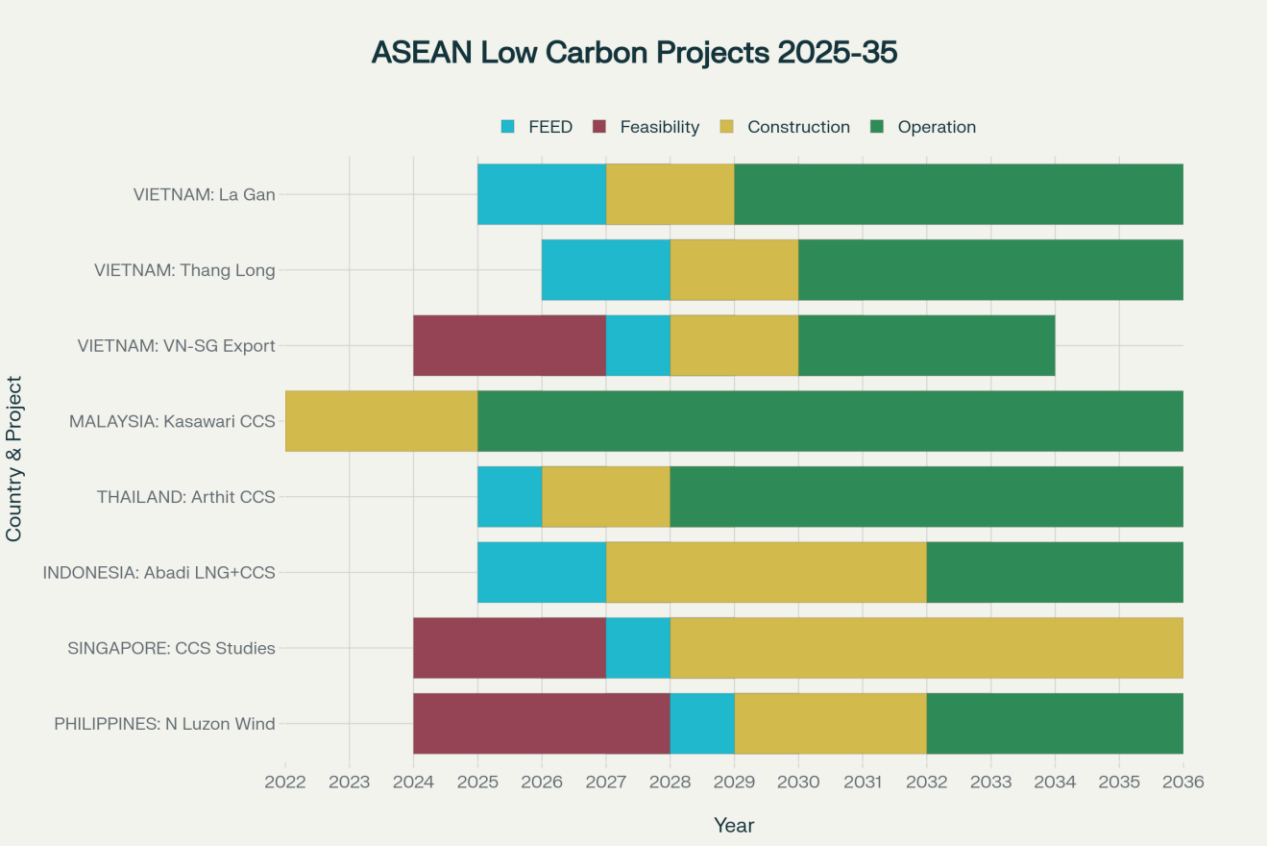
**DISCLAIMER:** This report has been prepared with the help of Perplexity AI (www.perplexity.ai). Especially for "mission critical" information, you are strongly advised to double check accuracy and authenticity using the extensive list of references provided. The report author cannot be held responsible for any factual errors. You can use the Perplexity AI platform to prepare a customised version of the report specific to the needs of your own business.

Dr Jim Hamill

---

# ASEAN LOW CARBON ENERGY PROJECTS & CONTRACTS

## A Strategic Report for the North East Scotland Energy Supply Chain




Timeline of major offshore low carbon energy projects across ASEAN region showing development phases from 2025 to 2035.

## Executive Summary

The ASEAN region is experiencing unprecedented growth in offshore low carbon energy development, with a combined project pipeline exceeding **$40 billion in capital expenditure** across offshore wind and

carbon capture & storage (CCS) initiatives. This analysis identifies **11 major projects** spanning six countries—Vietnam, Malaysia, Thailand, Indonesia, Singapore, and the Philippines—that present substantial opportunities for North East Scotland's energy supply chain companies. The projects range from Front-End Engineering Design (FEED) through to Engineering, Procurement, and Construction (EPC) phases, with the first wave of opportunities emerging immediately in 2025-2026.

North East Scotland companies can leverage their extensive North Sea oil and gas expertise, particularly in subsea engineering, offshore platform design, CCS technology, and harsh environment operations, to capture an estimated **$3.5-7 billion market share** over the next two decades. The region's competitive advantages include proven track records in deep-water operations, floating foundation technology, carbon capture integration, and long-term operations and maintenance (O&M) services—all critical capabilities for ASEAN's emerging offshore energy sector.

## Market Overview: ASEAN's Energy Transition Imperative

The Association of Southeast Asian Nations has committed to ambitious decarbonization targets, with regional carbon neutrality strategies driving substantial investment in offshore renewable energy and CCS infrastructure. According to the ASEAN Centre for Energy's 8th Energy Outlook, the region aims to achieve **35% renewable energy in installed power capacity by 2030**, though current projections suggest delays until 2030 for meeting renewable energy mix targets. The power sector, which accounts for over half of ASEAN's total emissions, requires comprehensive decarbonization through both renewable energy deployment and carbon management technologies.[1][2]

Southeast Asia faces unique energy challenges that create opportunities for offshore solutions. Land constraints, particularly in city-states like Singapore, combined with exceptional offshore wind resources—estimated at **178 GW technical potential in the Philippines alone**—drive the shift toward marine-based renewable energy. Vietnam's Power Development Plan 8 (PDP8) targets **6 GW of offshore wind by 2030, scaling to 70-91.5 GW by 2050**, while the Philippines has awarded **92 offshore wind energy service contracts with combined capacity exceeding 65 GW**.[3][4][5]

Carbon capture and storage represents the complementary pillar of ASEAN's decarbonization strategy. The ASEAN CCS Deployment Framework identifies Indonesia, Malaysia, Thailand, and Vietnam as leading markets, with Malaysia's Kasawari project establishing the region's first major offshore CCS facility. Thailand's Arthit CCS project, which received final investment decision in September 2025, demonstrates governmental commitment to flagship emissions reduction initiatives. Singapore's feasibility studies for power sector CCS, with **potential to abate 2.5 million tonnes CO2-equivalent by 2030**, represent 20%

of the nation's projected emissions reductions—comparable to replacing one million gasoline vehicles with electric alternatives.[6][7][8][9][10][11]

The financing landscape reflects strong international support for ASEAN's energy transition. Offshore wind projects increasingly utilize multi-sourced financing structures combining international commercial banks, export credit agencies, development finance institutions, and domestic lenders. The Global Wind Energy Council's recent study on innovative finance mechanisms demonstrates that blended finance approaches, including export credit guarantees paired with concessional finance, can reduce all-in interest rates by **120 basis points**, significantly improving project bankability. For Scottish companies, this financing architecture creates opportunities to participate through technology partnerships and risk-mitigation instruments familiar from North Sea developments.[12][13]

## Vietnam: Southeast Asia's Offshore Wind Powerhouse

### La Gan Offshore Wind Farm

The **La Gan offshore wind farm** represents one of Southeast Asia's most ambitious renewable energy projects, with planned capacity of **3,500 MW (3.5 GW)** positioned off the coast of Binh Thuan province in the South China Sea. Developed by Copenhagen Infrastructure Partners (CIP) in partnership with Asia Petroleum Energy and Novasia Energy—each holding 33.33% stakes—the project targets first power generation by **2029** with construction expected to commence in **2025**. The wind farm will span approximately **600 km²** of marine area and utilize turbines of **12 MW capacity or larger**, mounted on fixed-type foundations.[14][15][16]

La Gan's strategic importance extends beyond its generation capacity. The project is designed to **power more than 7 million households** and offset **130 million tonnes of CO2 emissions annually**, making it a cornerstone of Vietnam's renewable energy transition. Copenhagen Offshore Partners, the project management entity, brings global offshore wind expertise to ensure implementation of the highest international standards and most advanced wind-power technology. The development timeline positions La Gan among Vietnam's first large-scale offshore wind installations, establishing critical precedents for regulatory frameworks, supply chain development, and grid integration protocols.[15][16][17][14]

For North East Scotland companies, La Gan presents **FEED engineering opportunities** estimated at $50-100 million commencing in 2025-2027, followed by **EPC contracts valued at $1-1.5 billion** for Phase 1 construction. Scottish firms with expertise in **offshore platform design, subsea engineering, foundation installation, and marine operations** are well-positioned to contribute technical services. The project's scale requires specialized capabilities in **harsh environment operations**—a hallmark of

North Sea experience—particularly for installation methods in the challenging South China Sea conditions. Long-term **operations and maintenance contracts**, potentially valued at $200-300 million over 20 years, represent sustained commercial engagement opportunities beginning in 2029.

