

Clean Energy Technology Manufacturing in Southeast Asia

SIPA Capstone - Final Presentation

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Overview & Approach



Client Context: International Energy Agency (IEA)

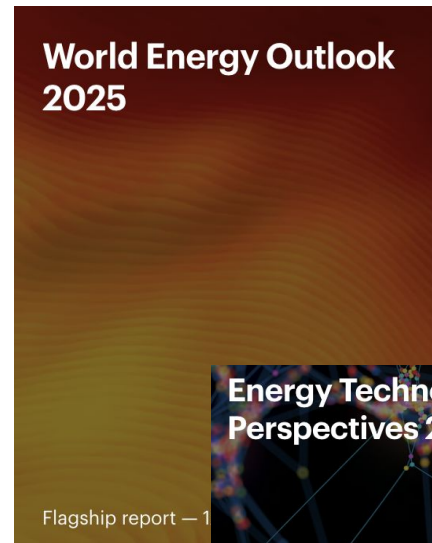


What is the IEA?

- Founded in 1974 as a response to the 1973 oil crisis
- An autonomous intergovernmental energy organisation
- Comprises 32 Member countries (+ 13 Association & 6 Accession countries)

What do they do?

- Leading international energy cooperation
 - Working closely with governments and industry stakeholders
 - Providing technology programme for research partnership
 - Ensuring quick responses to energy supply disruptions
 - Carry out training on energy statistic, modelling, and clean energy policies
- Providing authoritative analysis, data, policy recommendations & solutions to ensure energy security and support the clean energy transition



Disclaimer: Please note that the IEA contributed to this project in peer review capacity only and shall not be responsible nor liable to any third party in respect of the project, this presentation and the related materials (including the Excel Annex).

Project Overview

Objective

Assess the competitiveness, scale and policy environment of clean tech manufacturing in five ASEAN economies to inform IEA's ETP-2026 supply chain analysis and diversification scenarios.

Focus Countries



Indonesia



Malaysia



Philippines



Thailand



Vietnam

Focus Technologies



Solar PV



Wind



Battery



Electric Vehicle



Transformers

Project Workstreams

1. **Outlooks & Forecasts:** What do existing studies project for deployment, manufacturing and trade?
2. **Policies & Industrial Strategy:** What national policies, incentives and trade measures shape the sector?
3. **Manufacturing Pipelines:** What facilities are operational, under construction or announced?
4. **FDI Flows:** What inward and outward investments are shaping the region?
5. **Skills & Workforce Gaps:** Where are the constraints in talent and capabilities?
6. **Prices & Competitiveness:** How do regional producer and consumer prices compare globally?
7. **Industrial Synergies:** Which adjacent industries create spillovers or supply chain advantages?

Note: Outturn costs are excluded due to insufficient public data on total investment (CAPEX, contingency, financing, and construction), making estimates indicative rather than verifiable.

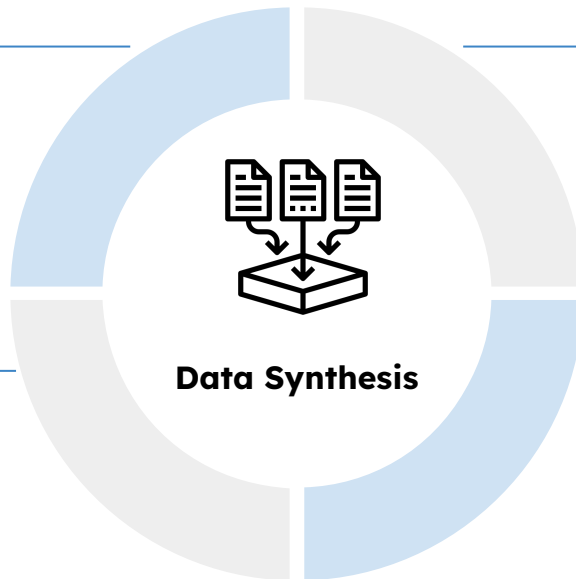
Project Methodology

Online News

Systematic review of online news sources to track project pipelines, FDI flows, and sector developments.

Interviews

Conducted some consultations with public, quasi-public entities, private sector actors and international organizations to capture real-time, on-the-ground intelligence across different workstreams.



Third Party Reports

Gathering key insights from targeted publications by global and regional think tanks, academic institutions, and industry groups.

Pricing Information

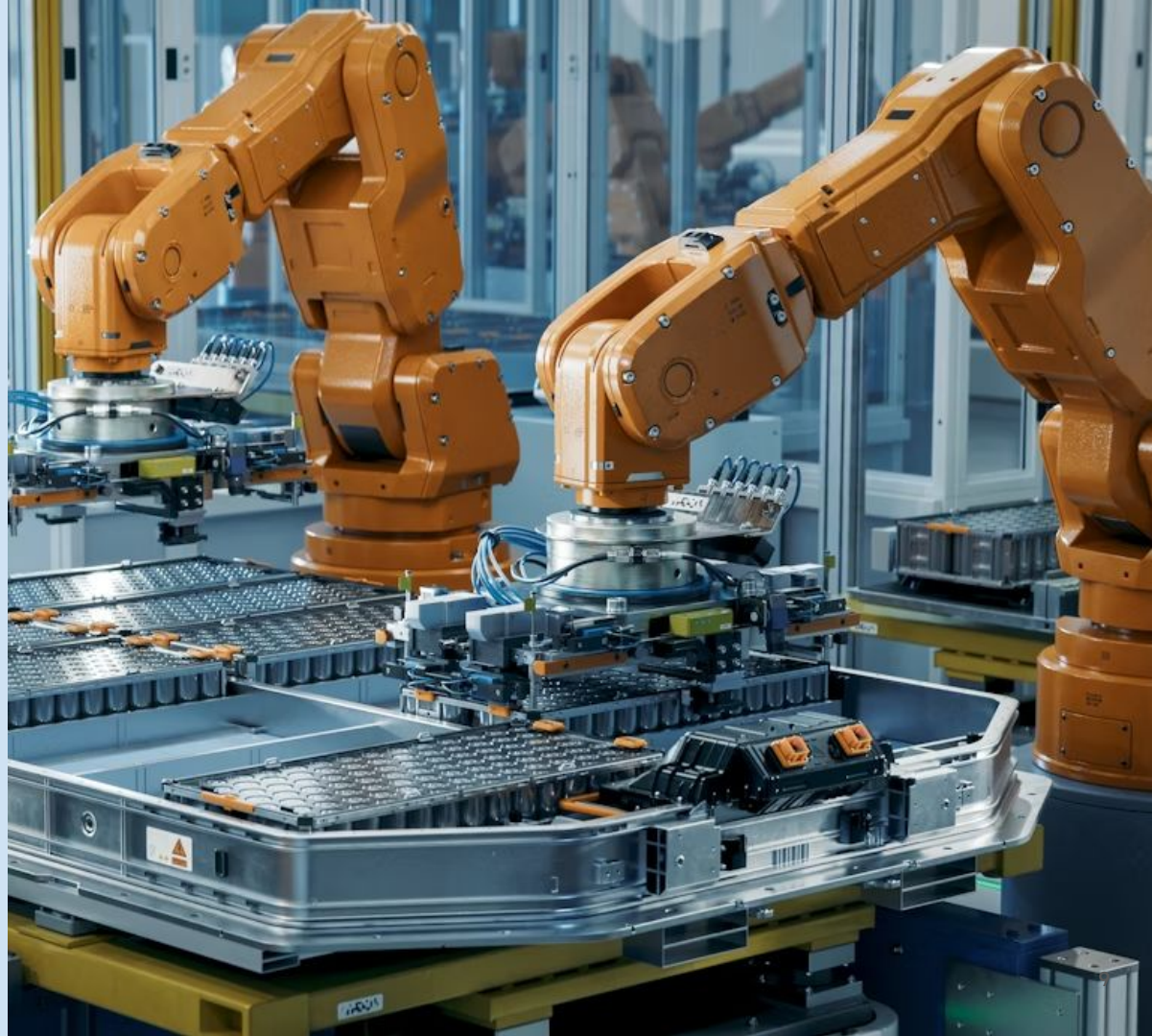
Analysis of e-commerce platforms as a proxy for real-time pricing data of different technologies and sub-components..

