Clean Energy Business Model and Net-Zero Roadmap for Thang Long II Industrial Park

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October 2025

Executive Summary

Potential and Challenges:

- Growing grid instability due to increasing solar penetration
- Legal restrictions that prohibit electricity trading between enterprises within the park
- Limited access to affordable financing, especially for SMEs

Proposed Business Model for Shared Clean Energy:

- Smart Energy Management System: A digital platform for real-time monitoring and optimization of energy resources, which, when paired with BESS, can perform peak shaving and enhance grid reliability
- Shared Energy Service Company: An intermediary to pool investments and lower financial barriers for SMEs
- Joint Investment–Individual Consumption Mechanism: A collaborative model where multiple enterprises co-finance shared renewable projects and receive electricity proportional to their investment, reducing unit costs and expanding participation

Investment Strategies and Financing:

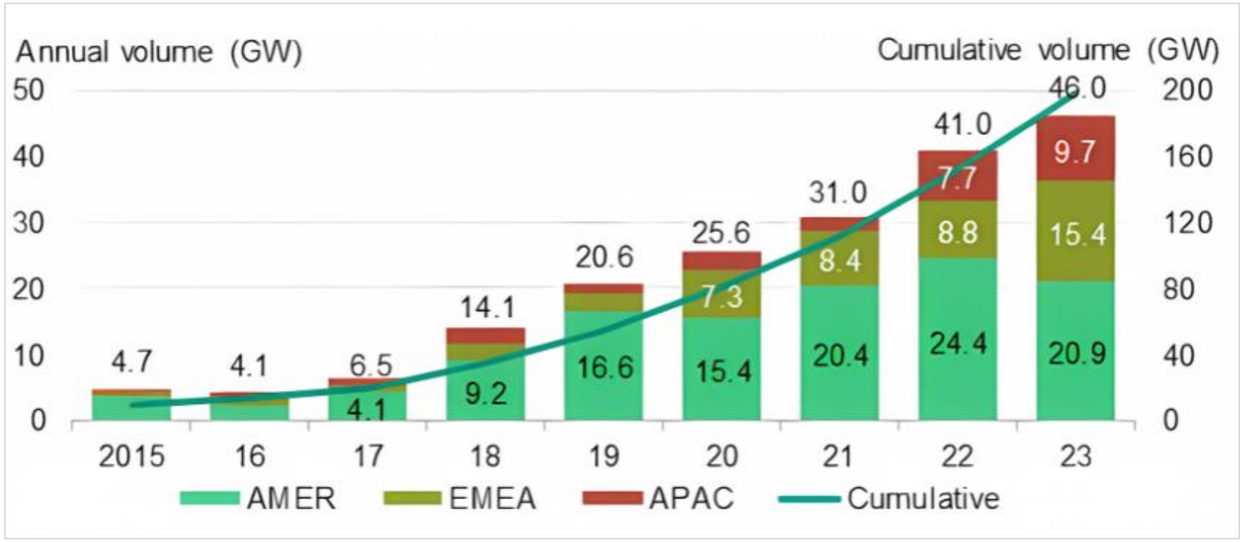
- Baseline Scenario (Net Zero by 2050): This pathway requires a USD 50–70M investment for 50–80 MWp of solar and 5–10 MWh of BESS. It relies on phased financing like bank loans and ESCO models, offering a 10–12% ROI with an 8–12 year payback period. This approach is suitable for SMEs and aligns with gradual regulatory reform
- Accelerated Scenario (Net Zero by 2035): This more ambitious path requires USD 80–100M for 130 MWp of solar and 30 MW/60 MWh of BESS. It delivers higher returns (12–16% ROI, 6–9 year payback) and relies on innovative financing like green bonds, PPPs, and international climate funds. This is better suited to TLIP II's strong FDI base

Financial Instruments:

- Green bonds
- Sustainability-linked loans
- Export Credit Agency financing
- Private equity
- Leasing models
- MDB guarantees
- Carbon finance

Investment Roadmap and Policy Recommendations:

- 2025–2027: Expand solar to 50 MWp, pilot a 20 MW/40 MWh BESS and ESCO structures, and launch the legal sandbox for internal DPPAs.
- 2028–2032: Scale the EMS across all tenants, increase internal solar to 130 MWp, and expand external DPPAs
- 2033–2035: Achieve 100% renewable electricity supply and deploy a 30 MW/60 MWh BESS for grid stability



Corporate Power Purchase Agreement Volumes, by Region

MNCs have been aggressively shifting toward long-term clean energy procurement, primarily through corporate PPAs

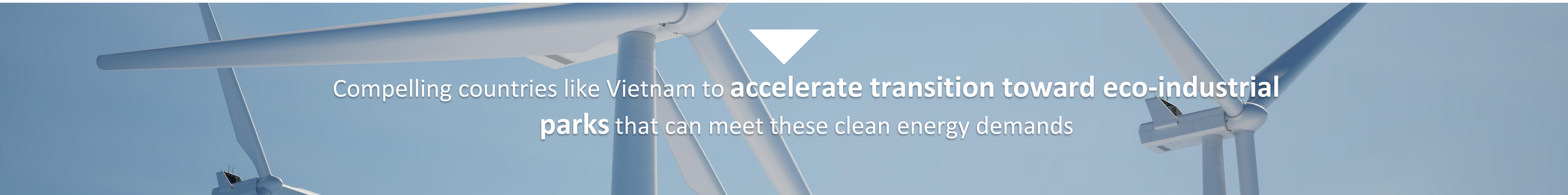
→ Impact on Investment Location Decisions

Investors now prioritize locations that offer **verifiable access to renewables** through mechanisms like:

- PPAs or DPPAs,
- Certifications such as I-REC,
- Transparent energy metering systems.

For FDI investors, the availability of **clean energy is now a critical factor,** and they require clear investment origins and well-defined PPA conditions to ensure long-term policy stability before committing capital

FDI Trends Favoring Locations With Clean Energy Access



Compelling countries like Vietnam to **accelerate transition toward eco-industrial parks** that can meet these clean energy demands

A New Model for Green Industrial Parks

The transition to green industrial parks is primarily fueled by two interconnected trends

Global Corporate Sustainability Commitments

Multinational corporations are increasingly seeking to **fulfill Net Zero and RE100 commitments**. This has led to a surge in corporate clean energy procurement, which reached a record 68 GW in 2024, a 29% increase from the previous year. As a result, FDI now prioritizes locations that offer verifiable access to clean energy

National Policy and Economic Strategy

In response, Vietnam is accelerating its transition toward eco-industrial parks, which are defined as parks where enterprises engage in cleaner production, resource efficiency, and industrial symbiosis. This is supported by government policies like Decree 35/2022/NĐ-CP and pilot programs that have demonstrated significant financial and environmental benefits

For example, a pilot EIP program by UNIDO and MPI helped participating enterprises save over $6.5 million per year and reduce annual CO2 emissions by 32 thousand tons.

Vietnam as an emerging hub for manufacturing and FDI in Southeast Asia

Vietnam's industrial park strategy is deeply intertwined with its socio-economic goals

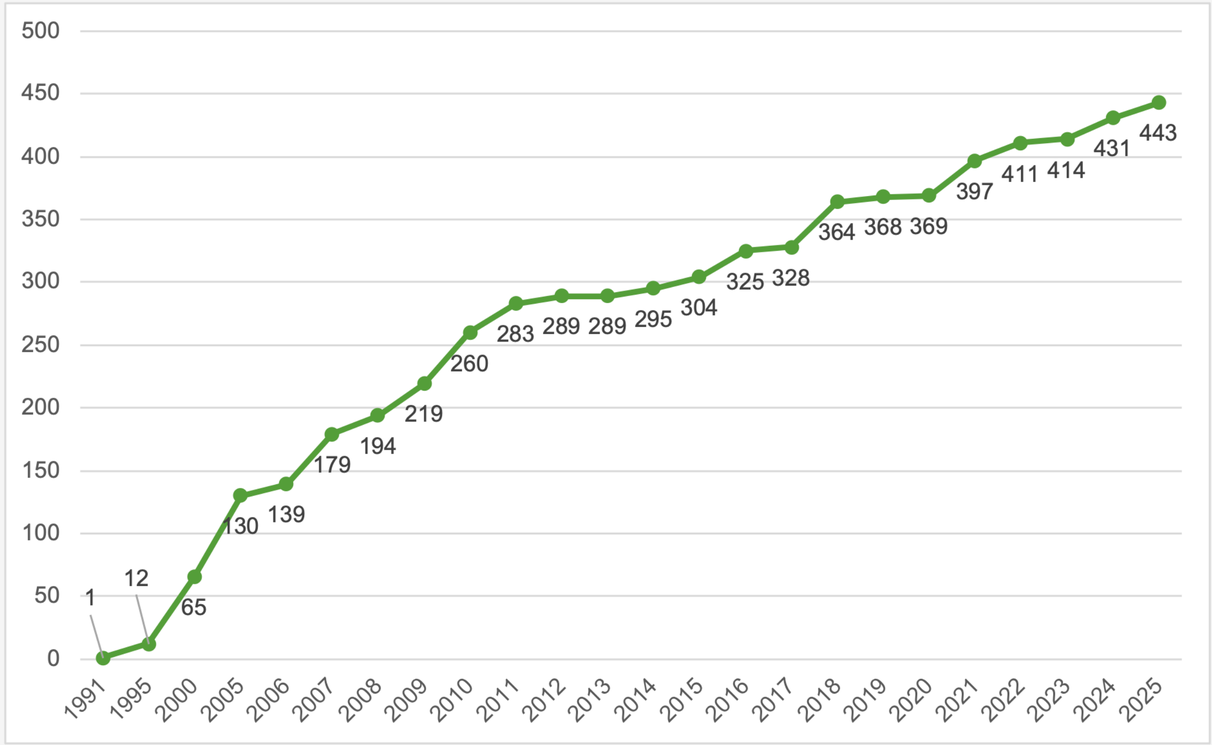
→ **Creating millions of jobs, boosting export revenues, and facilitating technology transfer**