### Thang Long Offshore Wind Power Project

The **Thang Long offshore wind project**, located off Soc Trang province, targets **3,400 MW (3.4 GW) capacity** through multi-phase development led by Mainstream Renewable Power in collaboration with local Vietnamese partners. The initial phase will deliver **400 MW capacity**, with subsequent phases scaling to the full 3.4 GW target. Project construction timelines extend into the **2030s**, positioning Thang Long as a second-wave development that will benefit from lessons learned during La Gan's implementation.[16][18]

The project's technical approach combines **fixed-bottom and floating wind technology**, reflecting the varied water depths along Vietnam's extensive coastline. This technology mix creates specific opportunities for Scottish companies with **floating foundation expertise**—a capability increasingly critical as offshore wind development moves into deeper waters globally. Aberdeen-based firms that participated in Hywind Scotland, the world's first floating wind farm, possess directly transferable knowledge for Vietnam's deepwater sites.[16]

Mainstream Renewable Power's track record in emerging markets, including recent awards of fully-owned wind energy service contracts in the Philippines, demonstrates the company's commitment to Southeast Asian expansion. For Scottish supply chain participants, engagement during Thang Long's **FEED phase (expected 2026-2028)** offers opportunities to influence procurement specifications and establish preferred supplier relationships. **Environmental engineering services, subsea cable design, and installation planning** represent core competencies where North Sea experience provides competitive advantages.[19]

## Vietnam-Singapore Cross-Border Offshore Wind Export

The **Vietnam-Singapore renewable energy export project** exemplifies ASEAN's evolving approach to regional energy integration, with **2,300 MW total capacity** dedicated to cross-border electricity trade. Phase 1 targets **1,200 MW** of electricity imports to Singapore, transmitted via new **subsea cables spanning approximately 1,000 kilometers** from offshore Vietnam installations. This initiative directly supports Singapore's goal to import **up to 6 GW of low-carbon electricity by 2035**, representing approximately one-third of the city-state's energy demand.[20][21][22][23][24]

The project structure involves **Sembcorp Utilities** (Singapore) and **PetroVietnam Technical Services Corporation (PTSC)** under a Joint Development Agreement signed in February 2023. Sembcorp received conditional approval from Singapore's Energy Market Authority in October 2023 to import 1.2 GW, with potential expansion to **approximately 2 GW by 2035** as outlined in the March 2025 Joint Report on Offshore Wind Power Trade Cooperation. The imported electricity will harness offshore wind power and potentially other renewable generation forms, transmitted through subsea infrastructure connecting Vietnam's wind resources to Singapore's national grid.[21][22][23][20]

Current project status centers on **technical surveys and feasibility studies**, with joint survey work commencing in August 2024. Survey packages aim to provide accurate data on natural and technical site conditions, including wind resource assessment, hydrological measurements, seabed geological surveys, and identification of advanced technologies for offshore wind system development. The **FEED phase is expected during 2025-2027**, followed by **EPC procurement in 2027-2029** and construction extending to **2030-2033**, with first electricity imports potentially beginning as early as 2033.[22][23][21]

For Scottish companies, this cross-border project offers distinctive opportunities in **subsea cable installation, offshore-to-onshore transmission engineering**, and **multi-jurisdictional regulatory navigation**—capabilities developed through North Sea interconnector projects. The **1,000-kilometer subsea cable** represents one of ASEAN's longest marine transmission systems, requiring specialized installation vessels, cable protection systems, and long-term integrity management—all areas where Aberdeen-based contractors maintain global expertise. **FEED consultancy contracts** estimated at $80-150 million and subsequent **EPC values of $800 million to $1.2 billion** position this as a flagship opportunity for international collaboration.

## Malaysia: Leading Southeast Asia's CCS Development

### Kasawari Carbon Capture and Storage Project

The **Kasawari CCS project** stands as Southeast Asia's most advanced offshore carbon capture and storage development, with **3.3 million tonnes per annum (MTPA)** CO2 sequestration capacity operational by **end of 2025**. Located in **Block SK316 approximately 200 kilometers offshore Bintulu, Sarawak**, in water depths of **108 meters**, the project represents Malaysia's first CCS initiative and positions PETRONAS as a regional leader in carbon management technology.[25][26][7][27]

PETRONAS Carigali Sdn Bhd reached **Final Investment Decision on October 20, 2022**, followed by award of the **Engineering, Procurement, Construction, Installation and Commissioning (EPCIC) contract to Malaysia Marine and Heavy Engineering (MMHE) on November 3, 2022**. The EPCIC scope

encompasses construction of a **14,000-metric tonne topside**, a **15,000-metric tonne eight-legged jacket**, and a bridge connection to the existing Kasawari Central Processing Platform. The infrastructure includes a **138-kilometer, 16-inch subsea pipeline** delivering compressed CO2 for injection at the depleted M1 field reservoir.[26][7][27][25]

The project's construction phase involved competitive FEED selection, with MMHE partnering with Ranhill Worley competing against National Petroleum Construction Company (NPCC) with Technip Energies. MMHE's successful FEED proposal demonstrated cost competitiveness and technical capability, leading to the integrated EPCIC award. Installation activities, subcontracted to **McDermott International** in January 2024, utilize heavy-lift and pipelay vessels for transportation and structural installation of the 138-kilometer pipeline section, the 15,000-metric tonne CCS platform jacket, and the inter-platform bridge.[27][28][29][25][26]

For North East Scotland companies, Kasawari's **commissioning in late 2025** transitions the project from construction to **long-term operations and maintenance** opportunities. Scottish firms specializing in **CCS monitoring and verification systems, platform maintenance, subsea integrity management**, and **CO2 injection optimization** can pursue **O&M service contracts** estimated at $50-100 million over 20-year operational periods. The project establishes critical benchmarks for subsequent Malaysian CCS developments, with PETRONAS positioning the country as a regional CCS solutions hub. Aberdeen companies that secure Kasawari O&M roles gain strategic positioning for **future CCS projects across ASEAN**, where PETRONAS collaborations with neighboring national oil companies create expansion opportunities.[7]

The Kasawari model demonstrates successful **technology transfer from oil and gas to carbon storage**, utilizing depleted hydrocarbon reservoirs and existing offshore infrastructure—an approach highly relevant to North Sea operators transitioning to CCS. Scottish engineers with experience in **platform conversions, CO2 handling systems**, and **subsea pipeline integrity** possess directly applicable expertise. Malaysia's regulatory framework, now established through Kasawari's development, provides clear legal and permitting pathways for future offshore CCS projects, reducing entry barriers for international technology providers.[6]

## Thailand: Pioneering CCS in the Gulf of Thailand

### Arthit Carbon Capture and Storage Project

Thailand's **Arthit CCS project** achieved a significant milestone with **Final Investment Decision in September 2025**, authorizing **USD 320 million (THB 10 billion)** investment over five years for the

nation's first carbon capture and storage development. Located at the **Arthit gas field in the Gulf of Thailand**, the project targets **1 million tonnes per year CO2 storage capacity**, with operations scheduled to commence in **2028**.[8][30][31][10]

PTT Exploration and Production Public Company Limited (PTTEP), Thailand's national petroleum exploration and production company, serves as project operator with extensive preparation including **reservoir assessments at depths of 1,000-2,000 meters, engineering design, and comprehensive Measurement, Monitoring and Verification (MMV) programs**. The development leverages **existing Arthit field infrastructure** while constructing additional facilities as required, ensuring capital efficiency and accelerated implementation timelines. Notably, the CCS operations will **not impact natural gas production** at Arthit, which supplies approximately **8% of Thailand's domestic natural gas demand** and has increased contracted delivery from 280 million $ft^3$/day to 330 million $ft^3$/day as of June 2025.[30][32][10][8]

The Arthit CCS project aligns with Thailand's **Nationally Determined Contribution (NDC) Action Plan on Mitigation 2021-2030**, endorsed by the government as a flagship greenhouse gas reduction initiative. Thailand aims to reduce GHG emissions by **30% from business-as-usual levels by 2030**, potentially increasing to 40% with technology transfer, financial resources, and capacity building support, while targeting **carbon neutrality by 2050 and net-zero GHG emissions by 2065**. The government has approved consideration of **investment support measures including tax incentives** for the Arthit CCS project, signaling policy commitment to commercial-scale CCS deployment.[31][10][8][30]

For North East Scotland energy supply chain companies, Arthit presents **immediate EPC tender opportunities** in Q3-Q4 2025 with contract awards expected in **Q1-Q2 2026**. The **$320 million total investment** translates to **$200-250 million in construction EPC contracts** and **$50-80 million in specialized subcontracting** for Scottish firms offering **CCS platform engineering, CO2 compression technology, subsea wellhead equipment**, and **MMV systems**. Aberdeen-based companies such as those supporting the Acorn CCS project in Scotland possess directly transferable expertise in **platform conversion for CO2 injection, reservoir monitoring, and corrosion management for supercritical CO2 transport**.

