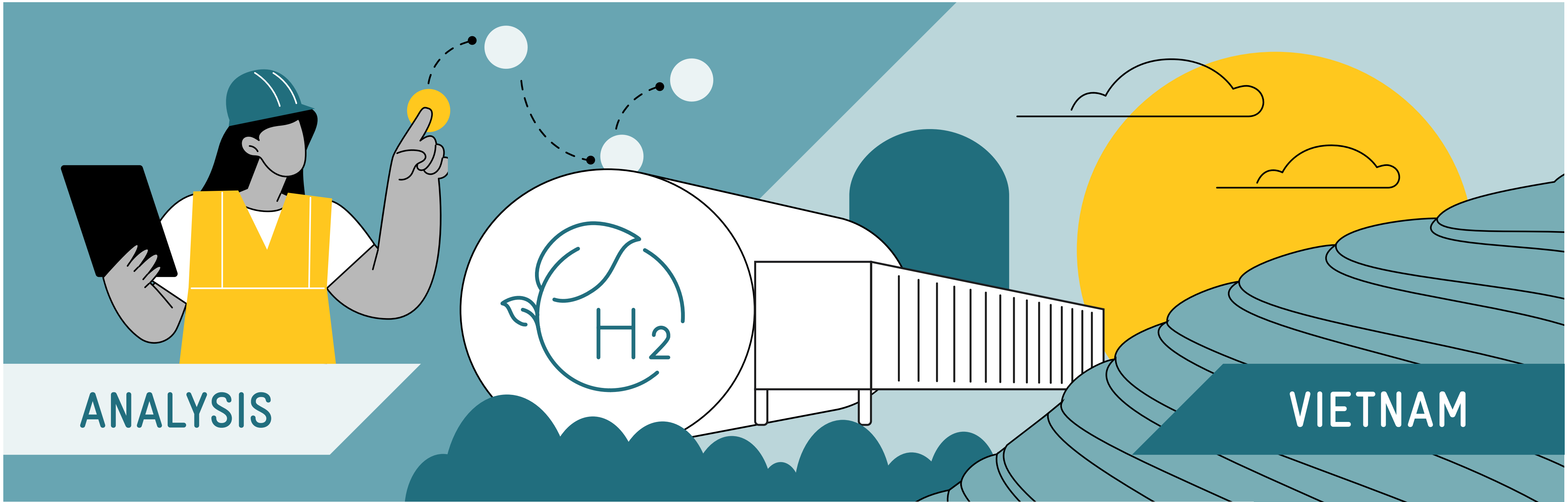


ANALYSIS

VIETNAM

Sector Analysis Vietnam

Green Hydrogen: Industrial Applications, Market Potential, and Strategic Opportunities

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

This publication was commissioned by the German Energy Solutions Initiative of the German Federal Ministry for Economic Affairs and Energy (BMWE)

TABLE OF CONTENTS

TABLE OF CONTENTS

List of figures

List of tables

Currency units

VND	Vietnamese dong
USD	United States dollar

Currency units and conversion rate as of 28.07.2025
EUR 1 = VND 0.00003252
IDR 1 = EUR 0.8506

EUR 1 = USD 30,748
USD 1 = EUR 1.1755

Source: exchange-rates.org, 2025

Technical units

GW	Gigawatt
GWh	Gigawatt hour
KTOE	Thousand tonnes of oil equivalent
KTPA	Thousand tons per annum
kWh	Kilowatt hour
MTPA	Million tons per annum
MW	Megawatt
MWp	Megawatt peak
tpa	Tonne per annum
tpd	Tonne per day