Dec 2023, Vietnam hosts **414 IPs**

span a total land area of **89,126 hectares**

approximately **69% of Vietnam's industrial land**

tributed to **over 50% of Vietnam's total export turnover**



Growth and Distribution of Industrial Parks and Export Processing Zones in Vietnam (1992 – 2025)

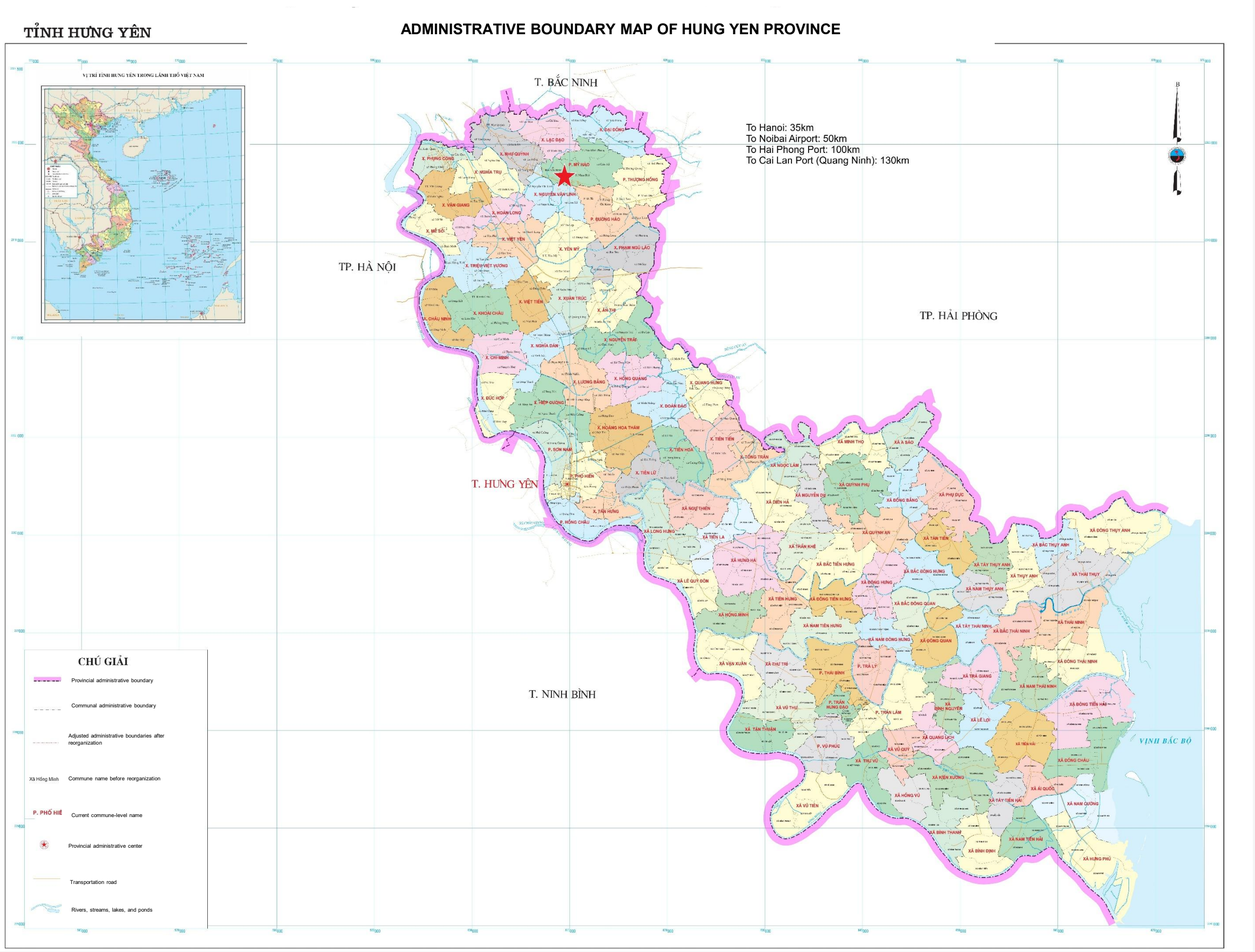
The Role of Industrial Parks in Vietnam's Economic Development

Definition: *an eco-industrial park is an industrial park where businesses collaborate to optimize resource use, share infrastructure, and engage in industrial symbiosis*

Vietnam has introduced regulatory documents to support this transition

- **Decree 82/2018/NĐ-CP** laid the groundwork for EIPs by introducing incentives for sustainable practices
- **Decree 35/2022/NĐ-CP** promotes public-private partnerships (PPPs) to develop sustainable infrastructure, such as worker housing, healthcare facilities, and waste management systems
- **Circular 05/2025/TT-BKHĐT** provides detailed guidelines for monitoring and evaluating EIP performance, requiring annual reports on resource efficiency, waste reduction, and renewable energy adoption

The Shift Toward Eco-Industrial Parks: Aligning Growth with Sustainability



Location of Thang Long II Industrial Park on the Viet Nam and Hung Yen Province Map

Thang Long II Industrial Park – Key Facts

- **Established:** 2006 (Sumitomo Corp & Licogi Dong Anh) – Hung Yen Province
- **Scale & Investment:** 247 ha industrial land, 95.4% filled; 103 FDI projects with $2.9 billion registered capital; ~25,000 workers
- **Infrastructure:** Water treatment 24,000 m^3/day; wastewater 15,000 m^3/day
- **Location advantage:** 30 km from Hanoi; well-connected to Hai Phong & Quang Ninh seaports
- **Investor appeal:** Preferred by Japanese firms under “China + 1” supply chain diversification strategy
- **Industrial focus:** Diverse industries, including electronics, precision mechanics, automotive parts, pharmaceutical production, high-tech industries

The Case Study: Thang Long II Industrial Park

Thang Long II Industrial Park as a Candidate for the New Model

Key characteristics that make TLIP II a suitable pilot site:

Strong FDI Presence

It has attracted 103 FDI projects worth $2.9 billion, primarily from Japanese corporations like Sumitomo

High and Stable Energy Demand

The park has a stable load profile and a high utilization factor of 89.5%, making it well-suited for renewable energy integration

Existing Renewable Infrastructure

As of June 2025, the park already has 23.93 MWp of rooftop solar installed, demonstrating a tangible commitment to clean energy

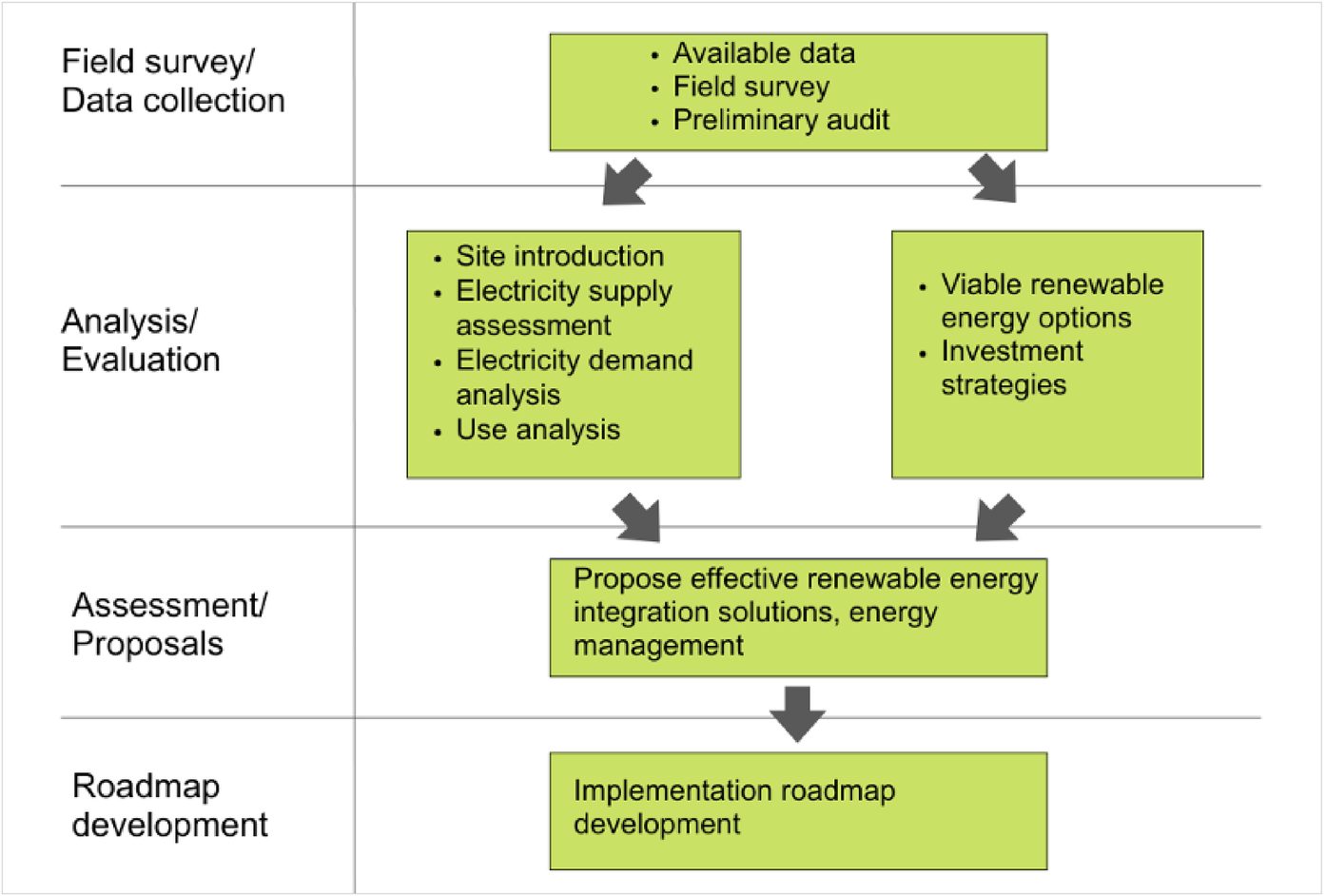
Scope of Study and Methodology

Scope:

- A comprehensive assessment of TLIP II's energy profile, including its electricity supply and demand;
- The development of renewable energy integration strategies;
- The formulation of an investment plan to improve energy optimization and industrial sustainability.