PTTEP's strategic vision positions Arthit as a **pilot for cultivating CCS expertise and driving adoption** across Thailand's **Eastern CCS Hub in the Northern Gulf of Thailand**. This hub concept mirrors Scotland's emerging St. Fergus CCS cluster, where coordinated industrial emitters share transport and storage infrastructure. For Scottish companies, successful participation in Arthit creates **pathways to subsequent Thai CCS projects** and establishes credibility in Southeast Asian markets. Mitsui Oil

Exploration Company (MOECO) holds a **4.7619% participating interest** in the project, demonstrating Japanese involvement and potential for tri-lateral UK-Thailand-Japan technology collaboration.[32][10][30]

The project timeline—with **commissioning and startup in 2028**—allows Scottish firms to position for **commissioning support services and long-term O&M contracts** estimated at $30-50 million for O&M setup and ongoing operations. North Sea expertise in **offshore CCS operations, particularly CO2 injection well management and long-term monitoring**, provides competitive advantages in a market where operational CCS experience remains limited across Southeast Asia.

## Indonesia: Mega-Project Integration of LNG and CCS

### Abadi LNG Project with Integrated Carbon Capture and Storage

The **Abadi LNG project** represents one of Asia's most ambitious energy developments, combining **large-scale LNG production with integrated carbon capture and storage** in a **$20 billion investment** targeting **9.5 million tonnes per year of liquefied natural gas** production and substantial CCS capacity. Located in the **Masela Block in the Arafura Sea, 170-180 kilometers southwest of the Tanimbar Islands** in water depths of **400-800 meters**, the project exemplifies Indonesia's approach to balancing energy security with decarbonization imperatives.[33][34][35]

INPEX Corporation holds **65% operator interest**, with **PT Pertamina Hulu Energi Masela (20%)** and **PETRONAS Masela (15%)** as partners following Shell's withdrawal and stake redistribution in October 2023. This ownership structure brings together Japanese technological leadership, Indonesian national oil company participation, and Malaysian offshore expertise—creating a genuinely Asia-Pacific development model. The Indonesian government approved an initial development plan in 2019, but INPEX submitted a **revised plan in April 2023 incorporating CCS technology**, which received approval in December 2023, demonstrating the country's commitment to world-class environmental standards for new fossil fuel developments.[34][33]

**Front-End Engineering Design (FEED) work commenced in August 2025** across multiple contract packages, with INPEX awarding three major consortia for offshore facilities and two for onshore LNG plant engineering. For the **offshore FPSO (Floating Production Storage and Offloading) facilities**, two consortia compete in a dual FEED approach: (1) **PT Technip Engineering Indonesia (lead), PT Technip Indonesia, and PT JGC Indonesia**, and (2) **PT Saipem Indonesia (lead), PT Tripatra Engineers & Constructors, PT Tripatra Engineering, and PT McDermott Indonesia**. This competitive FEED structure ensures the most technically and commercially compelling solution proceeds to the **EPC phase expected to commence in 2027**.[35][36][33][34]

The onshore LNG plant FEED involves **JGC/Technip Energies consortium** and **KBR/Samsung E&A/PT Adhi Karya consortium**, both developing designs for facilities on **Yamdena Island in Maluku Province**. Additionally, **PT Worley SEA Indonesia** manages FEED for **subsea umbilicals, risers, flowlines (SURF), and the gas export pipeline** from the FPSO to the onshore LNG complex. All engineering packages integrate **Carbon Capture and Storage components**, reflecting the project's pioneering status as the **first LNG development launching CCS during initial production** rather than as retrofit.[36][33][34]

For North East Scotland companies, Abadi represents the **single largest commercial opportunity** in ASEAN's offshore energy sector. The **FEED phase (2025-2027)** involves approximately **$200-300 million in engineering services**, while the subsequent **EPC phase (2027-2032) encompasses $3-5 billion in total construction value**. Scottish firms with **FPSO design expertise, CCS integration capabilities, subsea engineering proficiency**, and **deep-water operations experience** can pursue roles as tier-2 and tier-3 suppliers to the lead EPC consortia. Aberdeen's legacy in **North Sea FPSO projects** and recent **Acorn CCS development** provides credible credentials for Indonesian stakeholders.

Specific opportunities include **FPSO topside design for integrated CO2 capture**, **subsea tie-in engineering for production wells and injection wells**, **pipeline design for supercritical CO2 transport**, **condensate production systems** (targeting up to **35,000 barrels per day**), and **long-term integrity management systems** for combined LNG/CCS operations. The project's **early 2030s production startup** timeline allows Scottish companies to establish relationships during FEED, qualify for EPC subcontracts, and position for **commissioning support** and **multi-decade O&M services** valued at $500 million to $1 billion for installation phases and ongoing operations.[33][34]

Indonesia's regulatory framework for CCS, still developing through projects like Abadi, creates opportunities for Scottish companies to **provide policy advisory services and technology standards development**—roles where North Sea Transition Authority experience and UK CCS regulatory frameworks offer valuable precedents. The project also exemplifies **technology transfer from mature oil and gas basins** (North Sea) to emerging producers (Indonesia), a model that Scottish Enterprise and UK Department for Energy Security and Net Zero actively support through export credit guarantees and technical assistance programs.

## Singapore: CCS Feasibility Studies and Power Sector Decarbonization

### Singapore Power Sector Carbon Capture and Storage Studies

Singapore's Energy Market Authority (EMA) selected **five proposals from three major power generation companies**—Keppel Infrastructure, PacificLight Power, and YTL PowerSeraya—to conduct

**co-funded carbon capture and storage feasibility studies** for the power sector in July 2025. Each study receives **up to SGD 350,000 (approximately USD 273,000)** in grants, with completion expected by **January 31, 2026**. The studies investigate two primary **CCS pathways for Singapore's natural gas-fired power generation**, which currently accounts for **over 94% of electricity generation** and contributes roughly **40% of the country's total greenhouse gas emissions**.[37][9][38][11]

The **post-combustion carbon capture pathway** involves capturing CO2 directly from flue gases produced during natural gas combustion at power plants, while the **pre-combustion pathway** targets CO2 released during hydrogen production from natural gas, with the resulting hydrogen then combusted at power plants to generate electricity. Three studies focus on post-combustion technologies, and two examine pre-combustion approaches, providing comprehensive assessment of technological options for Singapore's constrained land environment.[38][39][37]

These feasibility studies represent critical groundwork for Singapore's **net-zero emissions target by 2050** and **import of approximately 6 GW of low-carbon electricity by 2035**. Carbon capture, utilization, and storage ranks among the **top three most impactful emission-reduction strategies** for Singapore, with potential to prevent **up to 2.5 million tonnes of CO2-equivalent emissions by 2030**—approximately **20% of projected national reductions**, comparable to replacing one million gasoline vehicles with electric vehicles. The EMA's Carbon Capture and Storage Programme Office emphasizes that **CCS deployments must be customized to specific project conditions** such as location and demand, necessitating detailed site-specific studies before large-scale implementation.[9][11][24][38]

