline: Preliminary approvals; full tender expected 2025-2026
- Initiation of Contract: 2026-2027 (estimated)
- Opportunities for NE Scotland: Foundations (fixed/floating), offshore engineering, O&M base setup

5

Gulf Energy Solar+BESS Portfolio (12 projects)

- Location: Thailand
- Technology: Solar PV + BESS
- CAPEX Value: $820 million (debt financing)
- Startup Date: 2026-2029
- Project Status: EPC/Under Construction
- Key Stakeholders: Gulf Energy Development, EGAT, ADB, AIIB
- Procurement Timeline: EPC contracts awarded; under construction 2024-2026
- Initiation of Contract: 2024 (financing); 2024-2025 (EPC)
- Opportunities for NE Scotland: Solar mounting, BESS integration, inverters, EMS, grid services

6

Thailand Floating Solar Projects (Srinagarind Dam)

- Location: Thailand
- Technology: Floating Solar PV
- CAPEX Value: $150-200 million (estimated)
- Startup Date: 2026-2027
- Project Status: Tender Stage
- Key Stakeholders: EGAT, project developers
- Procurement Timeline: Tender issued Aug 2025; award expected Q4 2025
- Initiation of Contract: Q4 2025–Q1 2026
- Opportunities for NE Scotland: Floating pontoons, mooring systems, cables, monitoring systems

7

Philippines QEA-4 Renewable Energy Auction

- Location: Philippines
- Technology: Solar/Wind/BESS
- CAPEX Value: $15-20 billion (total portfolio)
- Startup Date: 2026-2029 (phased)
- Project Status: Auction Complete/Pre-EPC
- Key Stakeholders: DOE, developers, ERC, utilities
- Procurement Timeline: Awards Nov 2025; PPAs by Q1-Q2 2026
- Initiation of Contract: Q1-Q2 2026
- Opportunities for NE Scotland: EPC, wind supply, BESS systems, project development

8

ACWA Power-Malaysia Renewable Energy Partnership

- Location: Malaysia
- Technology: Solar/Wind/Hydrogen/Desalination
- CAPEX Value: $10 billion initial
- Startup Date: 2025-2040 (phased)
- Project Status: FEED/Feasibility Studies
- Key Stakeholders: ACWA Power, MIDA, TNB, Terengganu Inc, UEM Lestra
- Procurement Timeline: Feasibility 2025-2026; Project agreements 2026+
- Initiation of Contract: May 2025 (MoU); 2026-2027 (contracts)
- Opportunities for NE Scotland: Floating solar tech, hydrogen, project management

9

TNB-ACWA Power Hybrid Hydro Floating Solar (Kenyir & Puah)

- Location: Malaysia (Terengganu)
- Technology: Hydro-Floating Solar
- CAPEX Value: $1.5-2 billion (estimated)
- Startup Date: 2028-2030
- Project Status: FEED/Planning
- Key Stakeholders: TNB Power Generation, ACWA Power, Ministry of Energy Malaysia
- Procurement Timeline: Heads of Terms signed May 2025; FEED 2025-2027
- Initiation of Contract: May 2025 (HoT); 2026
- Opportunities for NE Scotland: Floating platforms, hydropower integration

10

TNB-ACWA Power Integrated Water & Power Project (Pulau Carey)

- Location: Malaysia (Selangor)
- Technology: CCGT + Desalination
- CAPEX Value: $3-4 billion (estimated)
- Startup Date: 2029-2031
- Project Status: FEED/Planning
- Key Stakeholders: TNB, ACWA Power, Selangor State Government
- Procurement Timeline: HoT signed May 2025; FEED 2025-2027
- Initiation of Contract: May 2025 (HoT); 2026
- Opportunities for NE Scotland: Turbines, desalination, O&M

11

Sembcorp Jurong Island BESS Expansion

- Location: Singapore
- Technology: Battery Energy Storage
- CAPEX Value: $500 million (approx.)
- Startup Date: 2025 (expansion complete)
- Project Status: Operational + Expansion
- Key Stakeholders: Sembcorp Industries, Singapore EMA, Envision, Huawei
- Procurement Timeline: Expansion awarded 2024; completion 2025
- Initiation of Contract: 2024 (expansion); 2025
- Opportunities for NE Scotland: BESS systems, grid services

12

Sarawak-Singapore Subsea Cable Project

- Location: Malaysia (Sarawak) to Singapore
- Technology: HVDC Subsea Cable
- CAPEX Value: $2-3 billion (estimated)
- Startup Date: 2032
- Project Status: FEED/Front-End Engineering
- Key Stakeholders: Sembcorp Utilities, Sarawak Energy, Singapore EMA, Prysmian
- Procurement Timeline: Approval Oct 2025; cable tender 2025-2026
- Initiation of Contract: Oct 2025; 2026 (EPC/Supply)
- Opportunities for NE Scotland: Subsea cable installation, HVDC, cable protection

13

LTMS Power Integration Project (Laos-Thailand-Malaysia-Singapore)

- Location: Regional
- Technology: Regional Grid Integration
- CAPEX Value: $100 million+ (operational)
- Startup Date: 2022 (operational)
- Project Status: Operational (2022)
- Key Stakeholders: Laos EDL, EGAT, TNB, Singapore EMA, Keppel Electric
- Procurement Timeline: Operational since 2022; expansion studies ongoing
- Initiation of Contract: 2022 (Operational)
- Opportunities for NE Scotland: Grid integration, cross-border trading platforms

14

First Gen-Sinar Mas Indonesia Geothermal Portfolio

- Location: Indonesia (Multiple Sites)
- Technology: Geothermal
- CAPEX Value: $2.2 billion
- Startup Date: 2026-2028 (phased)
- Project Status: Development/Pre-Construction
- Key Stakeholders: First Gen Corp, EDC (Philippines), Sinar Mas Group
- Procurement Timeline: Partnership Aug 2025; EPC/drilling 2025-2026
- Initiation of Contract: Aug 2025; 2025-2026 (EPC)
- Opportunities for NE Scotland: Geothermal drilling, wellhead, turbines

15

PT Geo Dipa Energi Dieng-2 & Patuha-2 Expansion

- Location: Indonesia (Central Java & West Java)
- Technology: Geothermal
- CAPEX Value: $180 million (ADB loan)
- Startup Date: 2026 (both units)
- Project Status: EPC/Under Construction
- Key Stakeholders: PT Geo Dipa Energi, ADB, PLN, Ministry of Energy Indonesia
- Procurement Timeline: ADB loan 2025; EPC appointed; construction underway
- Initiation of Contract: 2025 (ADB loan); 2024-2025 (EPC)
- Opportunities for NE Scotland: Drilling, power equipment, turbines

16

INPEX Abadi LNG Project with CCS (Masela Block)

- Location: Indonesia (Maluku)
- Technology: LNG + CCS
- CAPEX Value: $20+ billion (FPSO + OLNG + CCS)
- Startup Date: 2030+ (FID 2026)
- Project Status: FEED (Dual FEED ongoing)
- Key Stakeholders: INPEX Masela Ltd, JGC, Technip Energies, SKK Migas
- Procurement Timeline: FEED contracts Aug 2025; EPC tender post-FID
- Initiation of Contract: Aug 2025; 2026-2027 (FID & EPC)
- Opportunities for NE Scotland: CCS tech, CO2 compression, subsea pipelines, LNG plant equipment