Limitation:

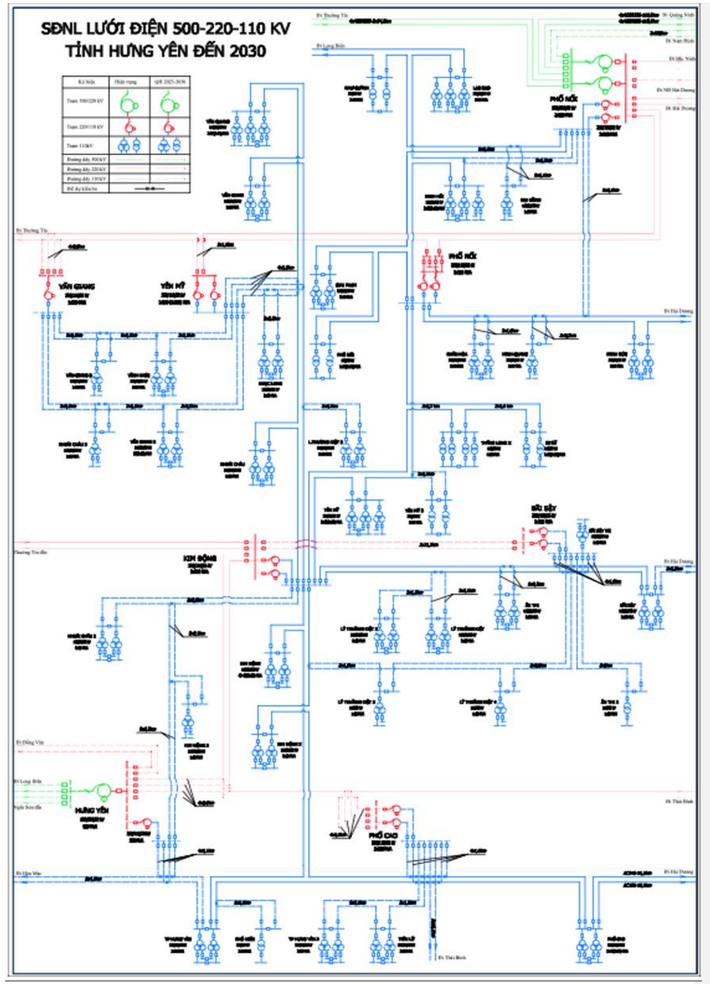
Study uses pre-June 2025 Hung Yen data; post-merger with Thai Binh, boundaries, governance, and industrial policies have changed, so findings may not fully reflect the new province's current context or energy infrastructure.



Overall approach to conduct the assignment

Current Status of the Power System in Hung Yen province

Hung Yen Province receives electricity from the national grid through the Northern Power System, utilizing the 500kV and 220kV networks via substations such as the 500kV Pho Noi, 220kV Pho Noi, and 220kV Kim Dong substations within the province, supplemented by support from the 220kV Long Bien (Hanoi) and 220kV Hai Duong 1 (Hai Duong) substations



Schematic Diagram of the 500-220-110kV Power Grid of Hung Yen Province up to 2030

Hung Yen Electricity System Key Issues

500 kV Pho Noi Substation:
AT3 transformer at 115.4% load; 220 kV Pho Noi–Pho Noi line at 112.4% → beyond safe limits, urgent need for capacity expansion or load redistribution.

110 kV network:
Currently stable but Pho Cao & Lac Dao substations nearing full capacity → risk of future bottlenecks with continued industrial growth (incl. TLIP II).

Electricity System Development Plan for Hung Yen Province

Goal:

Expand/upgrade 500 kV, 220 kV & 110 kV networks to meet rising industrial & residential demand and enable renewable integration.

Key upgrades:

500 kV Pho Noi Substation → capacity increase to **1,800 MVA.**

New **220 kV substations** (e.g. **Yen My 500 MVA**, Pho Cao 500 MVA).

Critical dependency:

Timely execution (e.g. Nam Dinh – Pho Noi line) to avoid persistent bottlenecks.

Impact:

Reliable grid underpins TLIP II's expansion; industrial growth, in turn, drives continued power system investment—creating a reinforcing cycle of industrial development and grid enhancement.

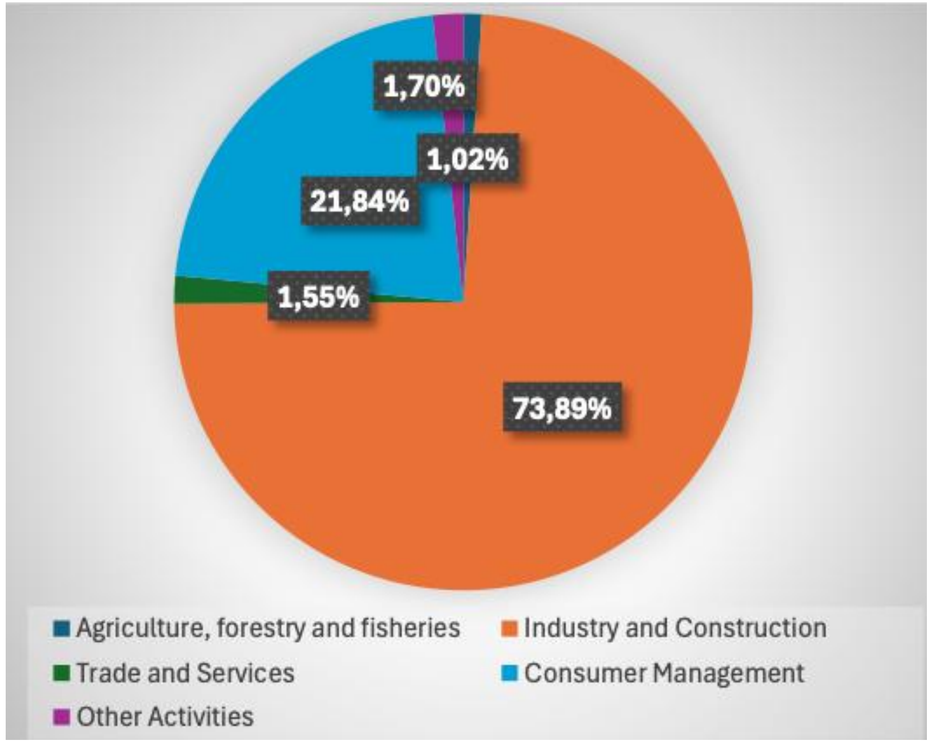
Assessment of the Resilience and Recovery Capacity of the Grid

Provincial Grid Strength	TLIP II Power Configuration	Future Expansion	Underground Cabling Advantage
• Supplied by 500 kV Pho Noi + multiple 220 kV substations → flexible load transfer during localized failures. • Low impact of extreme weather (heatwaves, thunderstorms, floods) shown by declining SAIDI/SAIFI trends → strong self-recovery capacity.	• 110 kV Thang Long 2 Substation: 3 × 63 MVA transformers, normally 2 in service → 30–40 % spare capacity, low load factor (51–69 %) → less overheating, longer equipment life, high redundancy. • Fed from 220 kV Kim Dong Substation via 110 kV line at ~50 % capacity → ample short-term scalability, supports Phase 3.	• Phase 4 (~400 ha): new 110 kV substation planned → stronger source independence, mitigates conductor overload, reduces single-feed risk.	• Far less vulnerable to storms, lightning, mechanical damage or sabotage than overhead lines. • In looped grid with Ring Main Units (RMUs) → rapid fault isolation, prevents cascading failures, shorter restoration times, maintains supply to priority production circuits during emergencies

TLIP II grid offers high redundancy, dual sources and future scalability, ensuring stable operations and rapid recovery even under extreme events

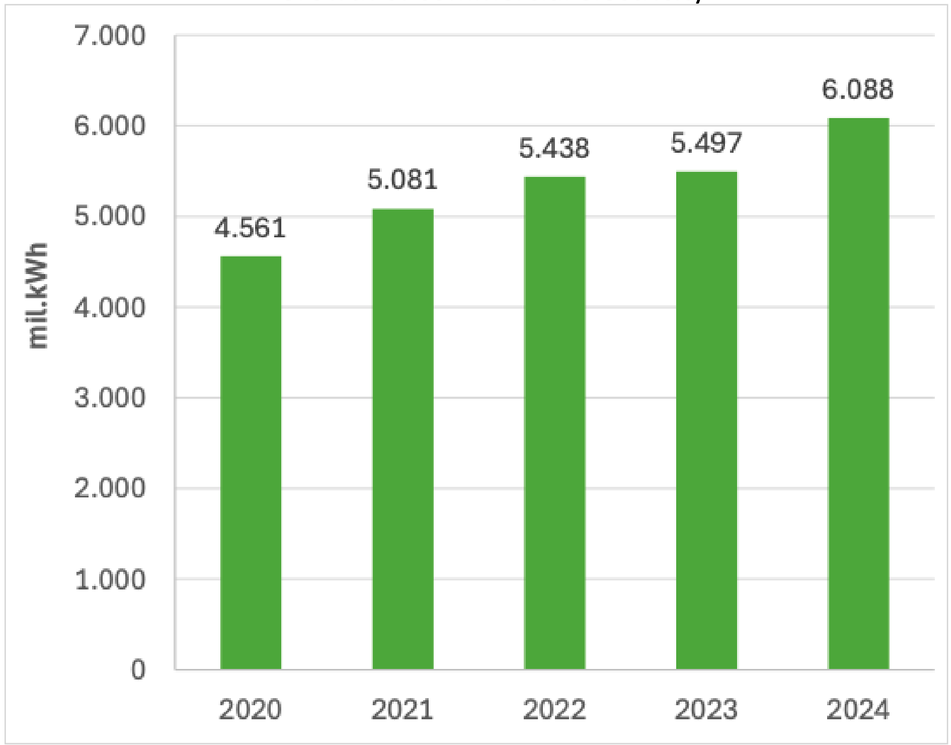
Detailed Load Assessment

Load composition of Hung Yen province by sectoral structure



In 2024, the electricity load in Hung Yen Province was overwhelmingly dominated by the **industrial and construction** sector, which accounted for **73.89% of the total** commercial electricity consumption