Abbreviations/acronyms

AEC	Alkaline electrolysis
AEMEC	Anion exchange membrane electrolysis cell
AFD	French Agency for Development
AHK	German Chambers of Commerce Abroad
AN	Ammonium nitrate
API	Active pharmaceutical ingredient
ASU	Air separation unit
ATR	Autothermal reforming
AZEC	Asia Zero Emission Community
BF	Blast furnace
BOF	Basic oxygen furnace
BMWK	German Federal Ministry for Economic Affairs and Climate Action
CAN	Calcium ammonium nitrate
CCS	Carbon capture and storage
CCU	Carbon capture and utilisation
CH3OH	Methanol
CHP	Clean Hydrogen Partnership
CHP	Combined heat and power
CO	Carbon monoxide
CO_2	Carbon dioxide
COP	Conference of the Parties
COVID-19	Coronavirus disease 2019
CSP	Concentrated solar power
DAC	Direct air capture
DAP	Diammonium phosphate
DME	Dimethyl ether
DO	Diesel oil
DRI	Direct reduced iron
EAF	Electric arc furnace
EEZ	Exclusive economic zone
EIB	European Investment Bank
EU	European Union
EVN	Vietnam Electricity Group
FO	Fuel oil
GDP	Gross domestic product
GEF	Global Environment Facility
GHF	Green Hydrogen Trust Fund
GHG	Greenhouse gases
GICON	Großmann Ingenieur Consult GmbH
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
H_2	Hydrogen
H2Uppp	International Hydrogen Ramp-up Programme
HB	Haber-Bosch process
HUST	Hanoi University of Science and Technology
IADB	Inter-American Development Bank
ICMA	International Capital Market Association
IEA	International Energy Agency
IRR	Internal rate of return
JETP	Just Energy Transition Partnership
KFW	Kreditanstalt für Wiederaufbau
LCoA	Levelised cost of ammonia
IEA	International Energy Agency
LCoH	Levelised cost of hydrogen
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
MAP	Monoammonium phosphate
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MOST	Ministry of Science and Technology
MoU	Memorandum of understanding
MTBE	Methyl tertiary butyl ether
MTG	Methanol-to-gasoline
MTO	Methanol-to-olefins
MIGA	Multilateral Investment Guarantee Agency
N_2	Nitrogen
NH_3	Ammonia
NPK	Nitrogen – phosphorus – potassium
NPT	National Power Transmission Corporation
NPV	Net present value
NSMO	National Electricity System and Market Operation Company Limited

O_2	Oxygen
PDP	Project Development Programme
PDP8	The 8th Power Development Plan of Vietnam
PEM	Proton exchange membrane
PEMEC	Proton exchange membrane electrolyis cell
Petrolimex	Vietnam National Petroleum Group
PJICO	Petrolimex Joint Stock Insurance Company
PLC	Petrolimex Petrochemical Corpo-ration
PPA	Power purchase agreement
PSA	Pressure swing adsorption
PTSC	PetroVietnam Technical Services Corporation
PtX	Power-to-X
PV	Photovoltaics
PV Gas	PetroVietnam Gas Corporation, a subsidiary of PVN
PVN / PetroVietnam	Vietnam National Industry - Energy Group
PVOil	PetroVietnam Oil Corporation, a subsidiary of PVN
PV Power	PetroVietnam Power Corporation, a subsidiary of PVN
R&D	Research and development
RE	Renewable energy
RON	Research octane number
SA	Ammonium sulphate
SME	Small and medium-sized enterprise
SMR	Steam methane reforming
SOE	State-owned enterprise
SOEC	Solid oxide electrolysis cell
TPES	Total primary energy supply
UAN	Urea ammonium nitrate
VAST	Vietnam Academy of Science and Technology
VNU	Vietnam National University
Vinachem	Vietnam National Chemical Group
Vinacomin	Vietnam National Coal and Mineral Industries Group
VPI	Vietnam Petroleum Institute

ENERGY SOLUTIONS – MADE IN GERMANY The German Energy Solutions Initiative

The German Energy Solutions Initiative of the German Federal Ministry for Economic Affairs and Energy (BMWE) aims to globalise German technologies and expertise in climate-friendly energy solutions.

Years of promoting smart and sustainable energy solutions in Germany have led to a thriving industry known for world-class technologies. Thousands of specialised small and medium-sized enterprises (SMEs) focus on developing renewable energy systems, energy efficiency solutions, smart grids, and storage technologies. Cutting-edge energy solutions are also built on emerging technologies such as power-to-gas, fuel cells, and green hydrogen. The initiative's strategy is shaped around ongoing collaboration with the German business community.

The initiative creates benefits for Germany and the partner countries by:

- boosting global interest in sustainable energy solutions
- encouraging the use of renewables, energy efficiency technologies, smart grids, and storage technologies, while facilitating knowledge exchange and capacity building
- enhancing economic, technical and business cooperation between Germany and partner countries

THE PROJECT DEVELOPMENT PROGRAMME (PDP)

PDP is a key pillar of the German Energy Solutions Initiative and is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. It connects development cooperation with private-sector engagement and supports climate-friendly energy solutions in selected developing and emerging countries, enabling local businesses to adopt solutions in energy efficiency, electricity and heat supply, and hydrogen, while facilitating market access for German solution providers.

Developing and emerging economies offer promising business potential for climate-friendly energy solutions but also pose challenges for international business partners. The PDP team works closely with local industries to develop financially viable projects by providing technical expertise, financial guidance, and networking opportunities.