17

ACWA Power Garuda Green Hydrogen Project (Gresik)

- Location: Indonesia (East Java)
- Technology: Green Hydrogen
- CAPEX Value: $500M–1B (estimated)
- Startup Date: 2027–2029
- Project Status: Feasibility Study
- Key Stakeholders: ACWA Power, PT Pupuk Indonesia, PT Garam, Ministry of Energy Indonesia
- Procurement Timeline: Study agreement May 2025; feasibility 2025-2026
- Initiation of Contract: May 2025; 2026-2027 (EPC)
- Opportunities for NE Scotland: Electrolysers, hydrogen storage, pipelines

18

Capul Island Tidal Power Plant

- Location: Philippines (Northern Samar)
- Technology: Tidal Energy
- CAPEX Value: $10 million
- Startup Date: Late 2025
- Project Status: EPC/Pre-Commissioning
- Key Stakeholders: Inyanga Marine Energy Group (UK), Energies PH, DOE Philippines
- Procurement Timeline: EPC awarded; installation Q4 2025
- Initiation of Contract: 2024-2025 (EPC award)
- Opportunities for NE Scotland: Marine turbines, subsea install, mooring, monitoring

19

Petronas Kasawari CCS Hub

- Location: Malaysia (Sarawak Offshore)
- Technology: CCS
- CAPEX Value: $1.07 billion
- Startup Date: 2025 (operational)
- Project Status: FEED/Engineering
- Key Stakeholders: Petronas, Malaysian Government, METI Japan, JOGMEC
- Procurement Timeline: Engineering phase; injection operations 2025
- Initiation of Contract: 2024-2025 (Engineering contracts)
- Opportunities for NE Scotland: CO2 transport, subsea pipelines, storage engineering

20

Malaysia CCS Flagship Projects (Lang Lebah & B1Q5T)

- Location: Malaysia
- Technology: CCS
- CAPEX Value: $2-3 billion (combined)
- Startup Date: 2030
- Project Status: FEED/Planning
- Key Stakeholders: Petronas, Ministry of Energy, international partners
- Procurement Timeline: FEED stage; EPC contractors 2026-2027
- Initiation of Contract: 2025-2027 (EPC/Engineering)
- Opportunities for NE Scotland: CCS engineering, offshore platforms, monitoring

Exhibit 7: Near-Term Contracting Opportunities (2025-2027)

The analysis identifies **high-priority projects** with the highest probability of contract awards within the next **6-24 months**, representing over **$5 billion** in near-term procurement opportunities for *North East Scotland* companies.

Tier 1: Imminent Contract Awards (Q4 2025 - Q2 2026)

Gulf Energy Solar+BESS Portfolio (Thailand)

- **Project Type:** 12 renewable energy plants (8 solar only, 4 solar-plus-BESS)
- **Capacity:** 649 MW solar, 396 MWh battery storage
- **Value: $820 million**
- **Status:** Under construction
- **Commercial Operations: 2026-2029**
- **Lead Funder:** Asian Development Bank ($260 million from ADB, $529 million parallel loans)

Contract Opportunities:

- Balance-of-plant EPC work ($50-150 million)
- BESS supply and integration
- Inverter systems
- Grid connection equipment
- Operations and maintenance contracts

Entry Strategy:

North East Scotland companies should engage with Gulf Energy's procurement team, ADB's private sector operations division, and EGAT (the offtaker) regarding grid connection and energy management systems. Gulf Energy is one of Thailand's largest IPPs, providing long-term partnership potential.

PT Geo Dipa Dieng-2 and Patuha-2 Geothermal Expansion (Indonesia)

- **Project Type:** Two 55 MW geothermal projects
- **Location:** Central Java and West Java
- **Value: $180 million** (ADB loan)
- **Status:** Under construction
- **Completion Target: 2026**
- **Goal:** Expand to meet Indonesia's **23%** renewable energy target by **2025**.
- **Long-term Plan:** PT Geo Dipa Energi aims to reach **1,910 MW** by **2035**.

Contract Opportunities:

- Geothermal drilling services ($30-80 million)
- Wellhead equipment
- Steam turbines
- Cooling systems
- Binary cycle equipment
- Long-term operations and maintenance

Entry Strategy:

North East Scotland companies with oil and gas drilling expertise can leverage transferable skills. Companies should contact PT Geo Dipa's procurement division, ADB's infrastructure finance team, and position capabilities in drilling equipment supply, wellhead systems, and power plant turbines.

Capul Island Tidal Power Plant (Philippines)

- **Project Type:** Pioneering 1 MW tidal energy facility
- **Location:** Northern Samar
- **Value: $10 million** (estimated)
- **Status:** Entering installation phase
- **Installation Start: Q4 2025**
- **EPC Contractor:** UK-based Inyanga Marine Energy Group
- **System:** Integrates with solar PV and energy storage in a 24/7 microgrid.

Contract Opportunities:

- HydroWing tidal turbine components
- Subsea installation services
- Mooring and anchoring systems
- Underwater cabling
- Grid integration equipment
- Microgrid management systems

Entry Strategy:

Scottish companies from Wave Energy Scotland and the European Marine Energy Centre in Orkney possess directly applicable expertise. Companies should engage Inyanga Marine Energy Group, Energies Pte the local developer), and the Philippines Department of Energy regarding technology supply and knowledge transfer.

Tier 2: Early-Stage Major Opportunities (2026-2027)

Philippines QEA-A Renewable Energy Auction

- **Capacity Awarded: 10.2 GW** across 123 projects
- **Total Investment: $15-20 billion**
- **Project Types:** Ground-mounted solar (**4.2 GW**), floating solar (**3.2 GW**), rooftop solar (**1.1 GW**), onshore wind (**2.4 GW**), solar-plus-BESS (**1.1 GW**)
- **Commercial Operation Dates: 2026-2029**
- **PPA Finalization: Q1-Q2 2026**
- **EPC Tenders Launch:** Immediately after PPA finalization
- **Individual Project Values: $100-500 million**
- **Ownership: 100%** foreign ownership allowed for RE projects.

Contract Opportunities:

- Solar mounting systems
- Wind turbine supply
- BESS integration
- Inverters and power electronics
- Grid connection equipment
- Project management
- Operations and maintenance

Entry Strategy:

Companies should review the published list of 123 qualified bidders, identify developers with strong financial backing, and propose partnership or equipment supply agreements. Registration with the Philippines Department of Energy and pre-qualification for grid connection work with distribution utilities will accelerate contract awards.

Thailand Floating Solar Tender (280 MW) Srinagarind Dam)

- **Capacity:** 280 MW floating photovoltaic
- **Location:** Srinagarind Dam
- **Value: $150-200 million** (estimated)
- **Tender Issued: August 2025** by EGAT
- **Tender Close Expected: Q4 2025** or **Q1 2026**
- **Broader Program:** Part of EGAT's plan to add **2.7 GW** of floating PV by **2037**.