Growth of commercial electricity



The total commercial electricity consumption in Hung Yen province has shown **consistent growth** from 2020 to 2024

Feasibility of Renewable Energy Technologies

Waste-to-Energy	Rooftop Solar Power	Biomass Energy	Wind Power
			

Waste to Energy

Waste-to-Energy Potential in Hung Yen Province

Hung Yen province has a total estimated potential for **waste-to-energy generation of 30.88 MW**

No.	Waste Treatment Facility	Planned Area (ha)	Land Demand by 2030 (ha)	Waste Treatment Capacity (tons/day)	Power Generation (MW)
1	Vu Xa, Kim Dong District	20.0	13.93	1,000	30.88
2	Lieu Xa, Tan Lap, Trung Hoa (Yen My District) and Di Su (My Hao District)	10.0	10.0	1,000	–
3	Dai Dong, Van Lam District	30.0	25.6	1,100	–
4	Hoa Phong, My Hoa	4.5	3.0	650	–

Waste-to-Energy Development Potential

Barriers and Challenges

- High Capital Investment
- Complex Technology
- Unattractive Tariffs
- Lengthy Approval Processes
- Land Scarcity
- Environmental Concerns

Rooftop Solar Power

Solar Potential in Hung Yen Province

Location and climate: situated between 20°36' and 21°00' North latitude, with an average annual temperature of 23°C.

Solar irradiance: receives ~1,650 hours of sunshine/year. The average solar radiation is 1,462 kWh/m²/year, with a daily average of about 4.01 kWh/m²/day.

Provincial Development Plan for Rooftop Solar:

- **Overall target:** aims for a total installed capacity of approximately 1,407.6 MWp by 2045, less than 30% of the province's total power capacity.

- **Phased goals:**

two phases:

  - 542.4 MWp by 2030
  - and an additional 865.2 MWp between 2031 and 2045.

- **Sectoral breakdown:**
  - Industrial zones and factories: 1,069.8 MWp by 2045 (412.2 MWp by 2030),
  - Residential areas and other facilities: 305.34 MWp by 2045,
  - Public offices and administrative agencies: 32.46 MWp by 2045.

Biomass Energy

Biomass Energy Potential in Hung Yen Province

Hung Yen's biomass potential is primarily derived from **agricultural residues**:

- Firewood: Sourced from fruit trees and perennial crops, it is still used by approximately 20% of rural households for cooking and processing agricultural products. Its use in urban areas has nearly disappeared,
- Rice straw: About 10–15% of rural households still use straw as fuel. However, most of it is burned in the fields after harvest, which contributes to air pollution and ecological damage,
- Rice husks: Primarily used for animal bedding, with only limited application as a household fuel.

Biomass Potential and Consumption in Hung Yen *Unit: KTOE*

Category	Firewood & Wood Waste	Rice Husks	Other Agricultural Residues	Total
Theoretical Potential	5.99	28.83	134.54	169.36
Technical Potential	4.18	23.06	94.18	121.43
Current Consumption	17.34	5.17	8.67	31.19

Theoretically mobilize **437,000 tonnes of firewood** and **777,300 tonnes of agricultural by-products annually ~** theoretical potential of **over 200 KTOE** per year

Challenges and Feasibility

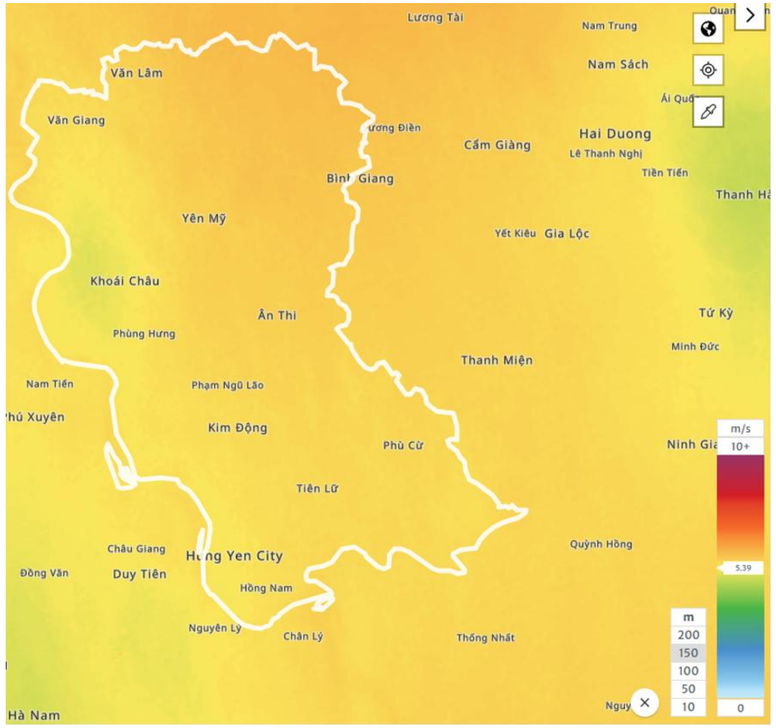
- Fragmented and dispersed supply
- High collection and logistics costs
- Lack of processing hubs

Wind Power

Wind Power Potential in Hung Yen Province

- **Wind speed:** At an altitude of 150 meters, the average wind speed is approximately 5.0–5.9 m/s. This is below the typical thresholds required for cost-efficient, commercial-scale wind turbine deployment.
- **Power density:** The average wind power density is about 160–192 W/m².
- **Prevailing wind direction:** The dominant wind directions are from the North and Southeast

➞ **The province currently has <u>no potential</u> for large-scale wind power development**



Average Wind Potential Map at 150m Altitude in Hung Yen Province

Renewable Energy Feasibility Comparison for TLIP II

Technology	Capacity Potential	Feasibility	Barriers	Investment Implications	Policy Needs
Rooftop Solar	80–120 MWp (~140–210 GWh/year)	**High**	Substation reverse power cap (~30% penetration without upgrades)	Strong ROI (12–15%), $1.2M/year savings, >100,000 tCO_2e reduction; aligns with RE100/ESG demand	Clarify intra-park DPPA rules (Decree 57/2025), enable shared RSP services, support EMS & BESS deployment
Waste-to-Energy	30.88 MW (Vu Xa, 20 ha)	Low	Land scarcity, pollution risks, $50M/MW CAPEX, long approval timelines	Not viable for TLIP II; only provincial-level consideration	Stricter emission standards, clearer siting rules, provincial financing support (not relevant for TLIP II)
Biomass	121.43 KTOE technical potential	Low	Fragmented supply, high logistics cost, no processing hubs	Only feasible for small-scale heat applications (1–2 MWth for textiles, food)	Develop biomass clusters, incentivise logistics hubs, but limited role in TLIP II
Wind	Negligible (<6 m/s avg at 150m)	Low	Poor resource conditions, low density	Infeasible in current tech environment	Long-term only if turbine tech improves (<7 m/s viability)

Rooftop Solar as the Core Renewable Energy Pathway

No.	Category	Phase 1+2	Phase 3	Phase 4	Total
1	Exploitable Land Area (ha)	247	427.5	819.2	1,493.7
2	Rooftop Area (ha)*	54	94	180	328
3	Estimated Installed Capacity (MWp)	50	80	150	80-120
4	Expected Operating Capacity (MW)	40	70	130	64-96

Rooftop solar is well-suited to TLIP II's infrastructure, energy demand, and economic profile:

- **Favorable solar resources:** Hung Yen province receives an average solar radiation of 4.01 kWh/m²/day
- **Significant capacity potential:** The park has the potential to host between 80–120 MWp of rooftop solar capacity, which could generate 140–210 GWh of clean electricity annually. This could meet up to 30% of the park's projected demand by 2030.
- **Grid compatibility:** The park's 110/22 kV substation can accommodate solar integration up to 30% of its peak load without requiring significant grid upgrades, making rooftop solar both scalable and grid-compatible.
- **Strong economic returns:** With installation costs of $520–$580/kWp, they can achieve a 12–15% ROI with a payback period of 5–7 years. For tenants, this can translate to annual electricity bill savings of 15–25%.

Assessment of Clean Electricity Demand at TLIP II

“No green, no deal” is fast becoming the new baseline in global industrial trade

The demand for clean electricity at TLIP II is not merely an option but a **"matter of survival and long-term competitiveness**" for its enterprises

Current Status & Enterprise Response at TLIP II

High concentration of FDI enterprises: TLIP II hosts **> 70 FDI projects**, and **97% of its tenants are foreign enterprises**, primarily from Japan. *Major corporations with strong emission reduction commitments: Panasonic, Daikin, TOTO, Kyocera, Hoya, Toyota, and Nestlé*

Existing environmental standards: A 2022 survey found that **~ 100% of factories** in the park had already obtained ISO 14001:2015 certification or equivalent, viewing it as a competitive advantage

Early adoption of solar: In 2021, Sumitomo, the park's developer, launched a **1 MWp rooftop solar project** that supplies clean electricity to tenants. Furthermore, **25 rooftop solar projects** with a total installed capacity of 23,931.67 kWp are already in operation, installed independently by investors for self-consumption. Sumitomo plans to expand the total solar capacity across its industrial parks to around 100 MWp by 2030

Clean energy is identified as

operational necessity and a strategic pathway for sustainable industrial development at TLIP II

Strategic Alignment with Industrial Park Needs

Rooftop solar offers distinct strategic advantages that align perfectly with the needs of an industrial park like TLIP II

Alignment with the "Self-Generation, Self-Consumption" Model

Rooftop solar allows enterprises to directly reduce electricity costs, improve energy security, and meet corporate sustainability goals without relying on the national grid

Scalability and Flexibility

Systems can be deployed in phases, matching the evolving demand and financial capacity of different enterprises and reducing the risks of large upfront capital commitments

Attraction for FDI

Many multinational tenants, particularly the Japanese firms that dominate TLIP II, require renewable energy in their supply chains. Parks with substantial solar capacity are more attractive to these investors

Foundation for a Smart Energy Ecosystem

Rooftop solar integration creates opportunities for coupling with smart EMS and BESS, enabling the park to evolve into a resilient, low-carbon energy ecosystem

Integration Pathways for Rooftop Solar in TLIP II

Short-Term Pathway

- **Self-Investment:** Tenants with sufficient capital can directly invest in rooftop solar systems to meet their own internal consumption needs. This reduces their dependency on grid power and offers clear cost-saving and environmental benefits.