Project Output

This project delivers two key outputs:

1. [Insights Deck](#) – Presents high-level insights synthesized across each country and technology.
2. [Detailed Excel Workbook](#) – Each workstream is organized into separate tabs for structured analysis, with data collated across countries and technologies. The workbook includes key details such as policy landscape, manufacturing projects, supply chain positioning, investment flows, and industrial synergies.

Country Level Insights



Regional Landscape: Literature finds ASEAN is scaling clean-tech manufacturing, but capacity growth does not yet equal competitiveness

Existing literature broadly agrees that ASEAN has become a credible clean-tech manufacturing base, especially in solar PV, EVs, and batteries. However, the region's growth is still weighted toward **FDI-led, export-oriented, mid/downstream capacity**, meaning ASEAN is scaling production faster than it is building deep industrial capability.

ADB / ClimateWorks

Renewable manufacturing could generate **USD \$90–100B by 2030** and **6M jobs by 2050**, acting as a major industrial opportunity.

IRENA

Estimates that a 1.5°C-aligned transition could create **2.2M jobs in Southeast Asia by 2030**, especially across renewables, grids, and EV infrastructure.

Sinovoltaics / PV Magazine

Solar PV has **78.8 GW of module capacity**, but remains concentrated in modules/cells rather than upstream stages.

Concentration of Strength

Manufacturing is currently concentrated in **mid/downstream activities** (solar modules, EV assembly).

Limited presence in: Advanced materials, battery cells, wafers, power electronics, R&D, and core intellectual property.

Capacity vs. Competitiveness

ASEAN is gaining **capacity**, but not yet uniform **competitiveness**. Success depends on:

- Supplier depth & technology transfer
- Domestic skills & clean power access
- Resilience to trade-policy shifts

The literature suggests ASEAN's clean-tech opportunity is real, but the region risks becoming a scale manufacturing base without commensurate value capture unless FDI is converted into deeper capability.

Regional Landscape: Literature shows ASEAN countries have complementary strengths, but regional clean-tech value chains remain fragmented

Country-level studies show that ASEAN countries are developing differentiated positions across the clean-tech value chain. This creates the basis for regional complementarity, but current strategies remain nationally driven and only partially integrated.

Thailand & Indonesia (Regional Hubs)

Krungsri Research finds Thailand dominates ASEAN EV sales (78.7%), while Indonesia has long-term upstream potential in nickel. **Mitsui & Co.** notes both target EV/battery hubs via assembly (TH) vs. mineral localization (ID).

Indonesia (Downstreaming Strategy)

Asia Briefing reports nickel smelting capacity grew from 2 to ~60 (2016-2023). However, moving to battery-grade materials and full BEV value chains remains a significant value-capture challenge.

Vietnam (Solar & Export Scale)

World Bank analysis shows solar grew to ~17 GW by mid-2024. Challenges include exposure to climate-trade measures and the need for clean-power manufacturing requirements.

Malaysia (Electrical and Electronics & Components)

Potentials in E&E, semiconductors, and power electronics. Literature warns that without stronger R&D and supplier linkages, it may remain in assembly-led manufacturing.

ASEAN Value-Chain Logic: Indonesia (Upstream/Battery); Thailand (EV/Auto); Malaysia (E&E/Semiconductors); Vietnam (Solar/Manufacturing scale-up).

The literature points to ASEAN's potential as an integrated clean-tech manufacturing region, but strategic coordination and standards are needed to move from fragmented hubs to high-value regional chains.



Snapshot Insights

- Focus on shifting downstream from raw nickel extraction to fully integrated battery and EV manufacturing
- In contrast, there is a push to move upstream and downstream for solar panel manufacturing, utilizing Indonesia's silica sand reserves
- Both policies seek to capture greater economic value and to support both domestic consumption and export markets. They also support the country maintaining its trade surplus.



Policy Framework

- Export bans and LCRs are the key policy levers
- For battery supply chain, this has led to the development of SEZs in which midstream Chinese-Indonesian oligopsonies put pressure on raw nickel mining companies
- For solar, there is a tension between manufacturing and deployment: encouraging the use of domestic raw materials in manufacturing while still ensuring the rules allow for feasible economics for new solar project deployment



Foreign Direct Investment

- Greenfield FDI inflows to the battery subsector since the export ban in 2014-2025 are more than US\$20bn (~1.39% GDP), largely dominated by China and South Korea
- Despite the supportive industrial policies, overall domestic capital investment has remained steady at ~10% of GDP since 2012, suggesting that FDI is critical for capital inflow
- European FDI withdrawals may reflect concerns around ESG (labor & captive coal), given CBAM/Battery Passport



Manufacturing Pipeline

- Dragon and Titan are two flagship projects involving Chinese-Indonesian consortiums designed to cover the battery value chain from nickel mining, high-pressure acid leaching smelters to precursor and cathode plants and battery cells
- President Subianto on Dragon in 2025: *"This project is a historic milestone. It demonstrates our seriousness in building an environmentally friendly energy ecosystem."*



Synergies

- Indonesia has an established mining sector for its silica sand reserves which is the raw material for solar cells and the glass in solar panels. Opportunities for further build out of upstream and new downstream segments of the solar supply chain, with potential export ban and LCRs
- Oil and gas driven offshore steel fabrication and shipbuilding offer transferable capabilities for offshore wind towers, foundations and installation



Key Skills Gaps

- Significant need for upskilling in green manufacturing to support domestic capability
- Cultural stigma attached to vocational education with 65% of high income households prioritize university degree over vocational programs
- OEM's have established short training courses (e.g. Toyota Indonesia Academy) which help build capability but won't create structural transformation

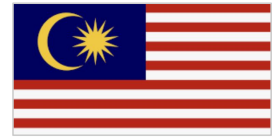
💡 Other Key Insights

Indonesia's Sovereign Wealth Fund 'Danantara'