Contract Opportunities:

- Floating platform systems
- Mooring and anchoring for reservoir environments
- Underwater cabling
- Inverters and transformers
- Grid connection infrastructure
- Monitoring systems

Entry Strategy:

Scottish companies can leverage offshore engineering expertise in floating systems and dynamic cable management. Companies should respond to EGAT's tender either directly (if qualified) or through partnership with Thai EPC contractors. Pre-qualification often requires previous floating solar or offshore renewable energy experience.

First Gen-Sinar Mas Geothermal Portfolio (Indonesia)

- **Project Type:** Six geothermal plants (440 MW total)
- **Location:** West Java, Flores, Jambi, West Sumatra, Central Sulawesi
- **Value: $2.2 billion**
- **Partnership Announced: August 2025**
- **Drilling Campaigns Start: 2025-2026** (initial investment **$60 million**)
- **Lead Developer:** First Gen's Energy Development Corporation (Philippines' largest geothermal operator)

Contract Opportunities:

- Geothermal drilling rigs and services ($200-500 million)
- Wellhead equipment and valves
- Steam gathering systems
- Power plant turbines and generators
- Cooling systems
- Binary cycle equipment
- Long-term operations and maintenance

Tier 2: Early-Stage Major Opportunities (2026-2027)

Philippines QEA-A Renewable Energy Auction

- **Capacity Awarded: 10.2 GW** across 123 projects
- **Total Investment: $15-20 billion**
- **Project Types:** Ground-mounted solar (**4.2 GW**), floating solar (**3.2 GW**), rooftop solar (**1.1 GW**), onshore wind (**2.4 GW**), solar-plus-BESS (**1.1 GW**)
- **Commercial Operation Dates: 2026-2029**
- **PPA Finalization: Q1-Q2 2026**
- **EPC Tenders Launch:** Immediately after PPA finalization
- **Individual Project Values: $100-500 million**
- **Ownership: 100%** foreign ownership allowed for RE projects.

Contract Opportunities:

- Solar mounting systems
- Wind turbine supply
- BESS integration
- Inverters and power electronics
- Grid connection equipment
- Project management
- Operations and maintenance

Entry Strategy:

Companies should review the published list of 123 qualified bidders, identify developers with strong financial backing, and propose partnership or equipment supply agreements. Registration with the Philippines Department of Energy and pre-qualification for grid connection work with distribution utilities will accelerate contract awards.

Thailand Floating Solar Tender (280 MW) Srinagarind Dam)

- **Capacity:** 280 MW floating photovoltaic
- **Location:** Srinagarind Dam
- **Value: $150-200 million** (estimated)
- **Tender Issued: August 2025** by EGAT
- **Tender Close Expected: Q4 2025** or **Q1 2026**
- **Broader Program:** Part of EGAT's plan to add **2.7 GW** of floating PV by **2037**.

Contract Opportunities:

- Floating platform systems
- Mooring and anchoring for reservoir environments
- Underwater cabling
- Inverters and transformers
- Grid connection infrastructure
- Monitoring systems

Entry Strategy:

Scottish companies can leverage offshore engineering expertise in floating systems and dynamic cable management. Companies should respond to EGAT's tender either directly (if qualified) or through partnership with Thai EPC contractors. Pre-qualification often requires previous floating solar or offshore renewable energy experience.

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- **Partnership Announced: August 2025**
- **Drilling Campaigns Start: 2025-2026** (initial investment **$60 million**)
- **Lead Developer:** First Gen's Energy Development Corporation (Philippines' largest geothermal operator)

Contract Opportunities:

- Geothermal drilling rigs and services ($200-500 million)
- Wellhead equipment and valves
- Steam gathering systems
- Power plant turbines and generators
- Cooling systems
- Binary cycle equipment
- Long-term operations and maintenance

Entry Strategy:

North East Scotland companies should engage First Gen Corporation's CFO office, Energy Development Corporation's business development team, and Sinar Mas Energy Division. Positioning should emphasize transferable oil and gas drilling expertise, high-temperature equipment supply, and O&M capabilities. Indonesian subsidiary presence or partnerships will provide competitive advantages.

Tier 3: Strategic Multi-Billion Dollar Opportunities (2026-2028)

ACWA Power-Masdar Renewable Energy Partnership

- **Total Investment: $10 billion**
- **Capacity Target:** Up to **12.5 GW** by **2040**
- **Technologies:** Floating solar PV, CCGT, green hydrogen, desalination
- **Partnership Signed: May 2025**
- **Near-term Projects:** 2 GW Hybrid Hydro Floating Solar (Kenyir & Pauh Reservoirs), 2.1 GW Integrated Water and Power Project (Pulau Carey)
- **Feasibility Studies:** Underway through **2025-2026**
- **Project Agreements & EPC Tenders:** Expected **2026-2027**
- **Early-phase Project Values: $500 million** to **$2 billion**

Contract Opportunities:

- Floating solar platforms and mooring systems
- Electrolyzer technology for green hydrogen production
- Gas turbine supply and services
- Desalination equipment
- Project management and engineering services
- Grid integration systems

Entry Strategy:

Alongside ACWA Power's Southeast Asia regional office, register investment intentions with MIDA, and establish dialogues with consortium partners Tenaga Nasional Berhad (TNB), Terengganu Inc, and UEM Lestra. Early engagement in feasibility studies positions companies for subsequent EPC awards.

Sarawak-Singapore Subsea Cable Project

- **Capacity:** 1 GW transmission
- **Route:** Sarawak to Singapore (approx. 700 km subsea cables, 70% in Indonesian waters)
- **Value: $1-3 billion** (estimated)
- **Subsea Cable Procurement: $500 million** to **$1 billion**
- **Conditional Approval: October 2025** (Sembcorp Utilities & Sarawak Energy consortium)
- **Construction Start: 2026**
- **Commercial Operations:** Around **2032**
- **Preferred Supplier:** Prysmian for high-voltage submarine cable systems

Contract Opportunities:

- HVDC converter stations
- Offshore platforms or landing stations
- Route survey and seabed preparation
- Cable laying vessels and installation services
- Cable protection systems
- Testing and commissioning
- Long-term operations and maintenance

Entry Strategy:

North East Scotland companies should engage Sembcorp Utilities' project team, Sarawak Energy's business development division, and potentially Prysmian's installation subcontractor procurement. Capabilities in subsea cable installation, HVDC systems, offshore construction, and long-term subsea asset maintenance align directly with project requirements.

INPEX Abadi LNG Project with CCS (Indonesia)

- **Project Type:** Mega-project for LNG and natural gas production with CCS
- **LNG Production: 9.5 million tonnes** annually
- **Natural Gas Supply: 150 million** standard cubic feet per day (domestic)
- **Value:** Exceeds **$20 billion**
- **Dual FEED Contract Awarded: August 2025** (JGC Technip Energies consortium)
- **FID Target: 2026-2027**
- **Commercial Operations:** By **2030+**
- **Goal:** Align with Indonesia's net-zero **2060** target.