Medium-Term Pathway

- **ESCO-Led Models:** Either the park management or an IPP would finance and operate shared rooftop solar and BESS infrastructure. Tenants would purchase electricity under long-term contracts. This approach allows for economies of scale and centralized maintenance, and it can unlock access to green credit lines from domestic and international financial institutions like the ADB and World Bank. However, the scalability of this model is currently constrained by the lack of a clear legal framework for internal electricity distribution in Vietnam.

- **Microgrid with Smart EMS:** The next stage involves developing a park-wide microgrid controlled by a smart EMS. This system enables real-time monitoring of generation and consumption, optimizing electricity flows, enabling demand response, and reducing distribution losses by 2–5%. The EMS is crucial for maximizing the internal use of renewable electricity and is a prerequisite for more advanced functions like intra-park energy trading.

Advanced and Long-Term Pathway

- **BESS Deployment:** Integrating BESS is the next logical step. A 2–5 MWh BESS, though requiring an investment of $1.5–2 million, could generate annual savings of around $0.5 million through peak shaving and tariff arbitrage, achieving a Return on Investment of 12–15%. BESS would allow the park to store excess midday solar generation for use during evening peaks, increasing self-consumption rates and providing critical backup power for tenants with sensitive production processes. The main barrier is the current absence of official guidelines for BESS integration in industrial park grids.

- **Internal DPPAs**: In the longer term, once legally permitted, TLIP II can establish an internal energy market where tenants can trade solar generation with one another through the park's microgrid. This would significantly reduce dependency on the national grid, maximize the efficient use of solar power, and foster energy symbiosis among tenants. External DPPAs, where tenants purchase power from off-site projects, can serve as a less competitive interim solution.

Policy Drivers, Incentives, and Legal Framework

Core Legal Framework

The central pillar of Vietnam's clean energy policy is its commitment to achieve net-zero emissions by 2050, a pledge made at COP26. Several key policies create the enabling environment for renewable energy adoption in industrial parks like TLIP II

Decree 35/2022/ND-CP

on the management of industrial parks and economic zones establishes the legal foundation for eco-industrial parks, emphasizes resource efficiency and promotes industrial symbiosis, which is a core concept for green industrial development.

Circular 05/2025/TT-BKHDT

provides the practical, detailed guidelines for developing and certifying EIPs, outlines the specific criteria, procedures, and reporting requirements necessary for a park to be recognized as an EIP, aiming to foster cleaner production and sustainable transformation.

Power Development Plan VIII

Revised PDP8 sets ambitious national targets for renewable energy.

- By 2030, it aims for 46–73 GW of solar power, constituting 25–31% of total capacity. A key goal is for 50% of households and 50% of public offices to be equipped with self-consuming rooftop solar systems.
- By 2050, the solar target expands to 293–296 GW, making up 35–38% of the total capacity.

Decree 57/2025/ND-CP

regulates DPPAs, officially enabling large electricity consumers to buy renewable power directly from generators, is a significant step toward creating a more competitive retail electricity market and provides a crucial mechanism for industrial tenants to secure clean energy.

Investment Incentives

Incentive Type	Description	Eligibility/Conditions	Legal Source
CIT preferential rates	Reduced CIT of 10–17% for 10–15 years (vs. 20% standard).	Priority sectors (high-tech, renewables); ≥ VND 12B investment; SMEs with ≤ VND 3B revenue (15%).	Law No. 67/2025/QH15; Decree 218/2013 (amended).
CIT Tax Holidays	Full exemption 2–4 years, then 50% reduction for 4–9 years.	New projects in priority sectors, high-tech zones, EIPs.	Decree 218/2013; Investment Law 2020.
Import/Export Duty Exemptions	Duty-free imports for machinery/equipment (fixed assets) and raw materials for 5 years.	Incentivised sectors/areas.	Decree 134/2016; Investment Law 2020.
Land Rent Exemptions/Reductions	Up to 3 years exemption during construction, 3–15 years post-construction; 50% reduction for PPP projects.	High-tech zones, EIPs, difficult socio-economic areas.	2024 Land Law; Decree 103/2024.
Green Credit and Support	Access to green credit from BIDV, Agribank, ADB, World Bank; R&D deductions;	SMEs, RE projects, high-tech industries.	Law No. 90/2025/QH15; Decree 31/2021/ND-CP.
Other Incentives	Accelerated depreciation, technology transfer, trade promotion; access to green bonds.	Innovation/environment projects.	Circular 05/2025; Law No. 90/2025/QH15.

Enterprise-Level Drivers of Renewable Energy Adoption

Approaches at the Enterprise Level

- **Self-Investment:** Large firms with strong financial capacity and stable energy demand can invest directly in their own renewable energy systems, such as rooftop solar or energy efficiency upgrades.
- **Third-Party Collaboration:** For companies with limited capital, especially SMEs, collaboration through leasing or ESCO-models. In this model, a third party invests in and operates the renewable systems, while the enterprise purchases the electricity at a discounted rate or receives rental income for its rooftop .

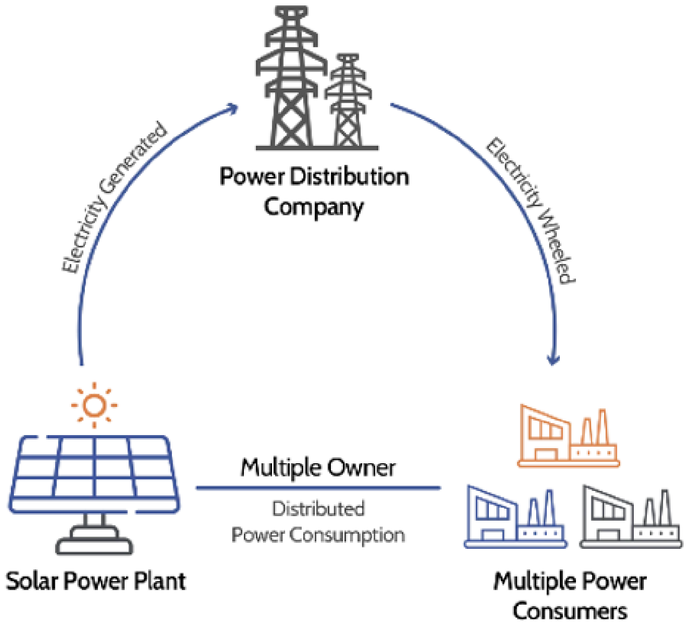
ENABLE

Financing Channels

- **Domestic Green Credit:** Commercial banks like BIDV and Vietcombank offer green credit products with preferential interest rates and longer repayment terms for renewable energy projects. However, access remains a challenge for SMEs due to stringent collateral requirements.
- **International Climate Finance:** Organizations like the GCF, JICA, ADB, and the IFC provide low-interest loans and credit guarantees to support Vietnamese enterprises.
- **Green Bonds:** Large enterprises can issue green bonds to raise capital for sustainable energy projects, which also enhances their ESG profiles and strengthens their position in global supply chains.

Self-Investment by Enterprises

Case Study of the Captive Power Model in India



Two primary types of captive power arrangements:

- Single Captive: One customer invests in a power plant solely for its own consumption.
- Group Captive: Multiple customers co-invest in a shared renewable energy plant, typically structured through a SPV.

Cost Advantages and Economic Benefits

- Exemption from Grid Surcharges: Captive projects are exempt from certain grid fees, primarily the CSS and AS, which normal open-access customers must pay. This makes captive power tariffs significantly cheaper.
- Long-Term Price Stability: Consumers sign long-term PPAs with the SPV, typically for 10–25 years, at fixed tariffs. This provides stability and predictability, hedging against volatile grid electricity prices.
- Significant Savings: The model can result in electricity tariffs that are 20–40% cheaper than grid power, leading to substantial long-term savings for industrial consumers.

Implications and Lessons for TLIP II

- Adopt a "Group Captive Intra-Park DPPA”
- Achieve Key Benefits
- Utilize a Legal Sandbox