- Danantara, established in 2025, has \$600bn of assets which compares to the SWFs of the UAE and Singapore's Temasek which have \$850bn and \$300bn, respectively
- Unlike other SWFs, Danantara funding largely comes from SOEs rather than natural resource windfalls. Danantara functions as a "super holding company," controlling all state enterprises including 'MIND ID'
- Danantara has already invested in four major manufacturing projects: solar manufacturing, Titan/Dragon and HPAL plant
- The SWF will likely support external capital mobilization but will also reinforce centralized control through SOEs

MIND ID

- MIND ID is a single holding company under which all state-owned mining assets were consolidated in 2024
- There is now one relatively clear channel for foreign investors and governments that want access to Indonesia's critical minerals: MIND ID and Danantara
- This institutional structure helps facilitate Indonesia's 51% domestic ownership rules which provide a ROFR to the state before offering ownership to private domestic investors



Snapshot Insights

- Malaysia is scaling as an FDI-led export platform for clean-tech manufacturing, anchored in solar and E&E-linked sectors.
- Growth is fast but shallow, driven by assembly and midstream, with limited upstream depth.
- The next step is to convert scale into capability - building local supply chains, specialised talent, and higher-value manufacturing.



Policy Framework

- Malaysia is structurally positioned as an FDI-led export manufacturing base (especially solar + E&E-linked components), with limited reliance on domestic demand pull.
- The framework is broad and well-coordinated but largely enabling rather than enforcing, with limited hard localisation requirements, resulting in assembly-led growth and uneven supply chain depth.
- Fiscal incentives are the most effective levers driving investment, but are skewed toward capex and assembly, not deep manufacturing (e.g., cells, upstream materials).



Foreign Direct Investment

- Clean-tech manufacturing is FDI-led (~50%+ share), focused on export-oriented advanced manufacturing.
- China is the dominant FDI source, using Malaysia as a cost-competitive export base and ASEAN gateway, accelerating integration into regional supply chains.
- Policy focus is shifting from attracting volume to “quality FDI” (technology transfer, local supply chain integration), but realisation remains uneven, with limited evidence of deep domestic value capture so far.



Manufacturing Pipeline

- EVE Energy (10 GWh battery cell plant, Kedah): One of the few true upstream manufacturing, signalling shift beyond midstream, but foreign-led (China).
- Deye (China) solar + ESS manufacturing base (Johor): Solar-storage convergence, aligned with Malaysia's E&E-driven export manufacturing base.
- BYD + multiple OEM CKD assembly investments: Systemic FDI into EV assembly, reinforcing Malaysia as an ASEAN export hub with limited localisation depth.



Synergies

- E&E spillover is the core advantage: the same supplier base can support solar, EV components, batteries, & smart grid equipment.
- Solar has the strongest fit, with existing PV manufacturing and materials base (aluminium, silicon, hydro power).
- Battery capability is midstream-heavy, with gaps in upstream materials.
- Wind and transformers are adjacency plays, leveraging O&G and electrical equipment capabilities.



Key Skills Gaps

- Malaysia faces a structural “skills-demand mismatch”: sufficient graduates, but limited demand for high-value roles in clean-tech manufacturing.
- The real bottleneck is specialised, deployment-critical talent (battery systems, power electronics, grid integration), now a binding constraint on FDI conversion to projects, despite ongoing TVET and training policy support.
- Malaysia’s workforce advantage is E&E-driven, enabling scale, but risks plateauing without stronger industry alignment.

💡 Other Key Insights

MIDA strengthens investor execution, but not necessarily localisation

- Execution strength: MIDA helps investors move from interest to operation by reducing approval, permitting, infrastructure, and coordination bottlenecks.
- Localisation gap: Faster project delivery does not automatically create technology transfer, domestic supplier upgrading, or deeper Malaysian value capture.

Price-led procurement limits manufacturing spillovers

Cost-competitive RE procurement has helped Malaysia scale deployment, but it also encourages developers to source low-cost imported components. Without stronger local-content incentives, this limits domestic supplier participation, technology transfer, and Malaysia’s move into higher-value clean-tech manufacturing.



Snapshot Insights

- Clean-tech manufacturing is emerging through selective niches - transformers domestically anchored, solar and batteries assembly-led, EVs nascent but remains shallow, export-oriented, and concentrated in a few first-mover projects.
- Policy has opened the door through CREATE MORE, foreign equity reform, and Green Lane but without local content rules or manufacturing mandates, investor entry has yet to translate into industrial deepening.



Policy Framework

- The policy stack favours investor entry and cost reduction over targeted manufacturing localisation.
- EVs are the only clean-tech segment with a dedicated industrial law (EVIDA); solar, wind, and batteries remain incentive-led, with no local manufacturing mandates.
- Recent reforms (100% foreign equity, CREATE MORE) improved investor certainty, though implementation remains uneven across permitting agencies.



Foreign Direct Investment

- Clean-tech manufacturing FDI is concentrated in two first-mover projects: Singapore-backed Gstar Solar and Australia-backed StB Giga Factory.
- Both projects are structured as export-oriented manufacturing platforms, with limited domestic supply-chain integration so far.
- Foreign capital is entering through assembly-led projects rather than broader industrial buildout.



Manufacturing Pipeline

- Gstar Solar (Subic): first GW-scale solar platform, expanding to 2 GW modules.
- StB Giga Factory (Clark): first battery plant, scaling from 300 MWh to 2 GWh.
- Mitsubishi (Laguna): first HEV assembly line, marking auto electrification entry.
- Wind has the strongest deployment pipeline, but turbine manufacturing remains fully import-dependent.



Synergies

- Semiconductors support solar, battery, and EV electronics through existing precision assembly and process-control skills.
- Transformers and automotive plants provide existing bases for grid equipment and EV manufacturing.
- Nickel and metal fabrication support battery materials and industrial components upstream.



Key Skills Gaps

- The Philippines has transferable industrial labour from electronics, automotive, and electrical manufacturing, but limited clean-tech production depth.
- Higher-value skill gaps remain strongest in battery systems, EV components, power electronics, and grid-grade testing.
- The core challenge is capability upgrading at higher technical levels, not basic workforce availability.

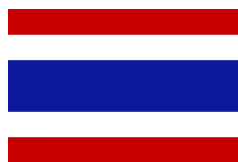
💡 Other Key Insights

Industrial zones are becoming de facto industrial policy

With no sector-specific manufacturing mandates, Subic, Clark, and Batangas are hosting first-mover solar, battery, and EV projects through zone incentives, port logistics, and streamlined entry. The US-backed Luzon hub extends this model into critical minerals and semiconductors, reinforcing zones as the Philippines' main platform for strategic industrial attraction.

Deployment is outpacing manufacturing

Against a 35% renewables target by 2030 and 65 GW of offshore wind contracts, domestic clean-tech manufacturing remains limited to solar module assembly, a single 300 MWh battery plant, and transformers - risking an energy transition that captures only a fraction of industrial value.