For North East Scotland companies, the completion of feasibility studies in **January 2026 opens pathways to pre-FEED and FEED engineering contracts** estimated at **$30-50 million** for subsequent detailed design phases. Scottish firms with expertise in **post-combustion capture technology, hydrogen production and integration, power plant modifications**, and **cross-border CO2 transport infrastructure** possess competitive advantages. The **S-Hub consortium**, led by Shell and ExxonMobil, has studied cross-border CCS since 2024, exploring pathways to transport captured CO2 from Singapore to overseas storage sites, particularly in Indonesia. This cross-border model creates opportunities for Scottish companies with **subsea pipeline experience and international CCS project development** capabilities.[9]

Singapore's power generation companies conducting feasibility studies represent potential long-term partners. **Keppel Infrastructure** operates major power assets and pursues clean energy diversification; **PacificLight Power** plans a **hydrogen-ready combined cycle gas turbine (CCGT) facility** to supply at least **600 MW from January 2029**; and **YTL PowerSeraya** manages significant generating capacity requiring decarbonization pathways. Establishing relationships during the feasibility phase positions

Scottish firms for **multi-decade partnerships** as Singapore transitions its baseload generation to low-carbon operations.[40]

The regulatory environment benefits from Singapore's **structured approach to energy transition**, with clear governmental support through EMA co-funding, policy frameworks for electricity imports, and commitment to achieving decarbonization targets. For Scottish companies, Singapore's status as a regional financial and trading hub provides **access to project financing, legal frameworks familiar to international investors**, and a **gateway to broader Southeast Asian markets**. Success in Singapore's CCS studies can serve as reference credentials for engagements across ASEAN, where governments increasingly look to city-state's pragmatic, technology-driven approach as a model.

Post-2030 deployment of **Singapore CCS infrastructure** could involve **$500 million to $1 billion in total EPC investment**, with Scottish companies contributing **engineering design for capture facilities, CO2 compression and liquefaction systems, marine loading terminals for CO2 shipping**, and **monitoring and verification technologies**. The North Sea Transition Authority's regulatory experience with Acorn, Dolphyn, and other UK CCS projects provides valuable precedents for Singapore's regulators navigating similar permitting and safety frameworks.

## Philippines: Emerging Offshore Wind Frontier

### Northern Luzon Offshore Wind Project

The **Northern Luzon offshore wind project**, developed by Copenhagen Infrastructure Partners (CIP), represents a **2,000 MW (2 GW) flagship development** that the Philippine Department of Energy selected as an **offshore wind frontrunner** in the national deployment strategy. Located off the northern Luzon coast, the project benefits from the Philippines' exceptional **178 GW technical offshore wind potential**, much of which exists in water depths exceeding **50 meters**, necessitating floating offshore wind technology.[5][41]

The Philippines' regulatory framework for offshore wind development underwent substantial evolution in 2024, with the DOE releasing **Revised Omnibus Guidelines Governing the Award and Administration of Renewable Energy Contracts**. Key provisions include granting developers **site exclusivity through Offshore Wind Energy Service Contracts (OsWESC) without requiring auction**, a **3-year Certificate of Authority (COA)** for pre-feasibility studies and surveys without consuming the 25-year OsWESC term, and **5 years with potential 2-year extension** to achieve Declaration of Commerciality. This framework, benchmarking UK offshore wind projects' **7-10 year development timelines**, allows developers to de-risk projects during early stages before major capital commitments.[42][41]

Northern Luzon's development timeline positions **pre-feasibility activities during 2024-2027 under COA**, **FEED engineering during 2027-2029**, **construction from 2029-2032**, and **commercial operations by 2032**. The **overall 12-15 year development timeline aligns with international offshore wind markets**, providing sufficient time for grid infrastructure upgrades, port development, and supply chain establishment that the Philippines currently lacks.[43][44]

For North East Scotland companies, Northern Luzon presents opportunities across the **entire project lifecycle**. During the **pre-development phase (2024-2027)**, Scottish firms can provide **marine spatial planning expertise, environmental impact assessment services, metocean data analysis**, and **floating foundation feasibility studies**—all areas where Aberdeen-based consultancies supported Scottish offshore wind developments. The **FEED phase (2027-2029)** creates demand for **floating wind foundation engineering, dynamic mooring system design, installation methodology development**, and **grid integration studies**, with contracts estimated at **$50-80 million**.

The Philippines' emphasis on **floating offshore wind technology**, driven by deepwater sites, aligns precisely with Scotland's global leadership in floating wind. **Hywind Scotland's operational success**, combined with **ScotWind projects incorporating floating platforms**, provides Scottish companies with proven track records for Philippine stakeholders. Aberdeen's **Energy Transition Zone**, backed by **£26 million government investment**, includes testing facilities for floating offshore wind components, creating collaborative opportunities for Filipino engineers to access world-class R&D infrastructure.[45]

Construction phase opportunities (2029-2032) encompass **$600 million to $1 billion per project** in EPC and installation contracts, with Scottish firms contributing **floating platform fabrication partnerships, mooring system installation, turbine installation vessel services**, and **subsea cable laying**. The Philippines' **dispersed archipelagic geography** creates challenges for port infrastructure and vessel logistics—problems familiar to Scottish supply chains serving remote North Sea locations and Shetland developments. Long-term **O&M contracts for floating wind**, less mature globally than fixed-bottom maintenance, represent areas where **Scottish innovation in condition monitoring, predictive maintenance**, and **remote operations** can establish competitive advantages.

The Philippine government's **Green Energy Auction Programme (GEAP)**, expected to extend to offshore wind in Q4 2025 with suggested ceiling prices of **10-16 PHP/kWh (approximately USD 0.18-0.29/kWh)**, provides revenue certainty for developers while the market establishes commercial viability. Scottish companies partnering with CIP or other developers can benefit from these support mechanisms while contributing technical excellence that reduces project risks and costs. The **National Grid Corporation of the Philippines (NGCP)** commitment to upgrade transmission infrastructure in

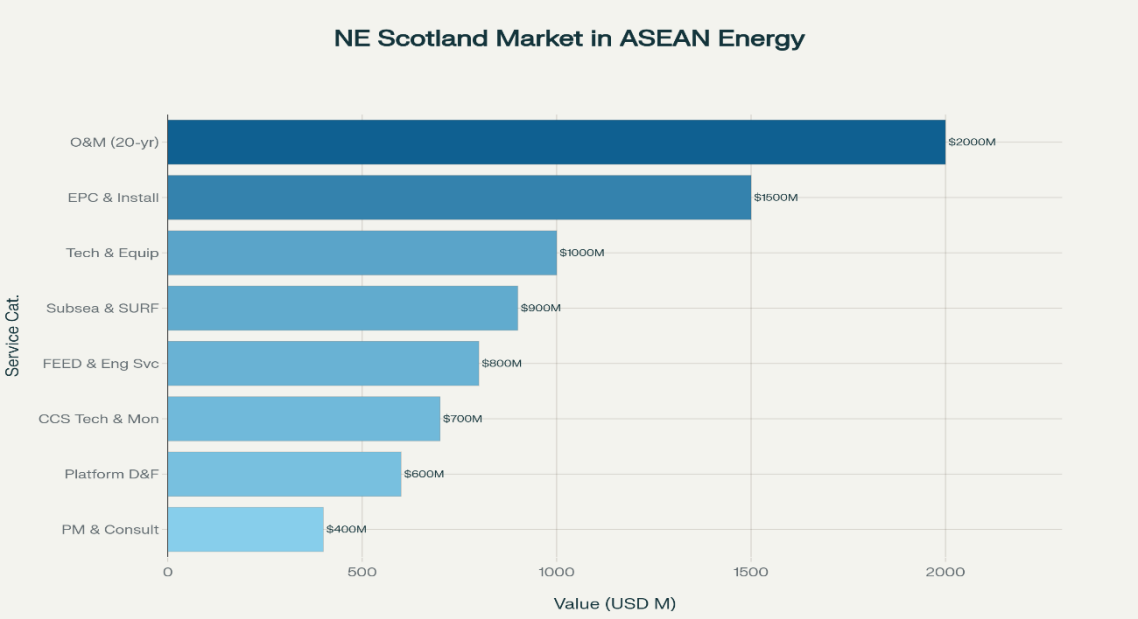
coordination with offshore wind timelines ensures grid access for projects achieving commerciality.[44][41][42][5]

## Guimaras Strait Wind Power Projects I & II

The **Guimaras Strait projects**, comprising two developments with **combined 1.2 GW capacity**, were among the **first offshore wind projects to obtain service contracts** in the Philippines. Developed by **Triconti Southwind Corporation (Project I)** and **Jet Stream Windkraft Corporation (Project II)**, the projects target offshore areas between **Negros Occidental and Iloilo Province**, benefiting from consistent wind regimes in the Visayan Sea.[5]

These pioneering projects, while at earlier development stages than Northern Luzon, establish important regulatory precedents and supply chain engagement models for subsequent Philippine offshore wind. For Scottish companies, Guimaras Strait represents **entry opportunities at project inception**, allowing influence over **procurement strategies, technical specifications**, and **local content partnerships** before more mature market dynamics emerge. The projects' location in the Visayas region, distinct from Luzon grid systems, requires **independent grid integration studies and transmission planning**—technical services where Scottish engineering consultancies with experience in island grid systems (Shetland, Orkney) offer relevant expertise.