ESCO Model

Example of ESCO Model

Share Savings Model

Super ESCO Model

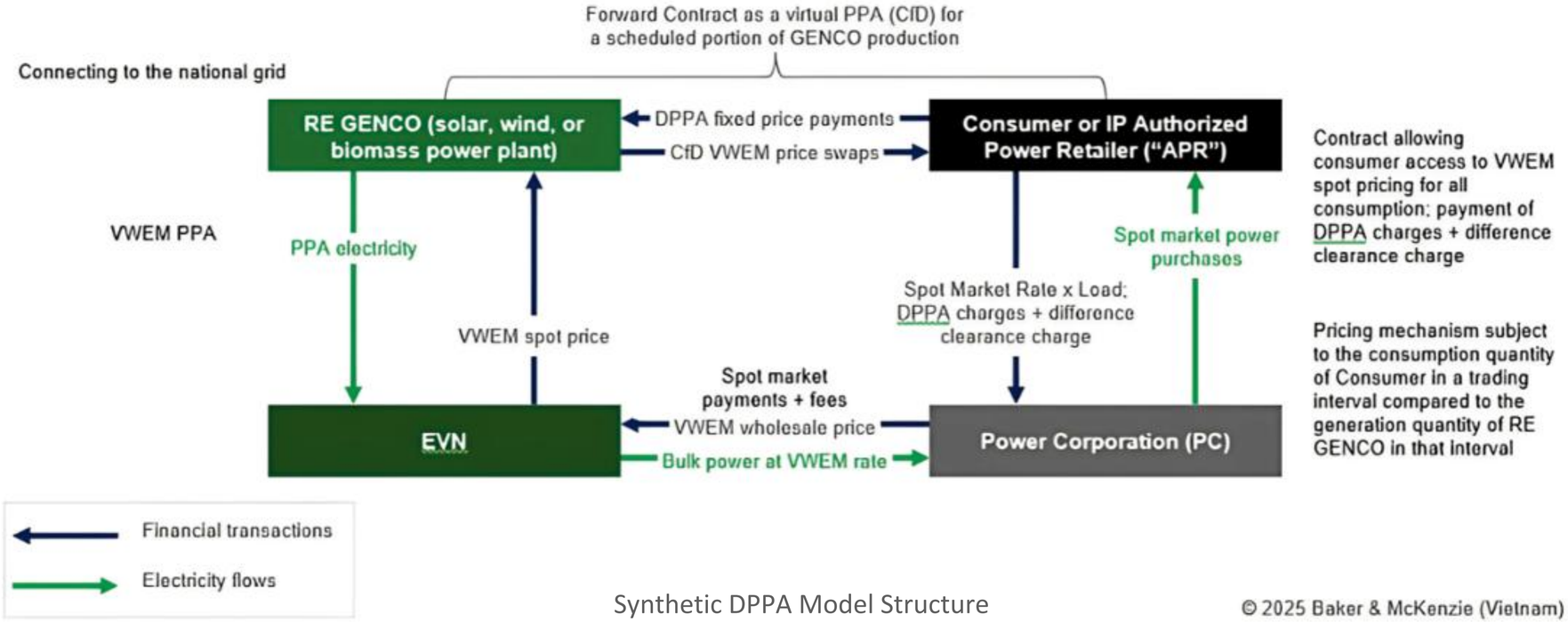
Cost Advantages and Economic Benefits

- No Upfront Cost: Removes investment burden for SMEs.
- Risk Mitigation: ESCO bears financial, technical, operational risks; tools like ESI cover defaults/underperformance .
- Professional Management: Specialized O&M ensures optimal performance.
- Centralized Systems: Supports shared infrastructure with smart EMS for efficiency and stability.
- Green finance access: Unlocks credit from domestic banks and international institutions.

Challenges and Regulatory Barriers

- Unclear Legal Framework: No clear rules for internal power distribution or revenue-sharing; current laws restrict sales to third parties, limiting ESCO scale.
- Nascent ESCO Market: Few experienced providers and limited competition hinder growth.

DPPA Model



Synthetic DPPA Model Structure

DPPA model is a crucial mechanism for enabling large energy consumers, especially MNCs in industrial parks, to procure renewable electricity directly from generators

Decree 57/2025/NĐ-CP outlines 2 models:

Private Wire DPP is a direct physical supply contract where the renewable power plant is connected to the consumer via a dedicated private transmission line, bypassing the national grid

Grid-Connected DPPA (Virtual PPA):

- In this model, the generator and consumer are both connected to the national grid but not directly to each other.
- The generator sells its power into the wholesale electricity market, while the consumer continues to buy physical electricity from EVN.
- The two parties sign a bilateral financial contract-for-difference (CfD), where they settle the difference between a pre-agreed "strike price" and the wholesale market price

DPPA Model

Recent Developments for Intra-Park DPPAs

Recent policies have begun to pave the way for a more flexible intra-park DPPA model within industrial parks. At the end of 2024, Decree No. 135/2024/NĐ-CP and Decree 58 introduced new flexibilities:

- Rooftop solar investors can sell electricity to customers within the same park (intra-park DPPA).
- They can also sell surplus power (up to 20% of output) to the grid at state-regulated tariffs.
- In multi-building complexes, generators can sell directly to on-site users and any remaining surplus to local distribution entities at a mutually agreed price.

Regulatory Gaps and Challenges

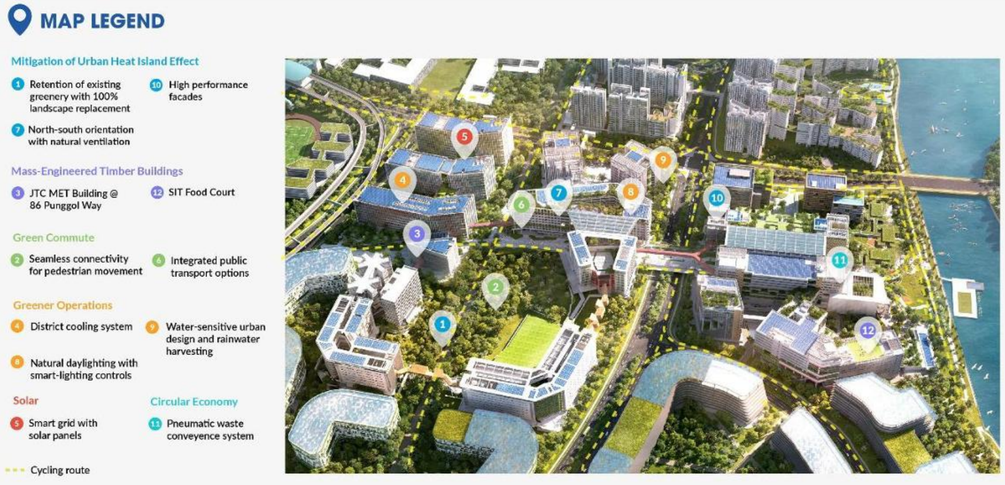
- Limited Scope for Internal Trading
- Restrictions on "Self-Consumption"
- Lack of Recognition for Internal Networks

Recommendations and International Lessons

To unlock the full potential of DPPAs, recommend clarifying regulations to explicitly allow internal trading within industrial parks, with clear rules on tariffs, settlement, and technical standards

Shared Energy and Storage Services in IPs

Case Study: Punggol Digital District-Wide Sustainability



Barriers and Policy Needs

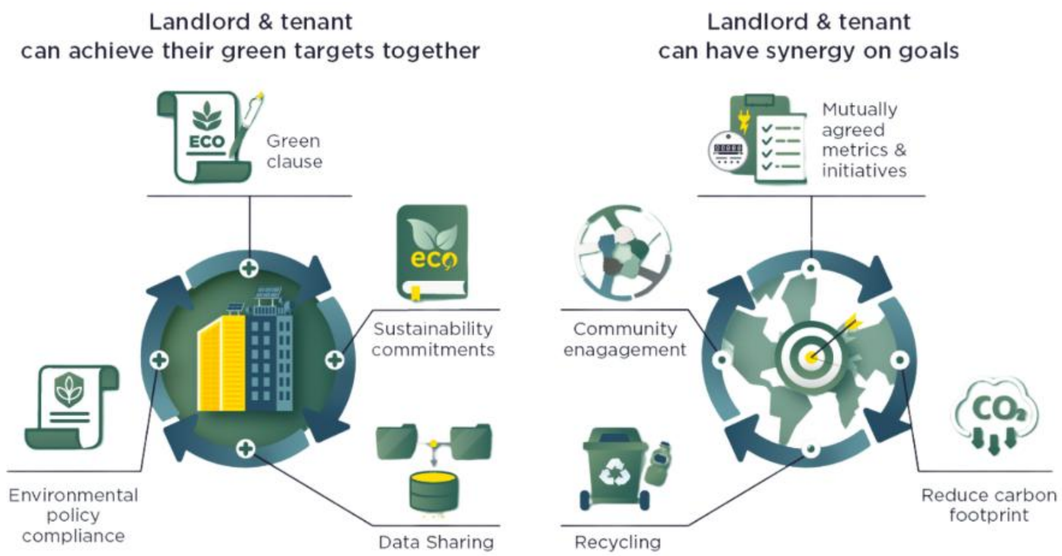
- Legal ambiguity: Current law allows non-EVN distribution in industrial zones, but clarity needed on ownership/governance of shared assets (wires, transformers, BESS).
- Collaboration gaps: No framework for “collective renewable energy consumers” or fair allocation of electricity by investment/consumption.

Key Advantages of the Shared Model

- Economies of Scale: A centralized, large-scale BESS is cheaper per kWh compared to multiple small, individual battery systems.
- Efficient Load Management: The smart EMS maximizes the park's renewable self-consumption by reallocating unused electricity from one firm to another, which minimizes energy waste and curtailment.
- Enhanced Reliability: Shared storage helps balance intermittent renewable generation (from solar or wind), manages peak demand, and can guarantee a stable, 24/7 power supply across the park.
- Lower Investment Costs: By pooling resources, this model lowers the investment barrier for individual enterprises, particularly SMEs, and improves the park's overall renewable energy penetration.

Green Leasing Model

General Model of Green Leasing



Green Leasing Model is a business arrangement designed to make renewable energy accessible to industrial park tenants who cannot invest directly in rooftop solar projects.

Key Advantages and Financial Benefits

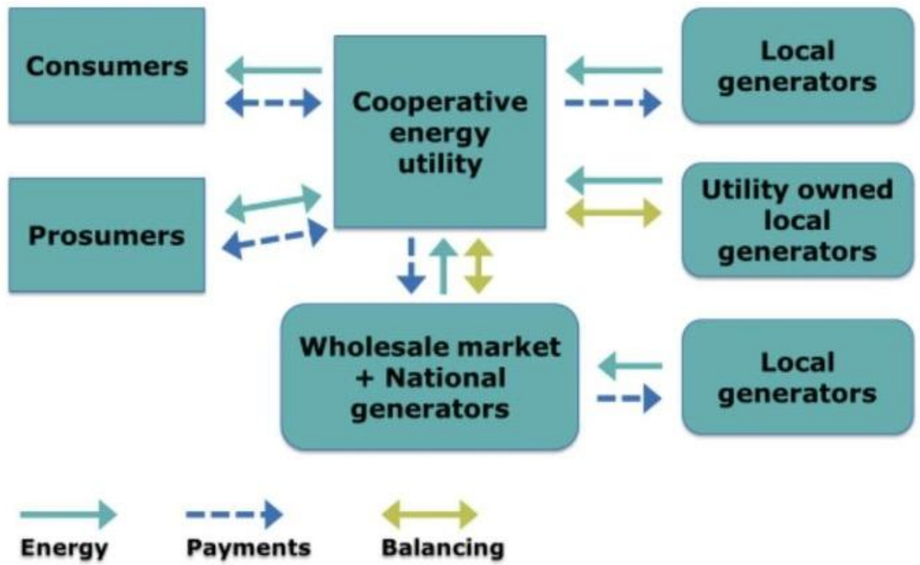
- Zero Upfront Cost: Tenants can access renewable energy without any initial capital investment, as the third-party provider covers all costs.
- Immediate Cost Savings: The model provides electricity at discounted rates, typically USD 0.06–0.07 per kWh, compared to EVN's average industrial tariff of around USD 0.08 per kWh.
- Flexibility: Tenants are not locked into long-term asset ownership, which suits their shorter operational timelines.