Contract Opportunities:

- CCS technology and equipment ($1-3 billion across multiple packages)
- CO2 compression systems
- Subsea pipelines for CO2 transport
- FPSO systems and equipment
- LNG plant equipment and construction
- Subsea umbilicals, risers, and flowlines (SURF)
- Gas export pipeline equipment
- Monitoring and verification systems

Entry Strategy:

North East Scotland companies should engage INPEX Masela's project office, JGC Corporation's project-management team, and Technip Energies' supply chain division during the FEED phase to pre-qualify for post-FID EPC tenders. Scottish companies from the Acorn CCS Cluster possess directly relevant capabilities in CO2 compression, subsea transport systems, storage engineering, and monitoring.

Policy and Regulatory Frameworks for Low Carbon Energy in ASEAN

ASEAN countries have implemented diverse policy and regulatory frameworks to advance their low carbon energy transitions, reflecting both regional cooperation and national priorities. This overview examines the key mechanisms, targets, and initiatives shaping the region's decarbonization efforts.

- [ ] Policy and Regulatory Frameworks
- [ ] Local Content Requirements
- [ ] Trade Barriers, Tariffs & Certification

Regional Cooperation and Frameworks

1

ASEAN Plan of Action for Energy Cooperation (APAEC)

The APAEC serves as the regional blueprint for multilateral energy cooperation, currently in Phase II (2021-2025) with Phase III (2026-2030) recently endorsed in October 2025. The plan encompasses seven programme areas including the ASEAN Power Grid, renewable energy, energy efficiency, and clean coal technology. Key targets include achieving 23% renewable energy in total primary energy supply and 35% in installed power capacity by 2025, alongside a 32% reduction in energy intensity.

2

ASEAN Power Grid (APG)

The APG initiative aims to connect all ten member states' electricity systems by 2045, facilitating cross-border renewable energy trading and improving regional energy security. As of 2024, thirteen bilateral interconnection links are operational with a total capacity of 5,212 MW. To accelerate progress, ASEAN launched the ASEAN Power Grid Financing Facility in 2025, backed by at least $10 billion from the Asian Development Bank and World Bank to support cross-border transmission infrastructure.

3

Carbon Pricing Mechanisms

Several ASEAN countries are developing or implementing carbon pricing systems. Singapore launched its carbon tax in 2019, while Indonesia introduced an emissions trading system (ETS) for coal-fired power plants in 2023. Malaysia, Thailand, Vietnam, and the Philippines are assessing carbon tax or ETS feasibility. The ASEAN Common Carbon Framework supports regional convergence of carbon pricing policies and methodologies.

Some Country-Specific Policies

Indonesia

Indonesia's 2025-2034 Electricity Supply Business Plan (RUPTL), termed "Beyond the Greenest RUPTL," calls for 52.9 GW of new renewable energy capacity and requires nearly $183 billion in investment. The plan includes 42.6 GW of renewable energy, 10.3 GW of energy storage, and 10.3 GW of gas-fired plants. The government has relaxed local content requirements for solar projects signed before December 2024 to attract investment. However, the plan lowers the 2030 renewable target from 20.9 GW to 18.6 GW, prioritizing energy self-sufficiency and industrial development through *hilirisasi* (downstream processing).

Vietnam

Vietnam's revised Power Development Plan VIII (PDP8), approved in April 2025, significantly increases renewable capacity targets: onshore and nearshore wind from 21,880 MW to 26,066-38,029 MW by 2030, offshore wind from 6,000 MW to 17,032 MW, and battery storage from 300 MW to 10,000-16,300 MW. The plan aims for 28-36% renewable energy by 2030 and 74-75% by 2050, requiring $134.7 billion by 2030 and $523 billion by 2050. Notably, the revised plan reintroduces nuclear power with 4,000-6,400 MW expected between 2030-2035.

Thailand

Thailand targets 31% renewable energy capacity by 2025 and 40% by 2035, advancing toward 51% renewable electricity generation by 2037 under its draft Power Development Plan 2024. A transformative Direct Power Purchase Agreement (DPPA) framework is set for implementation by end-2025, allowing renewable producers to sell directly to large corporate consumers, particularly data centers, with an initial 2 GW cap. The government offers feed-in tariffs with 3.67 GW of additional capacity between 2022-2030, including 2,632 MW solar and 1,000 MW wind.

Philippines

The Philippines targets 35% renewable energy in its generation mix by 2030, 50% by 2040, and over 50% by 2050 under its Philippine Energy Plan 2023-2050. The country has lifted foreign ownership restrictions on renewable energy businesses, enabling 100% foreign ownership to attract investment and technology transfer. The Green Energy Auction Programme (GEAP) has secured over 12 GW of committed renewable capacity through three completed rounds, with a fourth round targeting an additional 10.5 GW. A Renewable Portfolio Standards (RPS) policy requires electricity suppliers to source a mandated percentage from renewable sources.

Malaysia

Malaysia's National Energy Transition Roadmap (NETR), launched in July 2023, outlines ten flagship projects across six levers: energy efficiency, renewable energy, hydrogen, bioenergy, green mobility, and carbon capture. The plan targets 31% renewable electricity by 2025, 40% by 2035, and 70% by 2050. In September 2024, Malaysia launched the Corporate Renewable Energy Supply Scheme (CRESS), enabling companies to purchase power directly from renewable developers through the grid with lower participation thresholds and greater flexibility. The NETR flagship projects are expected to attract over RM25 billion in investment and reduce emissions by 10,000 Gg CO2eq annually.

Singapore

Singapore targets 40% renewable electricity (32 TWh) by 2035 through its Singapore Green Plan 2030, combining domestic solar expansion from 0.6 GW to 2 GW and importing up to 4 GW of low-carbon electricity from neighboring countries. Current approved import projects include 2 GW from Indonesia, 1 GW from Cambodia, and 1.2 GW from Vietnam. Singapore operates a carbon tax since 2019 and is positioning itself as a regional carbon trading hub through Article 6 cooperation agreements with Cambodia, Laos, Vietnam, and the Philippines.

Financing and Investment Mechanisms

ASEAN requires approximately $56 billion annually in power investment from 2023-2030, yet actual international renewable investment reached only $43 billion in 2022, highlighting a significant financing gap. To address this, regional initiatives include:

1

Just Energy Transition Partnerships (JETP) in Indonesia and Vietnam, leveraging international financial support for coal phase-out and renewable expansion.

2

ASEAN Climate Finance Mobilisation and Access Strategy, promoting green bonds, green sukuk, and sustainable finance instruments aligned with ASEAN Green Bond Standards.

3

Green Investment Tax Allowance and Green Income Tax Exemption in Malaysia, alongside tax incentives, import duty waivers, and preferential loans across most ASEAN countries.

4

ASEAN-UK Green Transition Fund, providing technical assistance for clean power systems, green grids, and industrial decarbonization.

Emerging Technologies and Cross-Border Initiatives

Renewable Energy Certificates (RECs)

Only the Philippines has a formal Renewable Portfolio Standards requiring RECs, while Indonesia is considering RPS legislation. Most ASEAN countries trade RECs domestically through international issuers like I-REC, though cross-border REC transactions face policy gaps including absence of shared regulations and lack of harmonized standards. Singapore's Energy Market Authority and multinational corporations are primary REC purchasers for voluntary renewable energy targets.