## Opportunities for North East Scotland Energy Supply Chain Companies




Market opportunity analysis for North East Scotland energy supply chain in ASEAN region by service category

## Competitive Advantages and Market Positioning

North East Scotland's energy supply chain possesses **distinctive competitive advantages** for ASEAN offshore low carbon projects, derived from **over 50 years of North Sea oil and gas operations** and **leadership in offshore wind development**. The region's capabilities in **subsea engineering, offshore platform design, harsh environment operations**, and **deep-water installations** translate directly to Southeast Asian requirements, where projects increasingly target challenging sites in water depths exceeding **100-800 meters** and tropical cyclone zones.[33][34][46][47]

The **Aberdeen Energy Transition Zone**, supported by **£26 million Scottish Government investment**, creates a world-leading center for **research, development, testing, demonstration, and manufacturing** using cleaner energies including offshore wind, hydrogen, and carbon capture. Combined with **Aberdeen Harbour's £350 million investment** in combined marine and offshore support facilities, the infrastructure supports **large-scale project fabrication and deployment**—capabilities critical for ASEAN's mega-projects like Abadi LNG+CCS and La Gan offshore wind.[45]

Scottish companies' **track record in floating offshore wind technology**, including the world's first commercial floating wind farm Hywind Scotland and extensive ScotWind floating developments, positions them as **global leaders** in a technology essential for Philippines and Vietnam deepwater sites. The **European Offshore Wind Deployment Centre** in Aberdeen Bay provides testing and demonstration capabilities that attract international partnerships and validate Scottish innovation for Asian markets.[46][48][49]

## Technology Transfer and Innovation Export

The **transition from oil and gas to renewable energy and CCS** represents a core competency where Scottish experience directly applies to ASEAN markets. Southeast Asian national oil companies—PETRONAS, PTTEP, PetroVietnam—face similar challenges to North Sea operators in **repurposing offshore infrastructure, managing declining production fields, and deploying CCS using depleted reservoirs**. Scottish companies that successfully executed these transitions domestically can export proven methodologies, reducing risk for Asian counterparts.[25][8][50]

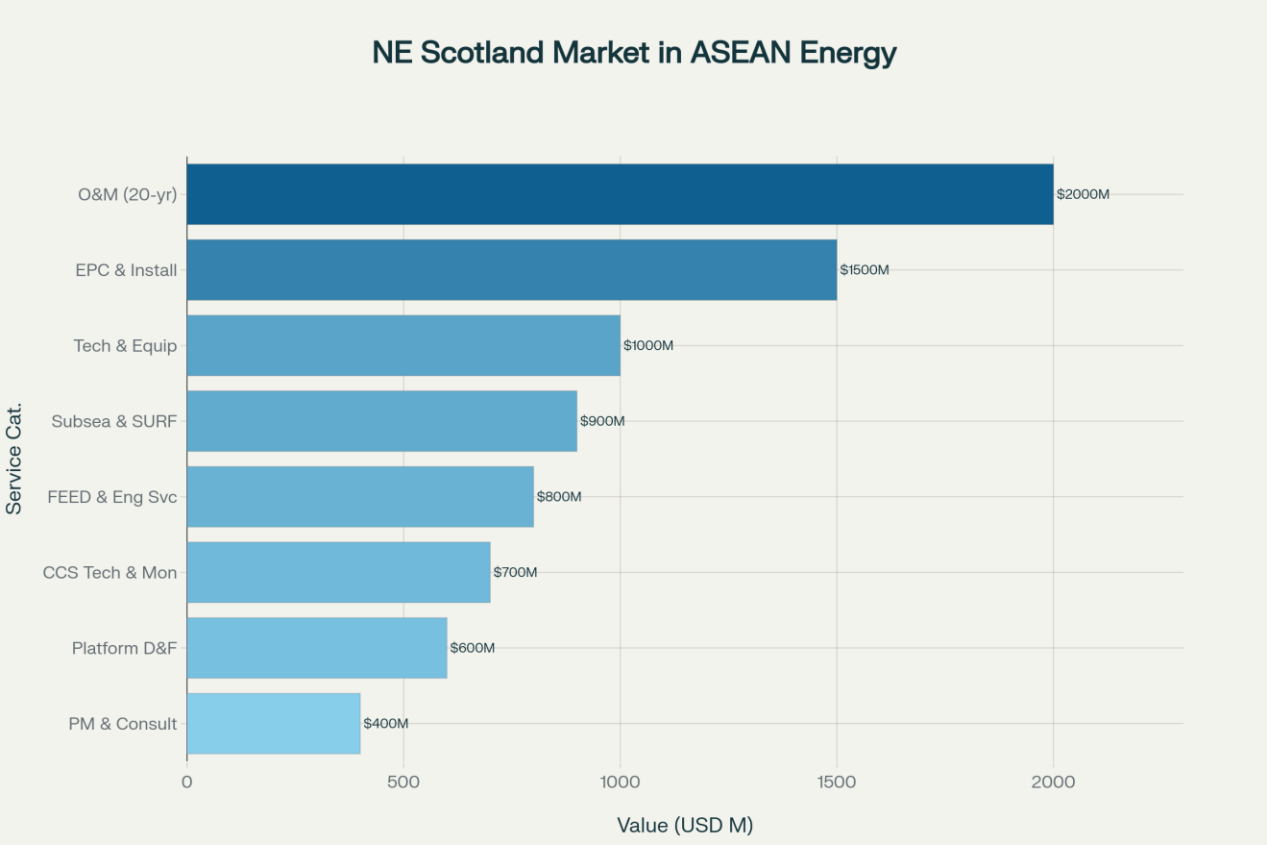
**Subsea engineering expertise**, particularly for **aggressive site conditions** characteristic of the North Sea, provides advantages in Southeast Asia's challenging environments. The **1,000-kilometer subsea cable** for Vietnam-Singapore electricity export, **138-kilometer CO2 pipeline** for Kasawari CCS, and **deep-water FPSO operations** for Abadi all require specialized capabilities that Aberdeen-based contractors developed through North Sea projects. The **Clean Energy Cluster Scotland**, serving as the

national offshore wind supply chain cluster, facilitates consortium formation and international market access for Scottish companies pursuing ASEAN opportunities.[34][51][52][22][25]

**Innovation in operations and maintenance** represents a high-value opportunity where Scottish companies can achieve **long-term market capture**. ASEAN offshore wind projects, requiring **20-25 year O&M contracts**, value proven reliability and condition monitoring technologies. Scottish firms developing **digital twin technologies, predictive maintenance algorithms**, and **remote operations centers** for North Sea wind farms offer competitive solutions for Southeast Asian projects seeking to minimize offshore personnel requirements and maximize availability.[46]

## Sector-Specific Market Opportunities

**FEED and engineering services** constitute the **first entry point** for Scottish companies, with aggregate opportunities of approximately **$800 million across identified ASEAN projects**. Early FEED engagement allows Scottish firms to **influence procurement specifications, establish preferred supplier status**, and **develop long-term relationships** with project developers. Immediate FEED opportunities include La Gan offshore wind ($50-100M, 2025-2027), Arthit CCS ($10-20M, 2025-2026), Vietnam-Singapore export project ($80-150M, 2026-2028), and Abadi LNG+CCS ($100-150M, 2025-2027).



Market opportunity analysis for North East Scotland energy supply chain in ASEAN region by service category

**Operations and maintenance services** represent the **largest long-term opportunity** at approximately **$2 billion over 2025-2045**. O&M contracts for offshore wind typically span **20-25 years** with revenues representing **15-25% of initial CAPEX**. For a 3.5 GW project like La Gan, O&M services could generate **$200-300 million** over the contract lifetime. Scottish companies with **proven North Sea O&M track records, vessel fleets, and remote monitoring capabilities** can capture significant market share, particularly as ASEAN projects prioritize minimizing offshore personnel through advanced technologies familiar to Scottish operators.