Snapshot Insights

- The strongest clean energy manufacturing sectors are solar, EVs, and battery with transformers representing a well-established industry
- Almost all committed EV manufacturing in Thailand is Chinese OEM, BYD, OMODA,; Japanese firms remain at feasibility stage (Mazda).
- Thailand recorded its first EV exports in April 2025 - 67,000 vehicles, representing 64% of total production

Policy Framework

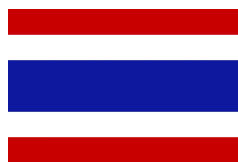
- Demand-side incentives are driving solar. Thailand is pulling consumers in rather than mandating supply, rooftop solar and tax deductions
- For EV, Thai policy supports both demand and supply side as it aims to be a hub of EV in SEA (30@30).
- Manufacturing localization is a core condition for investment: BOI incentives and EV support are tied to 40–45% local content, making manufacturing localization a key condition for investment benefits (EV 3.5)

Foreign Direct Investment

- Thailand's BOI applications hit a record 1.06 trillion baht (~\$32.5B) in the first half of 2025 (+139% year-on-year), led by a 20x surge in digital pledges, steady EV growth, and 191 renewable energy projects totaling 42.24 billion baht.
- China leads investment, driving Thailand's EV and digital hub ambitions
- Despite strong momentum, Thailand captures only ~1% of global greenfield FDI. (US\$1 trillion per year (2023-25))

Manufacturing Pipeline

- Chery's OMODA/JAECOO plant in Rayong (50,000–80,000 units/yr, USD 160m) delayed its opening, postponed from Q4 2025 to 2026 (now open on April 20th, 2026)
- Sunwoda (China) announced a USD 1bn+ EV battery cell plant in the Eastern Economic Corridor, first facility in Chonburi targeting lithium-ion cells for regional EV manufacturers



Synergies

- Auto parts base is EV-ready: 45% of components are unchanged; firms like Thai Summit and Aapico Hitech already produce compatible parts.
- Electronics skills transfer directly: PCB and cleanroom manufacturing maps onto solar inverter and EV battery production.
- Fuel network conversion: PTT's OR group is rolling out fast chargers across 100 stations nationwide.

Key Skills Gaps

- Thailand faces critical shortages of EV specialists, battery engineers, solar technicians & R&D specialists, with mechanical engineers being the hardest to recruit across ~690,000 automotive workers.
- Weak foundations compound the problem - 64.7% fall below foundational literacy & 74.1% lack essential digital skills.

Other Key Insights

Insight from a former Tesla employee

- Slow government processes and lack of coordination across agencies are holding back a major EV manufacturing.
- Insufficient importance has been given to charging stations, a critical push for EV promotion.
- Solar deployment lags behind policy ambitions due to unclear ownership and accountability across government agencies.
- Local Thai mechanics have adapted their skills to fix EV cars.

China EV 100 MOU (December 2025)

- Thailand's BOI signed an MOU with China EV100, China's leading EV policy think tank, marking the first such agreement between China EV100 and any ASEAN country
- The partnership aims to connect Thai entrepreneurs to the global EV supply chain, transfer technology from Chinese to Thai manufacturers, and develop Thailand's EV ecosystem including battery management, charging systems, and battery swapping infrastructure.



Snapshot Insights

- Emerging as a downstream clean tech hub, leveraging electronics manufacturing to scale solar, EV, and battery.
- An FDI-led, export-oriented "China+1" clean-tech manufacturing base, increasingly moving beyond assembly toward deeper localization in batteries and renewables supply chains
- Vietnam ranked 1st in Southeast Asia for BEV penetration (~26.3%).



Policy Framework

- PDP8 targets 46–73 GW solar and 26–38 GW wind by 2030, requiring ~USD 136 bn in planned investment over 2026–2030.
- Market liberalisation underway but incomplete: DPPA Decree 57/2025 opened direct RE procurement for large consumers, but standardised PPA templates remain unresolved.
- EV policy is primarily demand-side: registration fee exemptions and preferential SCT rates drive adoption. Supply-side incentives are broad rather than targeted.



Foreign Direct Investment

- Vietnam shows continued high FDI inflows in clean tech, particularly in solar, electronics, and EV supply chains
- FDI is diversified across partners (China, Korea, Japan, EU), reducing geopolitical concentration risk
- Clean tech investment is closely tied to export markets (US/EU), making Vietnam sensitive to trade policy (e.g: tariffs, CBAM)



Manufacturing Pipeline

- Sunwoda's Bac Giang battery/BMU plant shows Vietnam still attracts foreign clean-tech capital, with the pipeline expanding beyond solar into battery-related electronics and EV supply chains
- Foxconn's Quang Ninh project shows FDI targeting EV chargers and electronics, highlighting Vietnam's integration of clean tech into its electronics base and export supply chain.



Synergies

- Electronics manufacturing ecosystem (semiconductors) provides direct synergies with solar PV, EV electronics, and battery system
- Strengths in machinery and precision assembly enable rapid scaling, but remains constrained in upstream materials and advanced engineering
- Industrial clustering around ports (Hai Phong, Bac Ninh) creates logistics & export synergies for clean tech supply chains



Key Skills Gaps

- Vietnam's clean-tech workforce is thin at the technical end: <30% have formal qualifications, limiting the shift from assembly to higher-value manufacturing.
- Training is expanding but limited: GE Vernova's RENEW Skills targets 4,000 learners by 2027, small relative to demand.
- Green jobs offer no wage premium, weakening incentives for reskilling (which takes 3–10 years) without policy support.

💡 Other Key Insights

Vietnam's clean-energy bottleneck is technical depth, not capacity

Only 3-5% of the workforce holds green job skills, limiting the shift from assembly to higher-value manufacturing in solar, batteries, and grid equipment, creating a gap between "landing" a factory and truly localizing a supply chain.

Vietnam's clean-tech export model is the most trade-exposed among the 5 countries

Over half of Vietnam's \$225B in 2024 exports are destined for OECD markets now tightening climate-trade policy. The WBG estimates a 30% export shock could reduce Vietnam's GDP by ~6% by 2030. The US already imposed preliminary countervailing duties on Vietnamese solar cells in October 2024

Technologies Cross-Cutting Insights



Solar PV

All countries have strong export-oriented panel and module assembly sectors, with significant investment from Chinese FDI.

- Malaysia, Thailand, Vietnam also have strong cell manufacturing capabilities.
- Indonesia is also in the early stages of developing its quartz raw material mining sectors.
- A key challenge for all countries to ensure solar panels employ the latest cell technology.



Wind

No countries have significant wind manufacturing capabilities.

- Only Malaysia and Vietnam are at the early stages of building out their industries.
- Indonesia and Malaysia have both identified manufacturing synergistic wind potential with existing O&G component manufacturing sectors.



Transformers

- Thailand and Philippines are the only countries with well-established transformer industries.
 - Thailand has a large domestic, export-oriented sector with around ~90 manufacturing companies.
 - In contrast, the Philippines' sector is monopolistic with one large operating company.
- Indonesia, Malaysia, and Vietnam each have only limited domestic manufacturing capability.