Hydrogen and Ammonia

The ASEAN Low-carbon Energy Technologies Roadmap (ALERT) provides a structured approach for hydrogen and ammonia integration across three phases: short-term (2025-2030) focusing on regional collaboration through a proposed Hydrogen ASEAN Alliance, medium-term (2031-2040) ramping up blue and green production, and long-term (2041-2050) achieving full integration.

Carbon Capture and Storage (CCS)

The ASEAN CCS Deployment Framework and Roadmap, published in September 2024, outlines policy recommendations for member states to facilitate CCS adoption, viewed as pivotal for achieving carbon neutrality by 2050.

Challenges and Implementation Gaps

Despite ambitious targets, the 8th ASEAN Energy Outlook projects delays in achieving energy intensity and renewable mix targets, now expected by 2026 and 2030 respectively, though the region is expected to exceed its installed renewable capacity target by 4%. Key barriers include limited market opportunities, insufficient transparency, regulatory complexities, fragmented market structures, infrastructure limitations, and technological barriers. Policy gaps preventing cross-border renewable trade include absence of shared energy sector regulations and need for harmonization of standards.

ASEAN's policy landscape demonstrates strong regional ambition tempered by practical implementation challenges, with success dependent on sustained international cooperation, adequate financing mobilization, and effective regulatory alignment across diverse national contexts.

Local Content Requirements in ASEAN Low Carbon Energy Sectors: An Evolving Policy Landscape

Local content requirements (LCRs) in ASEAN countries for renewable energy sectors vary significantly, reflecting different stages of industrial development and policy priorities.

- Indonesia initially set stringent LCRs at 40% for solar modules, 34% for goods, and 100% for services in on-grid solar PV projects. However, these requirements proved counterproductive given limited manufacturing capacity of only 500 MWp annually against solar potential of 532.5 GWp. Recognizing these constraints, Indonesia reduced its solar power plant local content requirement from 40% to 20% in August 2024, applicable to projects with power purchase agreements signed by end-2024 and operational by June 2026. Hydroelectric plant requirements decreased from 47.6-70.76% to 23-45%, while wind power plants now require only 15% local content.
- Malaysia and Vietnam have adopted more flexible approaches, with the absence of local content requirements potentially contributing to their emergence as key solar supply chain hubs in the region. Malaysia's Large Scale Solar reverse auction program, however, mandates at least 51% Malaysian equity for participating companies and consortia. Thailand applies a similar 51% local equity requirement, though it lacks specific local content regulations except for a 40% threshold for battery-powered electric vehicles in free zones.
- The Philippines recently lifted foreign ownership restrictions on renewable energy businesses, contributing to record-high investment levels. This policy shift demonstrates the potential benefits of relaxing ownership barriers for accelerating renewable energy deployment.

Exhibit 8 summarises the current LCR position across different ASEAN countries. This may be subject to unexpected change.

Exhibit 8: LCR in ASEAN Low Carbon Energy Sectors By Country

Indonesia

Indonesia has implemented some of the strictest LCRs in the region, though recent policy changes signal a shift toward more flexible arrangements. Under the Ministry of Energy and Mineral Resources (MEMR) Regulation No. 11/2024, the government has relaxed requirements to accelerate renewable energy deployment:

Solar Power Plants: Reduced from 40% to 20% local content for projects meeting specific conditions—signing power purchase agreements by December 31, 2024, and commencing commercial operations by June 30, 2026.

Wind Power Plants: Set at 15% minimum local content requirement.

Hydroelectric Plants: Reduced from 47.6-70.76% to 23-45%.

The previous regulations had mandated 40% local content for solar modules, 34% for goods, and 100% for services in on-grid solar PV projects. These strict requirements were widely criticized as bottlenecks to solar development, particularly given Indonesia's limited manufacturing capacity of only 500 MWp per year against its solar potential of 532.5 GWp.

Malaysia

Malaysia employs local content requirements primarily through its Large Scale Solar (LSS) program, emphasizing local equity participation rather than product sourcing:

LSS Program Requirements:

- Package 1 (1-10 MW): 100% Bumiputera equity, SME status required[9][10]
- Package 2 (10-30 MW): Minimum 51% Bumiputera equity, 100% local Malaysian equity[10][9]
- Package 3 (30-500 MW): Minimum 51% local Malaysian equity; foreign participation allowed[11][9][10]
- Package 4 (Floating solar, 10-500 MW): Minimum 51% local Malaysian equity[10][11]

The use of locally manufactured or assembled PV modules and inverters serves as one criterion for selecting winning bidders. This approach has positioned Malaysia as the third-largest global manufacturer of PV modules, though Malaysian products face slightly higher costs compared to Chinese imports.[8]

Thailand

Thailand maintains relatively minimal local content requirements for renewable energy:

No Specific LCRs for renewable energy projects, except for a 40% threshold for battery-powered electric vehicles in free zones.

Foreign Ownership: While up to 100% foreign ownership of power facilities above 1 MW is permitted, foreign stakeholders cannot own land and must comply with Board of Investment requirements. Thailand is considering increasing restrictions, with draft regulations potentially capping foreign ownership at 49% and requiring half of energy company directors to be Thai.

Community-Based Projects: Selected bidders must establish joint investments with locals, sharing 10% of the project company for social and welfare development.

Vietnam

Vietnam has notably **no mandatory local content requirements** for solar and wind energy projects. This absence of LCRs has contributed significantly to Vietnam's rapid renewable energy growth, positioning it as a key solar supply chain hub in the region.

The country's feed-in tariff (FiT) mechanism, introduced in 2017 at 9.35 USD cents/kWh (the lowest among ASEAN countries), drove explosive growth without local content restrictions. Between 2018 and 2023, Vietnam scaled solar and wind capacity from virtually zero to over 21,000 MW.

Philippines

The Philippines has adopted a **flexible approach** to local content requirements:

No Strict Mandates: The Renewable Energy Act incentivizes the use of local materials and labor but does not mandate strict local content requirements.

Foreign Ownership: As of 2022, 100% foreign ownership is permitted for solar, wind, hydropower, and ocean energy projects. Geothermal resources remain subject to a 40% foreign capital limit except for large-scale projects under financial or technical assistance agreements.

This liberalization has contributed to the Philippines' renewable energy boom, with the country now representing approximately 80% of ASEAN's announced pipeline projects (185 GW out of 222 GW).

Singapore

Singapore has **no local content requirements** for renewable energy. The city-state focuses instead on importing up to 4-6 GW of low-carbon electricity by 2035 (representing approximately 30% of projected electricity supply) and maximizing domestic solar deployment to 2 GW.

Other ASEAN Countries

Brunei, Cambodia, Laos, and Myanmar have not implemented significant local content requirements for renewable energy sectors. These countries are at earlier stages of renewable energy development, with policies focused primarily on attracting investment rather than mandating local sourcing.