**EPC subcontracting and installation services** offer **$1.5 billion in potential contracts**, with Scottish firms typically serving as **tier-2 and tier-3 suppliers** to major Asian EPC contractors like MMHE, Saipem, and Technip Energies. Specialized services including **heavy-lift vessel operations, subsea tie-in installations, platform jacket erection**, and **foundation installation** leverage Scottish marine contracting expertise. The **dual FEED competition for Abadi FPSO** exemplifies opportunities where Scottish companies can align with competing consortia, increasing probability of contract awards.[34][35]

**CCS technology and monitoring systems** constitute a **$700 million market segment** where Scottish expertise provides clear differentiation. North Sea CCS projects—Acorn, Northern Endurance Partnership, Viking—establish Scottish companies as global leaders in **CO2 capture engineering, reservoir characterization, injection well design**, and **long-term monitoring and verification**. ASEAN's emerging CCS market, with Kasawari operational and Arthit commencing construction, requires these specialized capabilities. Scottish firms offering **MMV systems, CO2 compression technology**, and **integrity management for supercritical CO2 pipelines** can command premium positioning.[25][8][30]

**Subsea engineering and SURF (Subsea, Umbilicals, Risers, Flowlines)** represents **$900 million in opportunities**, particularly for complex projects like Abadi requiring **deep-water installations (400-800m)** and **long-distance tie-backs**. Aberdeen's status as a global subsea engineering hub, with companies like Subsea7, TechnipFMC, and Aker Solutions maintaining major facilities, provides access to world-class capabilities. The Abadi project's **SURF and gas export pipeline FEED contract to Worley** illustrates the scale of subsea engineering requirements, with Scottish firms capable of supporting prime contractors or pursuing direct awards.[36][34]

## Market Entry Strategies and Partnership Models

**Joint ventures with Asian fabricators and contractors** offer the most effective market entry strategy, combining Scottish **technical expertise with local market knowledge, fabrication capacity**, and

**regulatory navigation**. Malaysia Marine & Heavy Engineering's (MMHE) success on Kasawari and Abadi demonstrates local contractors' capabilities, while their partnerships with Ranhill Worley, Technip Energies, and Saipem show openness to international collaboration. Scottish companies can propose **technology licensing agreements, engineering services contracts**, or **equity partnerships** that leverage MMHE's fabrication yards while contributing North Sea-proven designs.[25][26][34]

**Direct engagement with project developers** during FEED phases establishes **preferred supplier relationships** before competitive EPC tenders. Copenhagen Infrastructure Partners, active on La Gan (Vietnam) and Northern Luzon (Philippines), maintains an **established presence in Scotland** through offshore wind investments, facilitating relationship development. INPEX Corporation's global LNG experience and **Japanese emphasis on quality and reliability** align with Scottish engineering standards, creating natural synergies for Abadi collaboration.[14][33][34][5]

**Government-to-government frameworks** through Scottish Enterprise, UK Department for Energy Security and Net Zero, and ASEAN energy agencies can **de-risk market entry** and provide **export credit support**. The **North Sea Transition Deal**, which includes provisions for **international supply chain development and CCS technology export**, offers frameworks for Scottish companies pursuing ASEAN opportunities. **UK Export Finance guarantees** and **Scottish Development International trade missions** reduce commercial risks while establishing governmental endorsement of Scottish capabilities.[53]

**Capacity building and skills transfer programs** create **long-term strategic relationships** while addressing ASEAN's need for **local workforce development**. Scottish universities—Aberdeen, Strathclyde, Heriot-Watt—can partner with Southeast Asian institutions to deliver **offshore engineering training, CCS technical courses**, and **O&M certification programs**. These educational partnerships, exemplified by Aberdeen's **Hydrogen Scotland cooperation with AquaVentus for European hydrogen development**, build trust and create alumni networks that influence future procurement decisions.[54]

## Critical Success Factors and Risk Mitigation

**Cost competitiveness** remains essential, as Scottish companies face **Asian fabricators with lower labor costs** and **European competitors with high-volume production facilities**. Success requires leveraging **innovation, reliability, and technical superiority** rather than competing on price alone. Scottish firms should target **high-value engineering services, specialized equipment**, and **long-term service contracts** where quality and track record justify premium positioning. **Early project engagement** during FEED allows Scottish companies to **influence specifications toward their capabilities**, creating technical differentiation that transcends cost competition.[46]

**Local content requirements**, increasingly prevalent across ASEAN nations, necessitate **partnerships with domestic companies** and **commitment to skills transfer**. The Philippines' evolving framework, Indonesia's national content policies, and Vietnam's preference for local participation require Scottish companies to structure **joint ventures with equity stakes for local partners, technology transfer agreements**, and **training programs for Southeast Asian engineers**. These requirements, while adding complexity, create **barriers to entry for competitors** and **long-term relationship stickiness** for Scottish companies that invest in local partnerships.[43][44]

**Track record demonstration** through **reference projects, case studies**, and **site visits** builds credibility with ASEAN stakeholders unfamiliar with Scottish capabilities. Companies should develop **North Sea-to-ASEAN technology transfer narratives**, showcasing how **Hywind Scotland floating wind experience** applies to Philippines deepwater sites, or **Acorn CCS development** informs Malaysian and Thai carbon storage projects. **Participation in regional conferences**—ASEAN CCS summits, Southeast Asia offshore wind forums—raises visibility and establishes thought leadership.

**Financial structuring** utilizing **export credit agencies, development finance institutions**, and **blended finance mechanisms** improves Scottish companies' competitive positioning. The Global Wind Energy Council's research demonstrates that **export credit guarantees combined with concessional finance reduce interest rates by 120 basis points**, significantly improving project economics. Scottish companies should coordinate with **UK Export Finance** to structure supplier credit facilities, performance bonds, and political risk insurance that enable Southeast Asian project developers to engage Scottish contractors with confidence.[13]

## Procurement Timelines and Contract Initiation

### Immediate Opportunities (2025-2026)

The **Kasawari CCS project's commissioning in Q4 2025** creates immediate **operations and maintenance tender opportunities** estimated at **$50-100 million over 20 years**. Scottish companies should engage PETRONAS Carigali now to position for O&M awards, emphasizing **North Sea CCS operational experience** and **remote monitoring capabilities** that reduce offshore personnel requirements. The project's status as **Southeast Asia's first major offshore CCS** establishes operational precedents, making early involvement strategically valuable for subsequent Malaysian and regional CCS projects.

**Thailand's Arthit CCS EPC tender launch** in Q3-Q4 2025 represents a **$200-250 million construction opportunity** with contract awards expected in **Q1-Q2 2026**. Scottish firms should target **EPC**

**subcontracts** for specialized packages including **CO2 compression systems, injection wellhead equipment, MMV instrumentation**, and **platform modification engineering**. PTTEP's extensive studies and **government endorsement as a flagship project** ensure procurement will proceed on schedule, with **tax incentive considerations** improving project economics.[8][30][10]

**Singapore's CCS feasibility studies completion in January 2026** opens pathways to **pre-FEED and FEED contracts** valued at **$30-50 million** for detailed engineering phases. Scottish companies should engage **Keppel Infrastructure, PacificLight Power, and YTL PowerSeraya** during the feasibility phase to understand site-specific requirements and position for subsequent engineering awards. The **power sector CCS pathway**—both pre-combustion and post-combustion—requires specialized expertise that Aberdeen firms developed through industrial CCS projects.

## Near-term Opportunities (2027-2030)

**Abadi LNG+CCS final investment decision and EPC tender in Q2-Q3 2027** represents the **single largest opportunity** at **$3-5 billion total EPC value**. The **dual FEED competition** underway provides Scottish companies opportunities to align with **both Technip/JGC and Saipem consortia**, increasing probability of eventual EPC participation. Specific high-value packages include **FPSO topside engineering, CCS integration systems, SURF installation**, and **subsea production systems** requiring deep-water expertise that Scottish contractors possess.[34][35][36]

**La Gan offshore wind FEED completion and EPC tender in Q3-Q4 2027** creates **$1-1.5 billion Phase 1 construction opportunities**. Scottish companies should pursue **foundation fabrication partnerships, subsea cable installation contracts**, and **grid integration engineering** roles. Copenhagen Infrastructure Partners' familiarity with Scottish capabilities through domestic wind projects facilitates engagement, while Vietnam's preference for **international technology transfer** supports Scottish involvement. The project's **12MW+ turbine specification** requires advanced installation methods where North Sea heavy-lift experience applies directly.