Technologies Cross-Cutting Insights



Batteries

All countries except for the Philippines (which only has one new company) have a presence in the battery manufacturing sector.

- Thailand and Vietnam are mostly focused on the downstream pack assembly part of the supply chain.
- Malaysia focused on some midstream battery components (e.g. cells and separators) manufacturing as well as downstream pack assembly.
- Indonesia has a very large domestic-use focused upstream nickel export industry with a developing domestic-consumption and export focused component and assembly sector.
- Vietnam is now also looking into developing its nickel reserves to build raw material capability.



EVs

All countries have an assembly-focused EV manufacturing sector.

- Vietnam and Thailand are the only countries that are also prioritize component manufacturing. CKD manufacturing is a strong theme across all countries as a result of changing tariffs.
- Malaysia is focused on becoming an ASEAN export hub with Indonesia focused on both export and domestic consumption, particularly in the E2W segment.

It is noteworthy that Vietnam is the only country that has its own EV manufacturing company, VinFast, that is a provider of FDI both in ASEAN and other parts of the world.

Abbreviations

Indonesia	• LCR = Local Content Requirement • SWF = Sovereign Wealth Fund • ROFR = Right of First Refusal • SEZ = Special Economic Zones • MIND ID = Mining Industry Indonesia (Indonesia's mining holding company owned by SWF, Danantara) • CBAM = Carbon Border Adjustment Mechanism
Malaysia	• E&E= Electrical & Electronics • OEM = Original Equipment Manufacturer • CKD = Completely Knocked Down • ESS = Energy Storage Systems • O&G = Oil and Gas • TVET = Technical and Vocational Education and Training
Philippines	• TVET = Technical and Vocational Education and Training • HEV = Hybrid Electric Vehicle • CREATE MORE = Corporate Recovery and Tax Incentives for Enterprises to Maximize Opportunities for Reinvigorating the Economy
Thailand	• BOI = Board of Investment • PCB = Printed Circuit Board • EEC = Eastern Economic Corridor
Vietnam	• PDP8 = Power Development Plan 8 • DPPA = Direct Power Purchase Agreement • SCT rates = Special Consumption Tax rates

Appendix - Detailed Excel Workbook Snapshots



Workstream 1: Regional and Domestic Outlooks

Country Focus	Technology	Domestic or Regional	Publisher/Organization	Name of report	Summarise key points (1-3 bullets)	Implications for manufacturing	Link to Source
ASEAN	General	Regional	ASEAN Center for Energy	ASEAN Plan of Action for Energy Cooperation (APERC)	- Regional energy strategy: The ASEAN Plan of Action for Energy Cooperation (APERC) - ASEAN aims to reach 30% renewable energy in total p	- Higher energy costs and investment pressure. The push for efficiency upgrades become mandatory. The 40% energy supply chain and export market risk. Global buyers and c	Link
ASEAN	General	Regional	IRENA	Socio-economic footprint of the Energy Transition Southeast Asia	- The report examines how a clean-energy transition in S - It is projected that under a 1.5°C-aligned pathway, rapid - Major job creation and social benefits: Expanding renew - Policy and cooperation are key: Realizing these benefit	- Labor force opportunity, but skills gap risk. The projects - New demand streams for manufacturers. Rapid expans - Policy and investment frameworks reshape where capit	Link
ASEAN	General	Regional	ADB	Renewable Energy Manufacturing in Southeast Asia Generate \$90 Billion to \$100 Billion in Sustainable Revenue by 2030	- The report argues that Southeast Asia could become a - it emphasized that expanding manufacturing of solar pa - It also points out that developing these clean-energy in	- Solar and battery manufacturing are major growth oppo - ASEAN's resource base gives manufacturers a structur - Policy alignment is the bottleneck, not industrial capac	Link
ASEAN	General	Regional	ASEAN Center for Energy	ASEAN Energy in 2026	- The report analyzes current energy developments, nati - It discusses how ASEAN must expand renewable ener	ASEAN manufacturing in 2026 faces a dual pressure, tig	Link
ASEAN	General	Regional	IEA	Southeast Asia Energy Outlook 2024	- IEA mentions that Southeast Asia is becoming a centra - Southeast Asia is becoming an important hub for clean - the rise in clean energy deployment produces a signific - At the same time, increased use of clean energy is help	- Southeast Asia is a major manufacturing centre, well in - Clean energy manufacturing is a real opportunity, but de - Southeast Asia's integration into global value chains ha	Link
ASEAN	General	Regional	Southeast Asia Public Policy Institute	Southeast Asia's Energy Transition: Policy and Deployment	- Southeast Asia's energy transition has strong potential - The region faces a major challenge: rapidly rising ener - There is no unified regional strategy, so stronger coordi	- Manufacturing will be affected by rising energy demand - The pace of transition—and therefore conditions for ma - Because the region lacks a coordinated strategy, manu	Link
ASEAN	Solar PV	Regional	The Diplomat	Southeast Asia's Solar Panel Boom	- Southeast Asia has become a major global hub for sole - The boom is driven largely by rapid expansion, falling c - the growth is also shaped by geopolitics: production ha	- Vietnam: Solar exports grew from \$2.1B (2017) to arou - Indonesia: Backed by hundreds of millions in foreign inv - Regional trend: Southeast Asia is scaling solar manufa	Link
ASEAN	General	Regional	Source of Asia	Renewable Energy in Southeast Asia in 2025-2026	- Renewable energy in Southeast Asia is growing steadil - Renewables currently make up about 35% of installed - Growth is driven by rising electricity demand (3–4% an - Vietnam ranks second and Indonesia ninth among dev	- Manufacturing growth will be tied to rising energy dema - The expansion of renewables requires large capital inve - The need to scale capacity significantly implies contin	Link

Approach: This workstream maps the regional and domestic clean energy outlook across priority countries and technologies, using secondary research from government agencies, multilateral institutions, industry reports, and market analyses. The focus is to identify policy direction, demand signals, manufacturing opportunities, and implications for clean energy supply chains.