Regional Trends

The absence or relaxation of local content requirements appears correlated with faster renewable energy deployment. Malaysia and Vietnam, both positioned as solar supply chain hubs, demonstrate that strategic approaches—whether through equity requirements (Malaysia) or no LCRs (Vietnam)—can achieve industrial development goals while accelerating clean energy transitions.

From an investor perspective, relaxed LCRs allow project developers to source materials and technologies from the most efficient global suppliers, potentially accelerating the adoption of advanced technologies not available locally. However, countries like Indonesia are attempting to balance this with support for domestic manufacturing through temporary relaxations and investment requirements.

Trade Barriers, Tariffs, and Certifications in ASEAN Low Carbon Energy Sectors

The ASEAN region faces a complex landscape of trade barriers, tariffs, and certification requirements that significantly impact the development and deployment of low carbon energy technologies. While the region has committed to ambitious renewable energy targets, aiming for 45% renewable electricity capacity by 2030, various regulatory, financial, and technical obstacles continue to shape the sector's trajectory.

Trade Barriers and Import Tariffs

Tariff Structure and Import Duties

ASEAN countries exhibit varied tariff structures for renewable energy equipment. Notably, Malaysia imposes tariff rates exceeding 15% on key solar PV components, increasing costs. Conversely, all ASEAN nations offer tax incentives and import duty waivers to promote renewable energy deployment. External trade actions, such as the US anti-dumping and countervailing duties on solar cells from Cambodia, Malaysia, Thailand, and Vietnam (effective June 2025), have severely impacted the region, redirecting manufacturers to domestic and alternative export markets.

Non-Tariff Barriers

Technical barriers to trade (TBTs) create significant non-tariff obstacles, including complex regulatory approvals for duty exemptions and frequent document submissions, increasing business costs. Additionally, specific inspections by destination countries and a lack of timely information on new regulations further impede trade. Malaysia and Thailand, for example, enforce strict certification and quality standards for imported photovoltaic products, leading to higher testing costs and longer market entry times.

Certification and Standards Framework

National Certification Systems

ASEAN countries have developed diverse certification frameworks for low carbon buildings. Key green building rating tools include Indonesia's Greenship, Malaysia's Green Building Index (GBI), Singapore's BCA GreenMark, and Vietnam's LOTUS. Implementation varies significantly: some countries, like Brunei and Thailand, mandate green building codes for government buildings, while Singapore requires minimum environmental sustainability standards for new large developments. Indonesia mandates codes for large buildings (e.g., 10,000-50,000 m^2 in Jakarta), but some sectors remain largely unregulated.

Renewable Energy Certificates

Renewable Energy Certificates (RECs) are emerging as crucial market-based instruments for tracking and verifying clean electricity generation, commonly denominated in one-megawatt hour (MWh) units. Singapore has established SS 673 for RECs, and Malaysia is developing its own framework. ASEAN transactions utilize international standards like I-REC and TIGRs, with bundled REC transactions available through utilities in Indonesia, Malaysia, Thailand, and Vietnam.

A significant challenge remains as global sustainability reporting standards (e.g., CDP, RE100) do not yet recognize cross-border RECs associated with ASEAN Power Grid interconnections. The operationalization of Article 6 mechanisms under the Paris Agreement provides a potential framework for future cross-border REC guidelines.

ASEAN Taxonomy for Sustainable Finance

The ASEAN Taxonomy for Sustainable Finance is a landmark regional effort to provide consistent classification of sustainable economic activities, addressing fragmentation that previously deterred investors. Version 2 expanded principles to finance transition activities, including coal phase-out, and accommodates diverse national decarbonization pathways while aligning with Paris Agreement goals.

Regional Carbon Market Development

Emerging Carbon Pricing Mechanisms

ASEAN countries are gradually implementing carbon pricing mechanisms, but progress is varied. Singapore currently operates a carbon tax, while Indonesia has launched an emissions trading system (ETS) for coal power plants, with its carbon tax postponed. Thailand plans a carbon tax of 200 baht ($5.60 USD) per tonne CO2e on oil products. Malaysia's National Carbon Market Policy is under development for 2026, and Vietnam plans a pilot ETS from 2025-2027, targeting full operation by 2028.

ASEAN Common Carbon Framework

The ASEAN Common Carbon Framework (ACCF) initiative calls for mutual recognition of carbon crediting methodologies to enable broader international acceptance of regional carbon credits. Indonesia has signed a mutual recognition agreement with Gold Standard, and Thailand has created premium T-VERs for international buyers.[20] Singapore is positioning itself as a regional carbon trading hub, having signed Article 6 cooperation agreements with Cambodia, Lao PDR, Vietnam, and the Philippines. The Thailand-Switzerland Article 6 cooperation marked a global first with the inaugural transfer of Internationally Transferable Mitigation Outcomes from an electric bus initiative.

Financial Instruments and Incentives

Tax Incentives and Green Finance

Malaysia offers comprehensive incentives like the Green Investment Tax Allowance. Vietnam provides Green Credit Funds and preferential loans. Indonesia has reduced basic customs duties on solar cells and modules, alongside implementing additional levies.

Green Bonds and Sustainable Finance

Green bond markets are expanding across ASEAN, primarily driven by public sector issuance, though Vietnam sees private commercial bank leadership. The ASEAN Low Carbon Energy Programme, a £15 million UK initiative, supports energy efficiency policy, data collection, investment scaling, and green bond advisory services.

Path Forward

ASEAN's low carbon energy sector development requires coordinated action. Key priorities include reducing tariff barriers, streamlining non-tariff measures, establishing clear governance, promoting intra-regional trade, and building trade facilitation capacity.

The establishment of a regional carbon market and mutual recognition agreements for certifications and technical standards can reduce compliance costs and facilitate technology transfer. These measures are crucial given the projected renewable energy capacity expansion (from 124.6 GW in 2025 to 178.1 GW by 2030) and substantial investment requirements through 2050. Success in these areas is vital for achieving net-zero emissions while ensuring energy security and economic competitiveness.

ASEAN operates under a common external tariff framework (CET) and various trade agreements like RCEP, which typically reduce renewable energy equipment tariffs to zero or near-zero rates. Bilateral agreements further establish preferential treatment.

Sustainability and Technical Certifications

- International Organization for Standardization (ISO) standards for equipment quality and project management
- Hydropower Sustainability Standard (HSS) for environmental and social governance compliance
- International Electrotechnical Commission (IEC) standards for wind energy equipment
- ASTM D7566 standards or equivalent EU specifications for Sustainable Aviation Fuel

Regulatory and Investment Challenges

Grid Infrastructure and Technical Requirements

Regulatory and procedural barriers include grid connectivity and aging infrastructure. Vietnam exemplifies these challenges, where rapid renewable energy expansion has overwhelmed transmission capacity, leading to significant curtailment issues. Obtaining grid connection approvals, along with technical requirements and associated costs, substantially impacts project economics. The region critically needs investment in advanced energy storage solutions and grid modernization.