**Vietnam-Singapore cross-border wind export EPC procurement in 2027-2029** encompasses **$800 million to $1.2 billion in contracts** for the **1,000-kilometer subsea cable system** and offshore wind installations. The **multi-jurisdictional nature** involving Vietnamese generation, Singaporean import, and potential Malaysian transit creates regulatory complexity where Scottish companies with **North Sea interconnector experience** offer valuable expertise. **Sembcorp Utilities and PTSC's joint development agreement** establishes clear partnership structure, with procurement expected to favor international contractors with proven cross-border project delivery capabilities.[21][22]

### Medium-term Opportunities (2030-2035)

**Philippines offshore wind construction phase (2029-2032)** across Northern Luzon and other frontrunner projects represents **$600 million to $1 billion per project** in installation and EPC contracts. The **floating wind technology requirement** creates competitive advantages for Scottish companies with **Hywind operational experience** and **ScotWind floating platform expertise**. Department of Energy commitments to **first offshore wind auction in Q4 2025** and **streamlined permitting through Energy Virtual One Stop Shop (EVOSS)** accelerate project timelines, with construction commencing approximately **4-5 years post-auction** for frontrunner projects.[42][41]

**Long-term operations and maintenance** contracts across all operational offshore wind and CCS projects create **sustained revenue streams** beginning in the 2029-2035 period. La Gan's **commercial operations in 2029**, Abadi's **early 2030s startup**, and **Philippine projects' 2032+ commissioning** generate cumulative O&M opportunities exceeding **$500 million over initial contract terms**. Scottish companies establishing operational presence through early O&M contracts position for **contract renewals, performance-based extensions**, and **additional projects** as ASEAN's offshore energy fleet expands.

The **Malaysia-Singapore-Vietnam cross-border offshore wind project**, with **Phase 1 completion targeted for 2034**, represents emerging **multi-country collaboration models** that require sophisticated **regulatory navigation, transmission coordination**, and **O&M strategies spanning jurisdictions**. Scottish companies with experience in **European offshore wind grid integration** and **multi-country regulatory frameworks** can contribute advisory services and long-term operational contracts for this pioneering ASEAN interconnection.[55][24]

## Strategic Recommendations

North East Scotland energy supply chain companies should **prioritize immediate engagement** with projects entering FEED and EPC phases in 2025-2026, particularly **Arthit CCS, Kasawari CCS O&M**, and **La Gan offshore wind FEED**. Early relationship development with **Copenhagen Infrastructure Partners, PETRONAS, PTTEP**, and **Sembcorp** establishes credibility before competitive tenders, allowing Scottish capabilities to influence procurement specifications. Companies should develop **ASEAN-specific marketing materials** highlighting North Sea-to-Southeast Asia technology transfer, emphasizing **harsh environment operations, CCS operational experience**, and **floating wind leadership**.

**Consortium formation among Scottish companies** creates comprehensive service offerings that appeal to ASEAN developers seeking integrated solutions. The **Clean Energy Cluster Scotland** should facilitate working groups focused on ASEAN markets, coordinating trade missions, sharing market intelligence, and

developing joint bids that combine engineering consultancies, fabricators, service providers, and technology companies. This collaborative approach mirrors successful **Norwegian offshore wind consortia** that captured significant Asian market share through coordinated national strategies.[51]

**Government support mechanisms** through **Scottish Enterprise, UK Export Finance**, and **Department for Energy Security and Net Zero** should include dedicated **ASEAN energy transition programs** offering export credit guarantees, technical assistance funding, and diplomatic engagement with Southeast Asian energy ministries. **Memoranda of Understanding** between Scottish Government and ASEAN energy agencies can establish frameworks for technology cooperation, skills exchange, and preferential access for Scottish companies to regional projects.

**Investment in regional presence** through **representative offices in Singapore, Kuala Lumpur, Jakarta, and Manila** demonstrates commitment to long-term market development. Singapore's status as regional business hub makes it ideal for **cluster coordination**, while **country-specific offices** support relationship building with national oil companies and energy ministries. Scottish companies should consider **seconding personnel to Asian partners**, facilitating knowledge transfer while building relationships that influence future procurement decisions.

The **$40+ billion ASEAN offshore low carbon project pipeline** represents a transformational opportunity for North East Scotland's energy supply chain, with **estimated addressable market of $3.5-7 billion** over the next two decades. By leveraging **North Sea expertise, technological leadership in floating wind and CCS**, and **commitment to partnership-based market entry**, Scottish companies can establish sustainable positions in Southeast Asia's energy transition, creating jobs, generating export revenues, and contributing to global decarbonization goals while securing long-term commercial success.

## Appendix 1: References and Sources


1. https://aseanenergy.org/wp-content/uploads/2025/02/ASEAN-Energy-in-2025.pdf
2. https://www.wfw.com/articles/powering-asias-future-legal-insights-on-energy-transition-trends-for-2025/
3. https://www.gwec.net/gwec-news/gwec-report-outlines-crucial-next-steps-for-vietnam-to-scale-investment-and-achieve-offshore-wind-targets
4. https://www.reccessary.com/en/news/vietnam-offshore-wind-rates-eyes-first-project-by-2025
5. https://www.nortonrosefulbright.com/en-419/knowledge/publications/ba0cab35/global-offshore-wind-philippines

6. https://www.aseanenergy.org/wp-content/uploads/2024/09/Report-CCS-Deployment-Framework-and-Roadmap.pdf

7. https://www.petronas.com/media/media-releases/petronas-carigali-reaches-final-investment-decision-kasawari-ccs-project

8. https://www.argusmedia.com/ja/news-and-insights/latest-market-news/2729155-thailand-s-pttep-reaches-fid-on-arthit-ccs-project

9. https://www.reccessary.com/en/news/singapore-selects-3-companies-ccs-feasibility-studies

10. https://www.pttep.com/en/newsroom/press-releases/1083/pttep-moves-forward-with-thailand-s-first-ccs-project-at-arthit-field-to-advance-the-national-net-zero-goal

11. https://sg.news.yahoo.com/three-power-companies-chosen-study-090000251.html

12. https://www.nortonrosefulbright.com/en/knowledge/publications/1a59df58/the-next-frontier-offshore-wind-development-in-asia

13. https://windinsider.com/2025/11/15/gwec-study-reveals-how-innovative-finance-can-accelerate-offshore-wind-growth-in-southeast-asia-report/

14. https://www.laganoffshorewind.vn/project-overview/

15. https://www.power-technology.com/data-insights/power-plant-profile-la-gan-offshore-wind-project-vietnam/

16. https://the-shiv.com/vietnams-wind-power-industry/

17. https://www.intellinews.com/onshore-and-off-vietnam-s-battle-to-balance-its-wind-power-sector-395562/

18. https://globalreferral.group/sea-change-vietnams-offshore-wind-projects-leading-the-way/

19. https://www.lsprenewables.com/news/mainstream-to-develop-philippines-wind-pair-/

20. https://www.rajahtannasia.com/viewpoints/singapore-and-vietnam-advances-asean-power-grid-goal-through-offshore-wind-power-trade-cooperation-and-cross-border-electricity-trade/

21. https://www.energy-omni.com/en/news/article/267Zg14yj9wS6Zj6

22. https://en.qdnd.vn/asean-community/vietnam-and-asean/vietnam-singapore-renewable-energy-project-reaches-new-milestone-569407

23. https://www.pinsentmasons.com/out-law/news/singapore-to-import-low-carbon-electricity-from-vietnam

24. https://www.world-energy.org/article/52263.html

25. https://www.nmdc-energy.com/ar/media/press-releases/petronas-awards-dual-feed-contracts-for-world-s-largest-offshore-ccs-project/

26. https://mhb.com.my/wp-content/uploads/2022/11/MHB-Press-Release-Kasawari-CCS-Project-Award-29-Nov-2022.pdf

27. https://www.nsenergybusiness.com/projects/kasawari-carbon-capture-and-storage-project/

28. https://splash247.com/mcdermott-wins-work-on-malaysian-carbon-capture-project/

29. https://www.offshore-technology.com/news/mcdermott-kasawari-ccs-project-contract/

30. https://solarquarter.com/2025/09/22/pttep-launches-thailands-first-ccs-project-to-advance-low-carbon-energy-transition/

31. https://www.rigzone.com/news/thailand_to_proceed_with_first_ccs_project-09-sep-2025-181730-article/

32. https://www.mitsui.com/jp/en/topics/2025/1252244_14859.html

33. https://www.blackridgeresearch.com/project-profiles/abadi-lng-project-cost-location-contractors-production-start-date-feed-work-commencement