Workstream 2: Country Level Policy Outlook (Example: Indonesia)

Country Focus	Technology	Name of Policy	Level	Legislation vs Proposal	Policy Type	Description	Key targets	Progress so far	Assessment (1-2 bullets)	Year announced
Indonesia	General	Nationally Determined Contribution	National	Proposal	Financing/Subsidy/...	- Indonesia submitted its latest NDC in 2022 - Conditional scenarios require a 1.5°C pathway	- Three scenarios that combine a 1.5°C pathway with a 2°C pathway - Conditional scenarios require a 1.5°C pathway	- The government and Perus submitted the NDC in 2022 - Only 11 months since announced - Specifically for 2025-2034 - Only ~15.2 GW RE installed	- According to Climate Action Plan, the government aims to reach net-zero by 2062 - Ambition-alignment gap: Requires ~5.2 GW RE installed by 2034 - Execution risk: requires ~5.2 GW RE installed by 2034	2025
Indonesia	General	National Electricity Plan	National	Proposal	Policy/Strategy/Regulation	- Plan for the national level energy - Note the government has also submitted a 1.5°C pathway	- New energy sources like nuclear - Note the government has also submitted a 1.5°C pathway	- Only 11 months since announced - Specifically for 2025-2034 - Only ~15.2 GW RE installed	- Ambition-alignment gap: Requires ~5.2 GW RE installed by 2034 - Execution risk: requires ~5.2 GW RE installed by 2034	2025
Indonesia	General	The Electricity Supply Business Plan (RUPTL 2025-2034)	National	Proposal	Policy/Strategy/Regulation	- Ten-year rolling plan specifying various energy sources - Of the 43 GW of renewable energy, 15.2 GW is from RE - ~61% of new power plants, with ~90% of RE plants and ~71% of total capacity	- Only 11 months since announced - According to the Ministry, a 1.5°C pathway is being considered - Second half of 2025 saw significant progress	- The Plan has not yet triggered a public consultation process - The Plan has not yet triggered a public consultation process	- The Plan has not yet triggered a public consultation process - The Plan has not yet triggered a public consultation process	2025
Indonesia	Solar PV Wind	Renewable Energy Tariff	National	Legislation	Financing/Subsidy/Tender/Procurement	- Indonesia has an auction process for RE - Direction selection: Applies to hydropower and geothermal - Direct appointment: Applies to wind and solar	- See National Electricity Plan: 30% of new capacity from RE - ~61% of new power plants, with ~90% of RE plants and ~71% of total capacity	- There is no clean published tariff yet - Some challenges identified	- The tariff is widely viewed as a challenge - The tariff is widely viewed as a challenge	2025
Indonesia	Solar PV Wind	Local Content Rules (renewables)	National	Legislation	Policy/Strategy/Regulation/Trade	- A minimum percentage of a solar panel must be manufactured in Indonesia - New minimum local content for solar panels	- The previous local content rule was 40% - Realized local content for solar panels is around 30% - As of March 2025, there was no published rule	- The local content rules have been revised to 40% - The combination of the above rules is a challenge - Government is oriented towards local content	- The local content rules have been revised to 40% - The combination of the above rules is a challenge - Government is oriented towards local content	2024
Indonesia	General	Import Duty Exemptions	National	Legislation	Financing/Subsidy/Trade	- Exempts import duties on machinery and equipment - 2 years import duty exemption for companies using local content - 4 years for companies using local content	- Import duty exemption for imported machinery and equipment - 2 years import duty exemption for companies using local content - 4 years for companies using local content	- Raw materials for domestic production - While the policy is a relevant incentive	- While the policy is a relevant incentive - While the policy is a relevant incentive	2015
Indonesia	General	Corporate Income Tax Holiday	National	Legislation	Financing/Subsidy/Trade	- 5-20 year reductions or exemptions on corporate income tax - Legislation includes 'Manufacturing and Service Sectors Tax Allowance'	- Corporate income tax reduced to 10% for 5-20 years - Corporate income tax reduction	- Active under Ministry of Finance - This is the most-utilized incentive	- While the policy is a relevant incentive - While the policy is a relevant incentive	2020
Indonesia	Solar PV	Solar Rooftop Quota	National	Proposal	Policy/Strategy/Regulation	- Under the Electricity Supply Business Plan (RUPTL) - Aiming to add 5.75 GW of installed capacity	- Aiming to add 5.75 GW of installed capacity - Targeting 5.75 GW of installed capacity	- The quota opened at 485 MW in 2023 - However, total cumulative installations are low	- Overall there is significant potential for growth - Overall there is significant potential for growth	2024
Indonesia	EV	EVs Quota and Fiscal Incentives	National	Legislation	Financing/Subsidy/Trade	- Indonesia has implemented various incentives for EVs - Target for 13mm E2Ws and 2mm E2Ws by 2030	- Target for 13mm E2Ws and 2mm E2Ws by 2030 - Target for 13mm E2Ws and 2mm E2Ws by 2030	- In 2025 there were ~400-500 units - In 2025 there were ~100k units	- There was a significant drop in sales - Annual sales are running below expectations	2024
Indonesia	EV Batteries	Local content rules (EVs)	National	Legislation	Financing/Subsidy/Trade	- Expands support for the battery supply chain - For 2/3-wheel EVs local content must be 40% - For 4-wheel and above EVs: 30%	- For 2/3-wheel EVs local content must be 40% - For 4-wheel and above EVs: 30% - For 4-wheel and above EVs: 30%	- As of early 2024, only two companies met the requirement - By 2025, the net widened to 30%	- The policy is designed to boost local production - The policy is designed to boost local production	2023
Indonesia	Batteries EV Solar PV Wind	Export Ban	National	Legislation	Trade Tender/Procurement	- Export bans on raw nickel ore and refined nickel - Export bans on quartz and silica - Also see rows related to Local Content Rules	- This is reflective of a broad strategy to boost local production - Also see rows related to Local Content Rules	- The number of Indonesian nickel exports has decreased - Indonesia's ban on exports of raw nickel ore	- The nickel export ban is widely viewed as a challenge - The nickel export ban is widely viewed as a challenge	2020
Indonesia	Batteries EV	Special Economic Zones	National	Legislation	Policy/Strategy/Regulation	- Special Economic Zones offer fiscal incentives for investors - NA	- NA	- As of 2025-2026, Indonesia has 10 SEZs - Downstream mineral processing is a key focus	- Central part of industrial policy - Has been central to attract investment	2012

Approach: We compiled a structured database of relevant energy and cleantech policies, capturing policy type, targets, timelines, and associated technology categories. Sources include official government strategies and implementing agencies, supplemented by international energy reports, regional think tank reports, industry analysis, and market research.

Workstream 3: Manufacturing Pipeline (Example: Malaysia)