Limitations and Challenges

- Limited scope: Leased rooftops alone may not meet larger tenants' demand.
- Regulatory hurdles: Current rules block internal electricity sales; Decree 57/2025 needs amendment for third-party leasing and sub-1 MW grid access.

Shared Renewable Energy Cooperative Model

Cooperative Energy Utility Business Model



Core Concept and Structure

A group of enterprises within an industrial park co-invests in centralized renewable energy and storage assets, include:

Rooftop solar plants	Ground-mounted solar farms	BESS

Economic Benefits

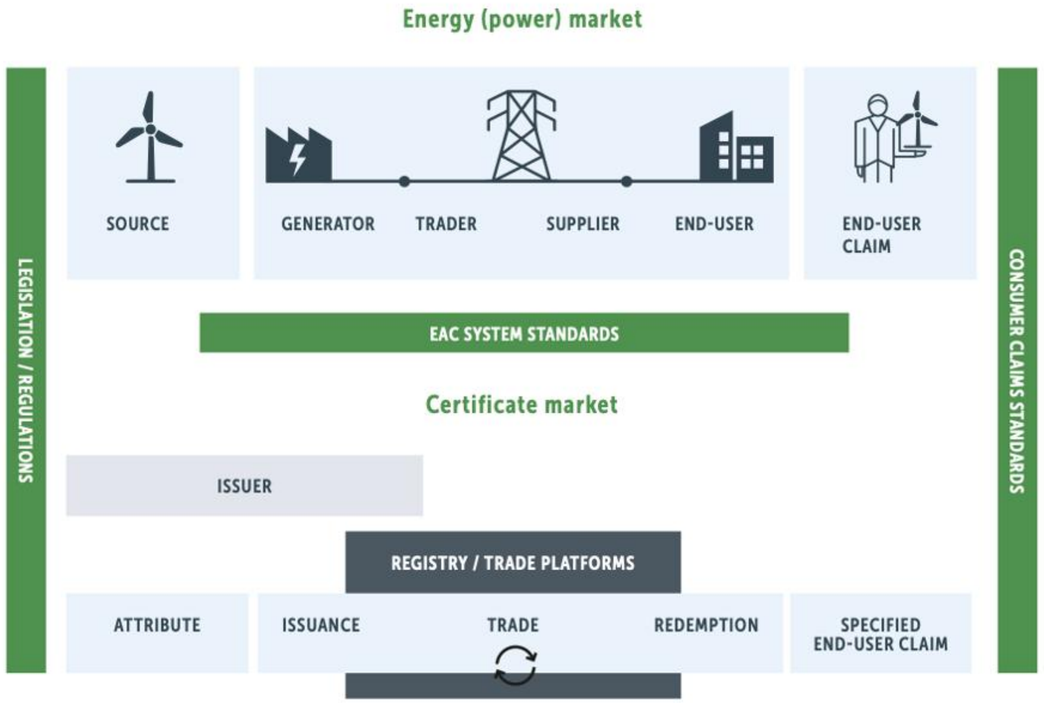
- Cost Reduction: By investing collectively, tenants can lower their project costs by 10–15% compared to individual installations.
- Investment Cost: The levelized investment cost is estimated to be around USD 0.47–0.50 million per MWp.
- Collective Savings: At a scale of 30 MWp, this model can generate annual collective savings of USD 0.6–0.8 million for participating enterprises, while strengthening the park's overall share of renewable energy

Challenges and Requirements

- Grid Upgrades: The model requires significant investment in internal park infrastructure, estimated at USD 1–2 million, to handle shared generation, reverse power flow, and load balancing.
- Complex Governance: Establishing and managing an SPE involves complex governance structures to handle shared risks and ensure fair benefit-sharing among members.
- Legal and Regulatory Gaps: A major barrier is that Vietnam's legal framework currently lacks clear provisions for establishing SPEs in industrial parks. This means the rules for cooperative governance and benefit-sharing mechanisms are undefined, creating uncertainty for investors.

I-REC Certificates

Interaction Between the Energy Market and the Certificate Market



The I-REC Market in Vietnam

- Dominant Standard: The I-REC standard is the dominant framework in Vietnam, accounting for about 95% of all issued certificates.
- Market Size: In 2023, 21 million I-RECs were issued in Vietnam, equivalent to 21 TWh of certified renewable generation. Hydropower projects (62%), solar (29%) and wind (9%).
- Price and Oversupply: Vietnam's I-REC prices are relatively low, ranging from USD 0.25 to USD 2.04 per MWh.

Strategic Role and Application at TLIP II

I-RECs are a cornerstone of TLIP II's decarbonization strategy, particularly as a short-to-medium-term solution while the legal framework for physical energy trading (like internal DPPAs) matures

Meeting Tenant Demand	Park-Level Commitment	Cost-Effective Compliance	Revenue Generation for Solar Investors

Limitations and Challenges

- No Physical Impact: Purchasing I-RECs does not reduce a tenant's dependence on grid electricity from EVN or improve the park's energy autonomy and resilience.
- Regulatory Gaps: Vietnam lacks a specific official framework for I-REC issuance, trading, and retirement..
- Price Volatility: The market is subject to price volatility and oversupply, making I-RECs an unstable long-term revenue stream for generators.
- Competition with Carbon Credits: There is an overlap between I-RECs and carbon credits, which can create confusion for enterprises seeking ESG compliance

Financial Barriers

- High Upfront Capital Investment
- Limited Access to Credit for SMEs
- Structural and Policy-Related Financial Gaps

Regulatory Barriers

- Restrictions on Intra-Park Electricity Trading
- Exclusionary Eligibility for DPPAs
- Lack of Legal Clarity for Innovative Models
- Regulatory Gaps in the I-REC Market

Technical Barriers

- Lack of Smart EMS
- Barriers to BESS Integration
- Grid Instability and Reliance on EVN

Investment Strategies and Business Models for TLIP II

Rooftop Solar Project in Thang Long II Industrial Park Management Board

Current Electricity Business Model and Challenges

Current Electricity Business Model

TLIP II operates under a conventional electricity distribution model:

✓ Centralized Purchase: The park purchases all its power directly from EVN through a dedicated 110 kV substation

✓ Internal Redistribution: The power is then redistributed to individual tenants via the park's internal 110/22 kV substation and a ring-structured grid

As of June 2025, enterprises within TLIP II have already installed 23.93 MWp of rooftop solar projects

Challenges

❖ SME Financing: SMEs (~70% of tenants) cannot afford $0.55M/MWp RSP costs due to limited collateral.

❖ Regulatory Gaps: Decree 57/2025/ND-CP restricts intra-park sales, limiting internal DPPA and ESCO models.

❖ EMS Absence: No smart energy management system (EMS) causes 2–5% losses (0.7 GWh/year at 50 MWp), hindering shared models

External DPPAs via the national grid: Tenants contract with off-site RE plants (e.g., solar, wind) via EVN’s grid, using financial reconciliation for ESG reporting.

01

Internal DPPAs with rooftop and localized solar PV to harness in-park potential and enhance energy autonomy.

02

Smart EMS with BESS integration to optimize multi-source dispatch, ensure grid stability, and provide verifiable renewable accounting.

03

I-RECs as a transitional mechanism bridging ESG compliance until internal energy trading matures.

04

Business Model Proposals for TLIP II

Green Bonds

Raise large-scale capital, attract ESG investors; legal basis exists but no precedent for industrial parks

Sustainability-Linked Loans

USD 20–25M; interest tied to meeting sustainability targets; flexible use across projects

Private Equity & Venture Capital

USD 10–15M for high-return tech (BESS, EMS); no debt servicing, adds expertise and networks

Export Credit Agency Financing

USD 10–12M from JBIC and others; low interest (2–4%), long tenors (12–15 years)

Leasing Models

Vendors own equipment; tenants pay lease via bill savings; enables SME access without upfront capital

Carbon Finance & RECs

Monetize 10k–20k tCO_2e reductions; generate USD 0.7–1.6M annually; boosts ESG and bankability

MDB Guarantees

ADB/World Bank risk guarantees; improve credit, cut borrowing costs, attract institutional investors

Crowdfunding

Raise USD 1–2M for pilots; modest returns (5–7%); builds community support and engagement

Financing Instruments for TLIP II's Net Zero Transition

Investment Roadmap for Net-Zero Energy Transition

Baseline Scenario (Net Zero by 2050)

A gradual pathway aligning with national commitments, driven primarily by incremental upgrades and evolving regulatory frameworks

- Goal: 100% renewable energy by 2050
- Investment: USD 50–70M
- Timeline: 2025 - 2050
- Suitability: SMEs/domestic firms with limited capital, gradual alignment with regulations

Accelerated Scenario (Net Zero by 2035)

An ambitious pathway leveraging TLIP II's strong FDI base, Japanese governance standards, and ability to mobilize international finance, making the park a pioneer in Vietnam's Net Zero transition

- Goal: 100% renewable energy by 2035
- Investment: USD 80–100M
- Timeline: 2025 - 2035
- Suitability: Large enterprises with net-zero targets, strong FDI base, ESG leadership, high investor appeal