34. https://www.blackridgeresearch.com/news-releases/inpex-awards-three-feed-contracts-abadi-gas-development

35. https://www.saipem.com/en/media/news/Saipem-award-by-INPEX-of-a-FEED-contract-for-the-FPSO-module-of-the-Abadi-LNG-project-in-Indonesia

36. https://www.jgc.com/en/news/2025/20250827_11.html

37. https://asian-power.com/news/keppel-pacificlight-and-ytl-conduct-ccs-studies-power-sector

38. https://globalflowcontrol.com/newsroom/singapore-launches-ccs-study-for-power-generation/

39. https://www.gasworld.com/story/singapore-appoints-trio-to-research-ccs-pathways-in-power-generation/2161690.article/

40. https://www.hidrojenteknolojileri.org/en/hydrogen-news-from-asia-march-2025/

41. https://owcltd.com/media/blog/philippines-offshore-wind-a-market-on-the-rise/

42. https://www.linkedin.com/pulse/philippine-offshore-wind-industry-2025-lookahead-kenneth-juquiana-nw86c

43. https://www.carbontrust.com/sites/default/files/2025-03/PHORA State of the OSW Market_March25 approved version.pdf

44. https://reglobal.org/offshore-wind-development-in-vietnam-and-philippines/

45. https://www.sdi.co.uk/news/energy-transition-investment-and-scotlands-supply-chain

46. https://www.gov.scot/publications/case-studies-support-scenario-mapping-offshore-renewable-energy-development-economic-benefits/pages/12/

47. https://evidencehub.northeast-ca.gov.uk/downloads/588/north-east-offshore-wind-supply-chain-final-report-april-2020.pdf

48. https://www.sdi.co.uk/buy-from-scotland/energy-and-low-carbon-companies/offshore-wind-energy-companies

49. https://aberdeenrenewables.com/events/oeuk-north-sea-ccs-hydrogen-summit-2026/

50. https://aberdeenrenewables.com/member-news-xodus-new-ccus-report-forecasts-apac-to-become-largest-co2-shipping-market/

51. https://www.offshorewindscotland.org.uk/the-scottish-offshore-wind-industry/clean-energy-cluster-supply-chain/

52. https://www.offshorewindscotland.org.uk/media/12628/sowec-guide-for-scottish-exporters.pdf

53. https://oeuk.org.uk/wp-content/uploads/2022/07/NSTD-CCS-Supply-Chain-Report-2022-OEUK.pdf

54. https://www.hydrogenscotland.com/north-sea-hydrogen-cooperation-aquaventus-and-hydrogen-scotland/

55. https://www.oedigital.com/news/531394-southeast-asia-s-2gw-cross-border-offshore-wind-scheme-targets-2034-buildout

56. https://www.orrick.com/en/Insights/2025/09/APAC-Energy-Pulse-October-2025

57. https://www.eria.org/uploads/ASEAN-Low-carbon-Energy-Technologies-Roadmap-ALERT–Phase_I.pdf

58. https://asiacleanenergyforum.adb.org/wp-content/uploads/2025/06/2.4_Technology-Innovation-for-Sustainable-Energy-Transition-Hybrid-Carbon-Capture-and-Offshore-Storage-Solutions.pdf

59. https://iea.blob.core.windows.net/assets/ac357b64-0020-421c-98d7-f5c468dadb0f/SoutheastAsiaEnergyOutlook2024.pdf

60. https://www.kirkland.com/publications/kirkland-alert/2024/08/renewable-energy-outlook---asia-and-middle-east

61. https://www.sciencedirect.com/science/article/abs/pii/S0360319924039867

62. https://www.sciencedirect.com/science/article/abs/pii/S0360544225037569

63. https://ore.catapult.org.uk/wp-content/uploads/2020/09/Solving-the-Integration-Challenge-ORE-Catapultr.pdf

64. https://ember-energy.org/latest-insights/thailands-cost-optimal-pathway-to-a-sustainable-economy/cost-optimal-pathways-for-thailands-power-sector-d/

65. https://www.apec.org/docs/default-source/publications/2025/8/225_ewg_exchange-of-best-practices-for-the-development-of-green-hydrogen-roadmaps-in-the-asia-pacific-region.pdf?sfvrsn=32b16f5a_1

66. http://www.the-innovation.org/data/article/energy/preview/pdf/XINNENERGY-2025-0020.pdf

67. http://www.sipet.org/sipetpartnernewsdetails.aspx?id=wws7s8wXVN717FScAbJMbqGQ%3D%3D

68. https://www.offshore-energy.biz/petronas-assigns-work-on-malaysian-carbon-capture-and-storage-project-to-rina/

69. https://www.nortonrosefulbright.com/es-419/knowledge/publications/1a59df58/the-next-frontier-offshore-wind-development-in-asia

70. https://www.oecd.org/content/dam/oecd/en/events/2025/03/philippines-cefim-training/training-summary-offshore-philippines-march-2025.pdf

71. https://rmi.org/wp-content/uploads/dlm_uploads/2024/04/SE-Asia-Philippines-Wind.pdf

72. https://documents1.worldbank.org/curated/en/099225004192234223/pdf/P1750040b777da0c30935a0e2aa346f4e26.pdf

73. https://www.inpex.com/english/ir/library/pdf/presentation/e-Presentation20240909-a.pdf

74. https://www.globalccsinstitute.com/wp-content/uploads/2025/10/Global-Status-of-CCS-2025-report-9-October.pdf

75. https://aseanenergy.org/wp-content/uploads/2024/09/ASEAN-CCS-Deployment-Framework-and-Roadmap.pdf

76. https://www.linkedin.com/posts/energy-market-authority-ema-_studying-possibilities-for-singapores-low-carbon-activity-7350467732057833473-L3J8

77. https://energynews.pro/en/inpex-completes-feed-contract-awards-for-abadi-lng-a-key-milestone-in-indonesia/

78. https://www.nortonrosefulbright.com/en/knowledge/publications/3ce561c9/carbon-capture-and-storage-in-thailand

79. https://www.sserenewables.com/news-and-views/2023/04/renewable-is-biggest-economic-opportunity-in-scotland-say-90-of-supply-chain-firms/

80. https://www.sdi.co.uk/business-in-scotland/find-your-industry/energy-transition-industries/offshore-wind

81. https://www.aberdeencity.gov.uk/news/aberdeen-city-council-and-bp-sign-joint-venture-agreement-develop-city-hydrogen-hub

82. https://www.scottishrenewables.com/membership/directory

83. https://group.vattenfall.com/uk/newsroom/pressreleases/2022/aberdeen-hydrogen

84. https://www.offshore-mag.com/home/article/14212754/aberdeen-council-favors-bp-for-hydrogen-partnership

85. https://www.rgueti.com/wp-content/uploads/2022/06/Making-the-switch-images.pdf

86. https://greenfreeport.scot/invest

87. https://www.gov.scot/publications/scottish-offshore-wind-green-hydrogen-opportunity-assessment/pages/4/

88. https://www.scottish-enterprise.com/how-we-can-help/business-opportunities/offshore-wind-opportunity

89. https://www.mainstreamrp.com/markets-projects/asia-pacific/philippines/

90. https://ore.catapult.org.uk/wp-content/uploads/2020/10/OREC01_7468-SME-Report-2-Offshore-Wind-Market-SP.pdf

91. https://www.blackridgeresearch.com/blog/list-of-global-top-biggest-largest-offshore-wind-turbine-power-oems-manufacturers-companies-suppliers-in-the-world

92. https://www.offshorewind.biz/2023/12/13/siemens-gamesa-and-vestas-collaborate-to-standardise-equipment-for-transportation-of-wind-turbine-towers/

93. https://media.orrick.com/Media Library/public/files/insights/2024/orrick-global-offshore-wind-report-2024.pdf

94. https://www.vestas.com/en/energy-solutions/offshore-wind-turbines

95. https://cdn.orsted.com/-/media/www/docs/corp/be/offshore-wind-at-a-crossroads.pdf?rev=ea162ac5657f4bd0bc3a0f1dd80bee42&hash=41F7E5F2BFA8F0E6D35C81C9501D9F91

96. https://www.siemensgamesa.com/global/en/home.html

97. https://ema.gov.sg/news-events/news/media-releases/2023/ema-grants-conditional-approval-for-one-point-two-gigawatts-of-electricity-imports-from-vietnam

98. https://www.siemensgamesa.com/global/en/home/products-and-services.html

99. https://www.offshorewind.biz/2025/05/27/malaysia-singapore-eye-importing-offshore-wind-power-from-vietnam/