Country Focus	Technology	Component	Company	Parent Company HQ	Country HQ	Project Location (City/Province)	Facility / Project Name	Project Status	Announced Capacity	Capacity Units
Malaysia	Solar	Solar inverters and energy storage systems (ESS) manufacturing base	Deye New Energy Technology (Malaysia)	Ningbo, Zhejiang	China	Senai / Iskandar Malaysia, Johor	Eco Business Park II manufacturing base	Announced; land secured; construction commencement (groundbreaking referenced by company) - 2025	-	-
Malaysia	Solar	Solar modules	Wuxi Longmax Technology (with ITRAMAS)	Wuxi, China	China	Penang (state; specific site not disclosed in primary announcement)	Joint solar combiner box manufacturing facility	Operational	500 MWp	
Malaysia	Wind	Onshore wind turbines / utility-scale wind power project	Sabah Energy Corporation Sdn Bhd (SEC)	Kota Kinabalu, Sabah	Malaysia	Kudat, Sabah	Malaysia's first large-scale wind turbine project / Kudat wind project	Feasibility completed; regulatory milestone achieved (ILON received); project to "kick off soon"	Up to 100 MW	
Malaysia	Wind	Offshore wind farm + subsea / cross-border transmission links	Project sponsor(s) not publicly disclosed in the sources reviewed	Not publicly disclosed	Not publicly disclosed	Cross-border project: offshore generation in Vietnam; links to Peninsular Malaysia and onward to Singapore	Vietnam–Malaysia–Singapore 2 GW offshore wind project	Announced / advancing; first phase targeted by 2034	2,000 MW	
Malaysia	Transformers	Power transformers / grid equipment manufacturing	JSHP Transformer (JST)	Changsha, Hunan	China	Selangor (Malaysia – exact site not publicly disclosed)	JST Transformer Manufacturing Facility	Announced / planned	25 kVA - 6000 kVA up to 35 kVa	
Malaysia	Batteries	Lithium-ion battery cells (cylindrical)	EVE Energy Co., Ltd.	Huizhou, Guangdong	China	Kulim, Kedah	EVE Energy Malaysia Battery Manufacturing Facility	Expansion completed / operational	10 GWh	
Malaysia	Batteries	Battery separator materials	INV New Material Technology	Jiangsu	China	Penang	INV Battery Separator Manufacturing Facility	Announced / construction	1.3 billion square meters of wet-process separators and coated separators	-

Approach: Built a structured database of clean energy manufacturing pipelines using industry analyses, market research, and company announcements from company websites. Data on announced manufacturing projects were systematically extracted and consolidated.

Workstream 4: FDI (Example: Thailand)

Country Focus	Technology	Name of Source	Date of Source	Summarise key points (1-3 bullets)	Origin Country/ies of FDI Insight where Applicable	Link to Source	Relevant Data
Thailand	General	Thailand Economic Monitor: Advanced Green Manufacturing for growth	2026	- Greenfield FDI in Thailand increased in 2024, with 202 approved - Despite this growth, Thailand captures only about 1% of global greenfield FDI - To attract more investment, Thailand needs competitive policies, such as tax incentives - Chinese investment has played a major role, with strong inflows in 2024 - More recently, major Chinese investments have focused on the electric vehicle (EV) sector	NA	Link	- Greenfield FDI in Thailand increased in 2024, with 202 approved
Thailand	EV	Thailand FDI Jumps 125% in 2025; China & Hong Kong Commit \$922 Million	2025	- Chinese and Hong Kong investors are playing a major role in Thailand's FDI growth - China is increasingly channeling investment into Southeast Asia - Hong Kong acts as a financial and investment gateway, helping Chinese firms access the Thai market	China (inflow)	Link	- From January to August 2025, China and Hong Kong committed a total of \$922 million in FDI to Thailand
Thailand	General	BoI eager to attract Chinese investors	2026	- Thailand's BOI is stepping up efforts to attract more Chinese investment - Officials are promoting Thailand as a strategic production and supply base for EVs - The focus is on drawing investment into high-value industries, such as EV manufacturing	China (inflow)	Link	- In 2025, China filed 982 investment applications with the BOI - Foreign direct investment was a key focus for the BOI
Thailand	EV	Charged Up: China Driving Thailand's EV Industry	2025	- Chinese automakers are heavily investing in Thailand's EV sector - Thailand aims to become a regional EV production hub in Southeast Asia - Chinese investment helps localize EV supply chains, which can reduce costs - The China-Thailand EV partnership is also seen as part of the broader Belt and Road Initiative	China (inflow)	Link	- Chinese EV manufacturers have increased their presence in Thailand - Along with the rising share of EVs in the Thai market
Thailand	General	Thailand First-Half Investment Applications Hit USD 32.5 billion on Soaring Data Center Sector, Significant Pledges in E&E and Infrastructure, BOI Says	2025	- The Thailand Board of Investment today announced that applications for investment in the first half of 2025 reached a record of USD 32.5 billion - The renewable energy sector saw a total of 191 applications in the first half	NA	Link	- The renewable energy sector saw a total of 191 applications in the first half
Thailand	General	ASEAN Investment Report 2025: Foreign Direct Investment and Supply Chain Development	2025	- FDI in Thailand increased by 31% to \$11 billion, with most investment coming from China - China remained the largest investor with \$2.5 billion (up 30%), followed by Japan and the EU - FDI from Japan and the European Union declined, with Japan accounting for 15% of total FDI	NA	Link	- Many MNEs from China were in Thailand across multiple ASEAN Member States - Original equipment manufacturers continued to upgrade or expand their production capacity - Some manufacturers plan to produce EVs in Indonesia. Hyundai plans to establish a complete EV production line in 2026
Thailand	EV	Worldbox: Thai auto industry faces short term challenges but long-term outlook remains bright	2025	- In April 2025, for example, the country recorded its first exports of EVs	NA	Link	- The country also continues to attract investment in the EV sector

Approach: FDI was identified through desk research, drawing on reports from international organizations, government agencies, and media sources.

Workstream 5: Key Skills Gaps (Example: Philippines)

Country Focus	Technology	Organization / Publisher	Name of Source	Date of Source	Summarise key points (1-3 bullets)	Relevant Data	Link to Source
Philippines	Solar	Board of Investments / Semiconductor and Electronics Industries in the Philippines Foundation / Organisation for Economic Co-operation and Development	Semiconductor and electronics ecosystem as solar manufacturing base	2024	- Philippines has strong electronics and semiconductor base relative to other ASEAN countries - Existing labour base supports module assembly but not upstream components - Constraint remains higher-value engineering depth	3.2 million direct + indirect semiconductor/electronics jobs	Link Link Link
Philippines	Batteries	Board of Investments / Technical Education and Skills Development Authority	First battery manufacturing entry and workforce preparation	2024	- Battery manufacturing begins from near-zero industrial base - First LFP battery plant creates initial production anchor - Workforce development still at early stage	2,500 jobs targeted by 2030; 300–600 MWh annual production	Link Link Link
Philippines	EV	Technical Education and Skills Development Authority / Government of the Philippines	Automotive workforce and EV transition readiness	2023	- EV benefits from strongest retraining pathway because automotive workforce is large - Existing technical workforce can shift into EV servicing and assembly - High-voltage diagnostics remain main skill gap	129,689 automotive enrolments; 95% certification rate	Link Link Link
Philippines	Transformers	First Philippine Holdings / Technical Education and Skills Development Authority	Domestic transformer manufacturing capability	2024	- Transformers are Philippines' most mature domestic electrical manufacturing sector - Existing domestic champion provides immediate industrial platform - Capability gap is higher-end testing and advanced grid engineering	First Philec holds 72% domestic transformer market share	Link Link Link

Approach: We reviewed credible policy, industry, and expert sources focused on green workforce and skills gaps, selecting those with strong sector relevance. From each, we extracted targeted insights (e.g., talent shortages, wage premiums, training pathways), categorized them by sector, and cross-validated findings to identify consistent workforce constraints and opportunities.