It identifies project leads, collects and analyses energy consumption data, and assesses projects from both a technical and economic perspective. This includes outlining the business case, calculating payback periods, and evaluating profitability. Companies can then choose to finance projects using their own funds or explore leasing and other financing options. PDP provides cost-free advice to local companies and connects them with German solution providers for project implementation.

Additionally, by offering training, organising reference project visits, and publishing studies on the potential of climate-friendly solutions and on navigating regulatory frameworks, the programme supports market development and fosters private-sector cooperation.

Executive summary

GREEN HYDROGEN FOR VIETNAM'S C&I SECTOR

This hydrogen sector analysis for Vietnam assesses the country's potential for green hydrogen development.. As part of a broader series, the analysis provides market insights to support early-stage project development and stimulate both domestic and international interest.

The analysis evaluates the feasibility of integrating green hydrogen into Vietnam's industrial and commercial sectors, identifies promising use cases, and offers techno-economic estimates to guide investment and policy decisions. The goal is to highlight viable opportunities, address implementation challenges of green hydrogen projects, and define a realistic roadmap for green hydrogen deployment in line with Vietnam's energy transition and industrial growth objectives.

Vietnam benefits from strong renewable energy potential, especially in solar PV and onshore/offshore wind, as well as a diverse industrial base including fertiliser, chemicals, steel, and oil refining—sectors with high potential for hydrogen adoption. Its favorable geographic position, growing export infrastructure, and integration into global supply chains further enhance Vietnam's prospects as a future hydrogen production and export hub.

Zusammenfassung

GRÜNER WASSERSTOFF FÜR VIETNAMS C&I-SEKTOR

In der vorliegenden Sektoranalyse wird das Potenzial Vietnams für die Entwicklung grünen Wasserstoffs analysiert. Als Teil einer umfassenderen Studienreihe liefert sie Markteinblicke, unterstützt damit Projektentwicklungen in frühen Phasen und soll sowohl nationales als auch internationales Interesse wecken.

Die Analyse bewertet die Machbarkeit der Integration grünen Wasserstoffs in den C&I-Sektor (commercial & industrial [Gewerbe und Industrie] – C&I) Vietnams. Außerdem identifiziert sie vielversprechende Anwendungsfälle und bietet technoökonomische Einschätzungen zur Orientierung bei Investitions- und Politentscheidungen. Ziel dessen ist es, umsetzbare Chancen aufzuzeigen, Herausforderungen bei der Umsetzung grünen Wasserstoffs zu benennen und einen realistischen Fahrplan für die Einführung grünen Wasserstoffs im Einklang mit Vietnams Energiewende und industriellen Wachstumszielen zu skizzieren.

Vietnam verfügt über ein hohes Potenzial bei den erneuerbaren Energien, insbesondere im Bereich der Photovoltaik sowie der Onshore- und Offshore-Wind, und über eine breit aufgestellte Industrie, unter anderem in den Sektoren Düngemittel, Chemie, Stahl und Erdölraffination. Diese Sektoren bieten großes Potenzial für den Einsatz von Wasserstoff. Die günstige geografische Lage, der Ausbau der Exportinfrastruktur und die zunehmende Einbettung Vietnans in globale Lieferketten stärken darüber hinaus Vietnams Perspektiven als künftiger Produktions- und Exportstandort für grünen Wasserstoff.

Green hydrogen could play a pivotal role in Vietnam's energy transition by:

- **Supporting industrial decarbonization:** Integrating hydrogen into processes such as oil refining, ammonia production, and steel manufacturing to reduce carbon emissions.
- **Enhancing energy security:** Diversifying the energy mix and reducing reliance on fossil fuels through the adoption of hydrogen-based solutions.
- **Facilitating export opportunities:** Leveraging existing infrastructure and trade relationships to position Vietnam as a regional leader in green hydrogen exports.

BUSINESS OPPORTUNITIES FOR GERMAN SOLUTION PROVIDERS

Vietnam's dynamic energy transition presents attractive opportunities for German companies and SMEs, particularly in renewable energy, electrolysis, industrial integration, and infrastructure development. Key advantages in Vietnam include:

- **Abundant renewable potential:** Vietnam's strong solar and wind resources – especially offshore wind – offer a solid basis for green hydrogen production. German companies with expertise in PV, wind technologies, and electrolyzers are well-positioned to support the development of both small- and large-scale projects.