Baseline Scenario – Net Zero by 2050

Phase 1 (2025–2030)
Foundation and Technical Standardization

- Technology Deployment
- Smart Management
- DPPA Pilot

Phase 2 (2030–2040)
Expansion and Deep Integration

- Scaling Up
- Centralized Control
- Infrastructure Growth
- Data Standardization

Phase 3 (2040–2050)
Full Operation and Mini-Grid Transition

- Energy Autonomy
- Net-Zero Goal
- Full Integration
- Fair Pricing

Financial and Technical Outlook

- **Total Investment:** USD 50–70M by 2050
- **Key Components:**
  - 50–80 MWp of rooftop solar
  - 5–10 MWh BESS
  - A park-wide smart EMS & grid upgrades
- **Funding:** Green credit lines, ESCO models, corporate equity
- **Returns:** ROI 10–12%, payback 8–12 years, savings USD 3–4M/year by 2035
- **Risk:** Low–moderate; phased rollout, proven tech, SME-aligned

Accelerated Scenario – Net Zero by 2035

Phase 1 (2025–2027)
Widespread Deployment and Centralization

- Accelerate Rooftop Solar
- Centralized Generation
- External DPPAs
- Smart EMS Installation
- BESS and Pilots

Phase 2 (2028–2032)
Establishing an Intra-Park Electricity Market

- Intra-Park Dispatch Center
- Shared BESS Deployment
- Standardized Reporting
- Scaling Up

Phase 3 (2033–2035)
Optimization and Full Net-Zero Operation

- 100% Renewable Supply
- Long-Term Contracts
- Mini-Grid Operator
- Certification and Replication
- Final BESS Capacity

Financial and Technical Outlook

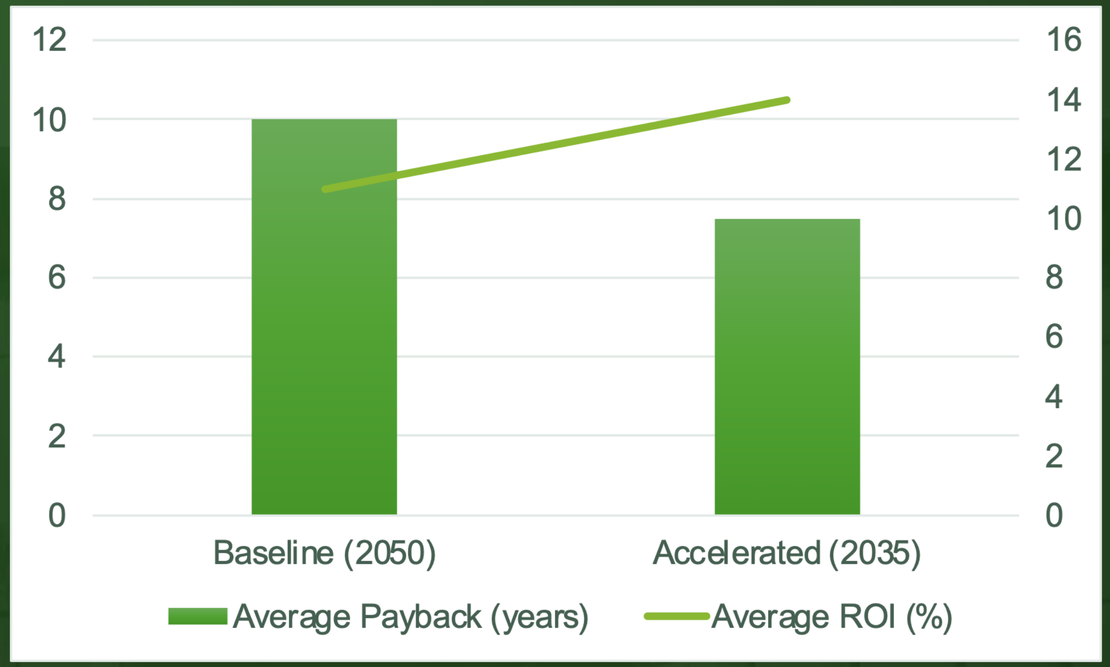
- **Total Investment:** USD 80–100M by 2035
- **Key Components:**
  - 130 MWp of rooftop/internal solar
  - 30 MW/60 MWh of BESS
  - A park-wide smart EMS
  - Associated grid upgrades
- **Funding:** Green bonds, PPPs, concessional climate loans, international financing
- **Returns:** ROI 12–16%; payback 6–9 years; savings USD 5–7M/year by 2035
- **Risk:** Higher; depends on fast policy reform, market incentives, and mobilizing international funds

Baseline Scenario & Accelerated Scenario Comparison

Aspect	Baseline Scenario (2050)	Accelerated Scenario (2035)
Total Investment	**USD 50–70M**	**USD 80–100M**
Key Components	50–80 MWp RtS, EMS, 5–10 MWh BESS, grid upgrades	130 MWp RtS, EMS, 30 MW/60 MWh BESS, grid upgrades
Annual Savings (2035)	USD 3–4M	USD 5–7M
ROI	10–12%	12–16%
Payback Period	8–12 years	6–9 years
Capital Mobilisation	Phased bank loans, ESCOs, corporate equity	Green bonds, PPPs, concessional loans, climate funds
Risk Profile	Low–moderate (incremental approach; stable but slower returns)	Higher (depends heavily on policy clarity, market incentives, international financing)
FDI Attractiveness	Medium (gradual alignment with ESG norms; suitable for SMEs)	Very high (strong alignment with RE100, ESG, and multinational investor requirements)
Suitable for	SMEs and domestic enterprises with limited capital	Large-scale FDI enterprises with explicit net-zero targets
Required Policies	Adjusted DPPA and EMS regulations from 2028–2030	Adjusted DPPA and EMS regulations after 2030; stronger carbon pricing/REC market
Co-benefits	Improves energy reliability, reduces O&M costs, gradual workforce adaptation	Positions TLIP II as a regional net-zero leader; enhances brand reputation; maximizes use of green financing instruments
Key Risks to Monitor	Slow policy reforms; limited SME financing capacity	Policy uncertainty; grid integration challenges; dependency on concessional finance

Baseline Scenario & Accelerated Scenario Comparison

	Baseline (2050)	Accelerated (2035)
Average Investment	USD 60M	USD 90 M
Average Annual Savings	USD 3.5M	USD 6M
ROI	11%	14%
Payback	10 years	7.5 years



→ **The accelerated scenario delivers higher returns** (14%) compared with the baseline scenario (11%)
Make it more attractive for international investors

Scenario for Capital Mobilization Flow

- Upfront investment: USD 50–70M
- ROI: 10–12%
- Payback: 8–12 years
- Financing: equity + phased bank loans + ESCO
- Best fit: SMEs with limited capital

Baseline

- Upfront investment: USD 80–100M
- ROI: 12–16%
- Payback: 6–9 years
- Financing: green bonds, PPP, climate funds
- Benefits: Greater cost savings, stronger energy independence

Accelerated

Potential Capital Mobilization Flow for Net Zero Transition

Investment Roadmap Risk Analysis

- High Capital Costs and Liquidity Risks
- Limited Access to Credit for SMEs
- Currency Fluctuation
- Inflation Risk
- Partner Withdrawal

Financial Risks

- Ambiguous Legal Framework
- Unclear Permitting Procedures
- Institutional Opposition

Legal & Institutional Risks

- Electricity Price Volatility
- REC Price Volatility
- Demand Fluctuation
- Technological Competition

Market & Price Volatility Risks

Proposed Risk Management Framework

Diversify and Share Financial Risk	Establish a Legal Sandbox and Stakeholder Dialogue	Implement Technical and Operational Measures	Adopt a Phased Implementation Approach
Counter the high upfront capital costs, long payback periods, and liquidity risks, the framework recommends moving away from single-investor models.	Address the significant legal and institutional uncertainties, a proactive approach involving regulatory piloting and collaboration is proposed.	Manage technical risks like grid instability from high renewable energy penetration, the framework emphasizes investing in smart technology and establishing clear operational rules.	Avoid the operational shocks of a large-scale deployment and to manage risks through a structured learning process, a phased approach is recommended.

Required Breakthrough Policies for an Accelerated Net-Zero Roadmap

Legalize Internal Direct Power Purchase Agreements	Empower the Internal Energy Dispatch Unit	Empower the Internal Energy Dispatch Unit	Establish Breakthrough Financial Policies	Integrate Clean Energy Criteria into Industrial Park Planning	Develop a National Net-Zero Industrial Park Standard
A new legal document must be issued to explicitly allow enterprises within an industrial park to sign long-term renewable energy purchase agreements with one another, such as through a private wire DPPA model, without needing a formal electricity license.	The government must establish official regulations that grant this entity the authority to dispatch loads, coordinate renewable sources, manage the BESS, and control the EMS. The policy should outline the functions, duties, technical standards, and legal responsibilities for such an industrial park-level dispatch center.	New policies are needed to allow the park's management board or a designated energy company to invest in, own, and charge for the operation of this shared power infrastructure, similar to how water or wastewater treatment facilities are managed.	◦ Establish a national Industrial Energy Transition Fund to support initial investments in renewable infrastructure, EMS, and BESS for pioneering parks. ◦ Provide credit guarantees, preferential interest rates, and import tax exemptions for businesses investing in the transition. ◦ Allow industrial park management boards or PPP joint ventures to issue green bonds, sponsored by local governments or state agencies.	Adopt a "Conditional Green Industrial Park" mechanism where new FDI businesses receive investment licenses and incentives on the condition that they commit to a renewable energy transition roadmap or meet energy-saving targets.	Develop and apply a national set of criteria for net-zero industrial parks, drawing from international standards like ISO 50001, RE100, or SBTi.

Without breakthrough policies, the accelerated net-zero roadmap will remain an ambition.
With them, Vietnam can turn its industrial parks into engines of clean growth and global competitiveness.

THANK YOU FOR YOUR ATTENTION!

UNOPS

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Federal Ministry for Economic Affairs and Climate Action

Department for Energy Security & Net Zero

Environment and Climate Change Canada
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