Workstream 6: Pricing (Example: Vietnam)

Country	Technology	Items	Local Price	Unit (Local Currency)	USD Price	Unit (USD)	Latest Date	Import / Domestic	Type of Market	Notes	Link to Source
Vietnam	Solar	LONGi 560W mono	2,240,000	VND/Watt	86.12	USD/Watt	2025	Domestic	Wholesale	Vietnamese distributor price	Link
Vietnam	Solar	JA Solar 550W mono	2,200,000	VND/Watt	84.59	USD/Watt	2025	Domestic	Wholesale	Solar SGX retailer listing	Link
Vietnam	Battery Packs	4W battery subscription – VinFast VF5 Plus	1,600,000	VND/kWh	67.13	USD/kWh	2023	Domestic	Consumer	Monthly battery lease; 37.23 kWh battery; lower upfront	Link
Vietnam	Battery Packs	4W battery subscription – VinFast VF7	2,900,000	VND/kWh	115.74	USD/kWh	2024	Domestic	Consumer	Over-limit (>3,000 km) rises to ~4.8M VND/month; 75.3	Link
Vietnam	Battery Packs	2W battery rental – fixed models	250,000	VND/kWh	9.61	USD/kWh	2025	Domestic	Consumer	LFP battery rental; max 1,000 km/month; verified from	Link
Vietnam	Battery Packs	2W battery rental – new swap models	175,000	VND/kWh	6.65	USD/kWh	2026	Domestic	Consumer	9,000 VND/swap (incl. charging); 1.5 kWh LFP per	Link
Vietnam	EV	VinFast VF3 (excl. battery)	240,000,000	VND/Vehicle	9,578.54	USD/Vehicle	2024	Domestic	Consumer	Cheapest 4W BEV in SE Asia; 18.64 kWh; 210 km	Link
Vietnam	EV	VinFast VF3 (incl. battery)	322,000,000	VND/Vehicle	12,851.21	USD/Vehicle	2024	Domestic	Consumer	Cheapest 4W BEV in SE Asia; 18.64 kWh; 210 km	Link
Vietnam	EV	VinFast VF5 Plus (excl. battery)	458,000,000	VND/Vehicle	19,214.63	USD/Vehicle	2023	Domestic	Consumer	37.23 kWh; 326 km NEDC range; A-segment SUV	Link
Vietnam	EV	VinFast VF5 Plus (incl. battery)	548,000,000	VND/Vehicle	22,990.43	USD/Vehicle	2023	Domestic	Consumer	37.23 kWh; 326 km NEDC range; A-segment SUV	Link
Vietnam	EV	VinFast VF7 (excl. battery)	850,000,000	VND/Vehicle	33,924.01	USD/Vehicle	2024	Domestic	Consumer	75.3 kWh; C-segment SUV; base trim	Link
Vietnam	EV	VinFast VF7 (incl. battery)	999,000,000	VND/Vehicle	39,870.69	USD/Vehicle	2024	Domestic	Consumer	75.3 kWh; C-segment SUV; base trim	Link
Vietnam	EV	VinFast VF9 Eco	1,499,000,000	VND/Vehicle	57,633.90	USD/Vehicle	2025	Domestic	Consumer	123 kWh; 3-row 7-seat flagship E-SUV; free V-Green	Link
Vietnam	EV	Toyota Yaris Cross HEV	728,000,000	VND/Vehicle	27,990.31	USD/Vehicle	2025	Imported	Consumer	Toyota Vietnam official listing	Link
Vietnam	EV	Toyota Camry HEV	1,460,000,000	VND/Vehicle	56,134.42	USD/Vehicle	2025	Imported	Consumer	Toyota Vietnam official listing	Link
Vietnam	EV	VinFast Evo200/Lite (excl. battery)	15,000,000	VND/Vehicle	576.72	USD/Vehicle	2025	Domestic	Consumer	Entry-level; LFP; 203 km range; rental: 250,000	Link
Vietnam	EV	VinFast Evo200/Lite (incl. battery)	25,900,000	VND/Vehicle	995.81	USD/Vehicle	2025	Domestic	Consumer	Entry-level; LFP; 203 km range; rental: 250,000	Link
Vietnam	EV	VinFast Feliz S (excl. battery)	24,000,000	VND/Vehicle	922.76	USD/Vehicle	2025	Domestic	Consumer	Mid-range; 3.5 kWh LFP; 198 km range; rental:	Link
Vietnam	EV	VinFast Feliz S (incl. battery)	34,900,000	VND/Vehicle	1,341.84	USD/Vehicle	2025	Domestic	Consumer	Mid-range; 3.5 kWh LFP; 198 km range; rental:	Link
Vietnam	EV	VinFast Klara S2 (excl. battery)	32,000,000	VND/Vehicle	1,230.34	USD/Vehicle	2025	Domestic	Consumer	Mid-range; 3,000W Inhub motor; 194 km range	Link
Vietnam	EV	VinFast Klara S2 (incl. battery)	42,900,000	VND/Vehicle	1,649.43	USD/Vehicle	2025	Domestic	Consumer	Mid-range; 3,000W Inhub motor; 194 km range	Link
Vietnam	EV	VinFast Vento S (excl. battery)	47,000,000	VND/Vehicle	1,807.07	USD/Vehicle	2025	Domestic	Consumer	Premium; 5,200W motor; 160 km range; ABS; PAAK	Link

Approach: Compiled country-specific consumer, wholesale, and producer price data for key clean technologies using literature-review benchmarks alongside observed market evidence from supplier quotations, local retailer searches, dealer price lists, and official quotes, while tracking whether products are domestically produced, imported, or locally assembled (e.g., CKD for EVs).

Workstream 7: Industry Synergies (Example: Philippines)

Country Focus	Technology	Existing industry	Synergy with clean tech manufacturing	Key Facilities/ Firms	Specific transferable capability	Link to Source
Philippines	Solar Batteries EV	Electronics / semiconductors	Large semiconductor and electronics e	Texas Instruments Baguio; Analog D	Precision assembly, semiconductor pac	Link
Philippines	Transformers	Electrical equipment manufacturing	Domestic transformer manufacturing b	First Philec Batangas	Copper winding, insulation systems, tra	Link
Philippines	EV	Automotive components / vehicle assembly	Existing Laguna automotive plants prov	Toyota Motor Philippines Laguna; Mi	Wiring harness integration, mechanical	Link
Philippines	Batteries	Nickel mining and minerals	Nickel resource base and HPAL proces	Nickel Asia Corporation; Global Ferr	Nickel extraction, mineral handling, HP	Link
Philippines	Solar Batteries EV	Industrial export zones / logistics	Export zones linked to ports create log	Subic Bay Freeport Zone; Clark Free	Export handling, bonded warehousing,	Link
Philippines	Solar Batteries EV Wind	Metal fabrication / industrial fabrication	Batangas and Luzon fabrication cluster	Batangas fabrication clusters; Lima I	Steel cutting, welding, structural fabrica	Link
Philippines	Solar Batteries EV	Vocational electrical workforce	Large national vocational network prov	TESDA national network	Electrical installation, industrial mainten	Link

Approach: Highlighted key insights on synergies between existing and clean technology industries from online reports.

Thank you!