Policy Uncertainty and Investment Risk

Regulatory inconsistency poses significant risks for investors across ASEAN. Vietnam's renewable energy sector has faced substantial uncertainty due to frequent policy changes, including transitions from feed-in tariffs to auction mechanisms and significant tariff reductions. This has led to many developers facing bankruptcy risk. Clear and consistent regulatory frameworks are essential for investor confidence and sustained growth, as demonstrated by the Philippines' decision to lift foreign ownership restrictions, which rapidly boosted investment.

Competitive Landscape: Key Players and Market Positioning

- [ ] By Country
- [ ] By Sector

Country Specific Competitor Analysis

China

South Korea

Japan

Europe

UK Specific

Regional & Local Champions

Chinese Dominance Across the Value Chain

Market Position: China has established overwhelming dominance in ASEAN's renewable energy sector, representing the most formidable competitive threat.

Key Strengths:

- Controls **over 80% of global solar PV supply chain** from polysilicon to cells and modules
- Accounts for **nearly 90% of global cathode manufacturing capacity** and virtually all anode capacity for EV batteries
- Provides **unbeatably low costs** combined with advanced technology and ultra-fast build times
- Invested **over $2.7 billion into ASEAN renewables** between 2013-2023
- Chinese OEMs developing **16-20+ MW turbines** versus Western focus on 15 MW models

Market Activities:

- **Chinese companies back 70% of Indonesia's captive coal capacity** while simultaneously investing in renewables
- Major manufacturing presence: **Trina Solar operates factories in Vietnam**, Longi invested over **$1.1 billion in Malaysia facilities** employing 8,000+ people
- **88% of global offshore turbine orders in Asia** went to Chinese suppliers in 2023
- Southeast Asia became **world's second-largest solar module producer** (70 GW capacity) after China, largely with Chinese company support

Strategic Approach:

- **Dual strategy** of financing both coal and clean energy projects
- Focus on **complete supply chain integration** from manufacturing to installation
- **Aggressive pricing strategies** that undercut Western competitors
- Relocation of manufacturing to ASEAN to **avoid trade barriers** while maintaining cost advantages

South Korean Industrial Capabilities

Market Position:

South Korea brings world-class technology and manufacturing expertise but has more limited regional presence than Japan.

Key Strengths:

- Global leaders in **nuclear energy, smart grids, EVs, and energy efficiency** technologies
- Strong industrial players: **Samsung, Hyundai, POSCO** actively engaged in green energy projects
- **$1.2 billion green hydrogen project** in Indonesia
- Korean companies secured **$3.4 billion in Southeast Asian projects** in 2024, up 79.1%

Market Activities:

- **Sarawak H2biscus Project** (Malaysia) with POSCO and Samsung Engineering targeting **200,000 tonnes of green hydrogen by 2027**
- Focus on EV assembly and component manufacturing hubs in Thailand
- Developing Small Modular Reactor (SMART) technology for archipelagic nations

Strategic Focus:

- Technology transfer and joint ventures with local partners
- Integration of energy systems with broader industrial development
- Positioning as bridge between advanced technology and ASEAN development needs

Japanese Strategic Positioning

Market Position: Japan acts as a major strategic partner with deep institutional relationships but faces challenges in renewable deployment.

Key Strengths:

- **Leading financial backer**: Japan's public institutions provided **USD 41 billion for fossil fuels versus USD 9 billion for clean energy** in Asia (2013-2022)
- Strong technology transfer capabilities in **biomass co-firing, LNG-to-power, and hydrogen/ammonia**
- **Asia Zero Emissions Community (AZEC)** initiative includes nearly all ASEAN nations
- Deep institutional relationships through decades of energy sector collaboration

Competitive Weaknesses:

- **Heavy emphasis on LNG as transition fuel** rather than direct renewable deployment
- Focus on unproven technologies (hydrogen, ammonia, CCUS) rather than established solar/wind
- Lost market share in solar PV and lithium-ion batteries to Chinese competitors
- Investment profile favors fossil fuels 5:1 over renewables

Market Activities::

- **Over 30 LNG-related projects** supported in Asia-Pacific by July 2024
- Major geothermal investment: **USD 500 million Muara Laboh expansion** in Indonesia with 80 MW capacity
- Brunei-Japan hydrogen supply chain project establishing **world's first global hydrogen corridor**
- Focus on retrofitting existing coal plants with biomass co-firing technology

European Players and Market Strategies

Market Position: European companies once held dominant positions in wind power but face declining market share, particularly to Chinese competitors.

Key Strengths:

- **66.6% increase in European renewable production** (2006-2016) demonstrates technical expertise
- Strong in **offshore wind turbine manufacturing**: Vestas, Siemens maintain technological leadership
- European development finance institutions committed **substantial capital**: EU enhancing ASEAN Power Grid support
- Advanced expertise in **grid integration, electricity market design, and regulatory frameworks**

Market Activities:

- **EU Business Avenues program** bringing 40 European companies from 15 EU states to Indonesia and Singapore
- **UK's Actis GP planning $500 million investment** in Southeast Asian renewables over two years
- **British International Investment (BII)** joint venture with FMO and SUSI Partners creating **$120 million Sustainable Asia Renewable Assets Company (SARA)**
- **Octopus Energy committed £1.5 billion** in Asia-Pacific by 2027, including significant Southeast Asian focus

Competitive Challenges:

- **European OEMs' wind market share rapidly reversing** as Chinese manufacturers dominate new orders
- **All new Thai wind projects expected to deploy Chinese OEM technology** going forward
- European companies had **dominant role in 1.5 GW Thai wind** (2012-2017) but now largely displaced
- **Limited European involvement in renewable energy financing** despite technology deployment
- Higher costs compared to Chinese alternatives affecting competitiveness

UK-Specific Competitive Activities

Key UK Players and Initiatives:

- **British International Investment (BII)**: $70 million into SARA joint venture focused on Southeast Asian renewables
- **Octopus Energy**: £1.2 billion in renewables, £300 million in Tokyo tech hub expansion
- **UK-ASEAN Green Transition Fund**: Launched Clean and Just Energy Transition Pillar
- **Various UK cleantech companies** receiving government support for APAC expansion

Strategic Positioning:

- Focus on **green finance** and **technology innovation** rather than manufacturing scale
- Leveraging **CPTPP trade agreement** for enhanced market access
- Emphasis on **public-private partnerships** and development finance mechanisms

Regional and Local Champions

Malaysian Players:

- **Petronas**: Leading hydrogen export collaboration with ENEOS (Japan), exploring methylcyclohexane transport technology
- **Sarawak Energy**: Dominates hydropower (89% of Malaysia's renewables)
- Malaysian companies required for **51% domestic ownership** in renewable energy projects to access government schemes

Indonesian Players:

- **Pertamina**: Partnering with TEPCO for hydrogen/ammonia facilities, integrating geothermal and solar
- Indonesian firms benefit from **100% foreign ownership relaxation** for projects >1 MW capacity

Thai Players:

- **PTT Group**: Leading large-scale hydrogen and green ammonia production with partners like ACWA Power and Siemens Energy
- **Gulf Energy Development, Ratch Group, B.Grimm Power**: Multi-type energy firms expanding renewables
- **Energy Absolute, Super Energy**: Pure-play renewable producers

Vietnamese Players:

- **Vietnam Electricity (EVN)**: State-owned utility dominates power sector, controls BOT schemes
- Local and international developers created **17 GW solar capacity surge** in 2020

Singaporean Coordination Role:

- **Sembcorp**: Cross-border collaborations for green hydrogen production and export
- **Singapore Energy Market Authority**: Leading 200 MW/200 MWh battery storage deployment
- Positioning as **regional green finance and technology hub**

Competitor Analysis By Sector

Offshore Wind	Carbon Capture and Storage	Hydrogen and Ammonia
Solar	Energy Storage and Batteries	Cross-Border Trade and Energy Transmission

Offshore Wind

Market Leaders:

- **Chinese manufacturers** (MingYang Smart Energy, CNOOC) dominating floating offshore wind in Asia-Pacific
- **Vestas, Tohoku Electric, BW Ideol** as established international players
- **Aker Offshore Wind, Ocean Winds, Shell, Green Investment Group** expanding presence

Market Opportunity:

- **Philippines first offshore wind auction** offering 3.3 GW for 2028-2030 delivery
- **Vietnam targeting 6 GW offshore wind by 2035** under Power Development Plan 8
- **Taiwan-Philippines connection** potential (less than 250 km) for shared infrastructure
- **Floating wind emerging** as critical technology for deep-water ASEAN sites

Competitive Dynamics:

- **Seabed conditions differ from Europe**: soft clay or hard rock, seismic activity, typhoons require different foundation approaches
- **Shallow water sites at premium**, driving rapid commercialization of floating wind
- **6 GW global floating capacity expected by 2030**

Carbon Capture and Storage

Market Leaders:

- **ExxonMobil, Shell, TotalEnergies, Petronas, Pertamina**: Established oil and gas majors driving CCS
- **Regional universities and research institutions** supporting development

Key Developments:

- **Petronas Kasawari CCS Project**: Largest CCS initiative in Southeast Asia (launched February 2025)
- **Indonesia-ExxonMobil collaboration** for offshore storage exploration (May 2025)
- **Vietnam's first CCS pilot** in coal-fired power plant (July 2025)
- **TotalEnergies CCS hub in Malaysia** with local partnerships (October 2025)

Market Outlook:

- **Singapore-Indonesia cross-border framework**: Indonesia allowing 30% storage capacity for foreign carbon
- **Policy frameworks developing** in Indonesia and Malaysia (Sarawak) with specific legal frameworks

Hydrogen and Ammonia

Market Leaders:

- **Petronas (Malaysia)**, **Pertamina (Indonesia)**, **PTT Group (Thailand)** as national champions
- **Japanese companies**: ENEOS, TEPCO, Tokyo Gas driving partnerships
- **International players**: ACWA Power, Siemens Energy providing technology

Strategic Projects:

- **Sarawak H2biscus**: 200,000 tonnes green hydrogen by 2027 (POSCO, Samsung Engineering)
- **Brunei-Japan supply chain**: World's first global hydrogen corridor operational
- **Thailand and Myanmar**: Identified as dominant players with 62% of ASEAN's exportable volume by 2050

Market Readiness:

- Most ASEAN hydrogen production currently "grey" (Indonesia, Brunei)
- **Malaysia and Singapore** among world's top 20 hydrogen exporters/importers
- **Regional roadmap targets short-term (2025-2030), medium-term (2031-2040), long-term (2041-2050) phases**

Solar Energy

Market Leaders:

- **Canadian Solar, JinkoSolar, Trina Solar**: Dominating Southeast Asian market
- **Thai Solar Energy Public Company, Scatec ASA**: Regional specialists
- **Taiwanese companies** (TSEC, Neo Solar Power) expanding aggressively into ASEAN markets

Market Dynamics:

- **Vietnam, Thailand, Philippines, Malaysia account for 98% of regional solar capacity**
- **Chinese-owned manufacturers hold 80% market share** in Malaysia's domestic solar production
- **Feed-in tariff schemes** proved highly effective in Vietnam (17 GW installed)
- **Rooftop solar gaining prominence** across ASEAN with new policies

Energy Storage and Batteries

Market Leaders:

- **GS Yuasa Corporation, Wärtsilä, BYD, Contemporary Amperex Technology (CATL), LG Chem**: Dominating ASEAN market
- **Philippines leading with ~30% market share** in 2024
- **Battery Energy Storage Systems (BESS)** segment experiencing rapid growth

Market Drivers:

- **Declining battery costs** making storage increasingly viable
- **Singapore's 200 MW/200 MWh battery storage program** driving deployment
- **Solar-plus-storage integration** becoming standard for new projects
- **Indonesia secured World Bank loan** for pumped storage facilities

Cross-Border Trade and Energy Transmission

ASEAN Power Grid initiative targets interconnection of national electricity systems through cross-border transmission and submarine cable installations. **Eighteen planned interconnection projects** would enable 200 GW of cross-border power trading by 2050, fundamentally altering energy trade patterns across the region. This initiative creates substantial infrastructure development opportunities for Scottish subsea cable providers, converter stations, and grid management technology companies.

Singapore-Malaysia cross-border electricity trading increased through 300 MW interconnections, with expansion to 1,500 MW under discussion. Singapore-Indonesia cross-border trading expanded through TotalEnergies-RGE project developing 1 GW of clean power export from Indonesia to Singapore via subsea interconnection, creating template for additional regional cross-border projects.

CO2 Transport and Storage Rights

Transboundary CO2 transport for CCUS deployment requires novel legal frameworks establishing rights to transport captured CO2 across international boundaries and utilise storage sites in neighbouring countries. Malaysia and Indonesia are negotiating frameworks for regional CCUS hub development with CO2 transport rights across maritime boundaries, representing emerging legal complexity for international project developers.

Summary & Conclusions

The ASEAN region presents an exceptional market opportunity for North East Scotland energy supply chain companies. The convergence of three factors creates compelling commercial case:

Massive Investment Scale

USD 3.7-6.7 trillion required investment to achieve carbon neutrality by 2050, with USD 137 billion annual funding shortfall

Technology Alignment

ASEAN's 40+ GW offshore wind pipeline (60% floating), USD 100+ billion decommissioning market, and emerging CCUS/hydrogen sectors perfectly align with Scottish capabilities

Competitive Opportunity

Limited regional supply capacity combined with Scottish competitive advantages create exceptional market positioning potential

Call to Action: North East Scotland companies should immediately initiate market assessment, partnership exploration, and preliminary project development. The ASEAN low carbon energy market opportunity awaits; Scottish energy leadership is ready. The window for market establishment is 2025-2027. Companies acting immediately and decisively will establish dominant market positions; late movers will find niches or face exclusion from premium opportunities.

Success in ASEAN markets would establish Scottish energy companies as major international players while securing long-term revenue growth, achieving significant social impact through climate action, and creating high-quality employment in North East Scotland supporting the region's energy transition.

Next Steps

Leverage the full potential of Perplexity AI to:

- [ ] Evaluate the ASEAN market potential for your own organisation.
- [ ] Identify and rank order market/project opportunities specific to your own company.
- [ ] Develop and implement a market entry and development strategy.

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