Aus den folgenden Gründen könnte grüner Wasserstoff eine zentrale Rolle in Vietnams Energiewende spielen:

- **Er trägt zur Dekarbonisierung der Industrie bei:** Integration von Wasserstoff in industrielle Prozesse wie Erdölraffination, Ammoniakproduktion und Stahlherstellung für die Reduktion von CO_2-Emissionen.
- **Er stärkt Energiesicherheit:** Diversifizierung des Energiemixes und Verringerung der Abhängigkeit von fossilen Energieträgern durch wasserstoffbasierte Lösungen
- **Er schafft Exportchancen:** Nutzung von Infrastrukturen und Handelsbeziehungen, um Vietnam als regionalen Exporthub für grünen Wasserstoff zu positionieren

GESCHÄFTSCHANCEN FÜR DEUTSCHE LÖSUNGSANBIETER

Vietnams dynamische Energiewende eröffnet deutschen Unternehmen attraktive Chancen, insbesondere kleinen und mittleren Unternehmen (KMU) und vor allem in den Bereichen erneuerbare Energien, Elektrolyse, industrielle Integration und Infrastrukturentwicklung. Zentrale Vorteile in Vietnam sind:

- **großes Potenzial der Erneuerbaren:** Vietnams große Solar- und Windressourcen insbesondere im Bereich des Offshore-Wind bieten eine solide Grundlage für die Produktion grünen Wasserstoffs. Deutsche Unternehmen mit Expertise in Photovoltaik-, Windtechnologien und Elektrolyseuren sind gut aufgestellt, um die Entwicklung von Projekten im kleinen wie großen Maßstab zu unterstützen.
- **Nachfrage der Industrie:** Vietnams vielfältige Industriesektoren, darunter Düngemittel, Chemie, Stahl und Erdölraffination, bieten

- **Industrial demand:** Vietnam's diverse industrial sectors – fertiliser, chemicals, steel, and oil refining – create immediate applications for green hydrogen. German firms can contribute via industrial process optimization, pilot deployments, and technology transfer.
- **Export and supply chain potential:** With a growing logistics network, proximity to major Asian markets, and an expanding seaport infrastructure, Vietnam has the potential to emerge as a regional export hub for green hydrogen and derivatives like ammonia. German firms active in transport, storage, and port infrastructure can benefit from early engagement in these evolving supply chains.

CHALLENGES ON THE PATH TO A HYDROGEN ECONOMY

Despite the potential, several challenges must be addressed:

- **Regulatory clarity and coordination:** While Vietnam has made early moves with its hydrogen strategy, the detailed regulatory framework for green hydrogen production, certification, and offtake agreements is still developing, creating uncertainty for investors.
- **Economic constraints:** Green hydrogen remains more expensive than conventional alternatives. Competitive cost structures will require targeted incentives, concessional finance, and collaboration to de-risk early investments.
- **Infrastructure limitations:** Dedicated hydrogen infrastructure – such as pipelines, storage, and port facilities – is in its infancy. Strategic planning and public-private cooperation will be critical to developing an integrated hydrogen ecosystem.

unmittelbare Anwendungsfelder für grünen Wasserstoff. Deutsche Unternehmen können durch Optimierung industrieller Prozesse, Pilotprojekte und Technologietransfer einen wichtigen Beitrag dazu leisten, diese Nachfrge zu decken.

- **Export- und Lieferkettenpotenzial:** Vietnam verfügt über ein wachsendes Logistiknetzwerk, pflegt die Nähe zu wichtigen asiatischen Märkten und baut seine Hafeninfrastruktur aus. Damit hat das Land das Potenzial, sich zu einem regionalen Exportzentrum für grünen Wasserstoff und dessen Derivate zu entwickeln, zum Beispiel Ammoniak. Ein frühzeitiges Engagement deutscher Unternehmen in den Bereichen Transport, Speicherung und Hafeninfrastruktur kann ihnen langfristige Wettbewerbsvorteile verschaffen.

HERAUSFORDERUNGEN AUF DEM WEG ZUR WASSERSTOFFWIRTSCHAFT

Trotz des großen Potenzials müssen noch Herausforderungen bewältigt werden:

- **regulatorische Klarheit und Koordination:** Obwohl Vietnam mit seiner Wasserstoffstrategie erste Schritte unternommen hat, ist der detaillierte regulatorische Rahmen für die Produktion, Zertifizierung und Abnahmeverträge grünen Wasserstoffs noch im Aufbau begriffen. Dies schafft Unsicherheit für Investoren.
- **wirtschaftliche Rahmenbedingungen:** Grüner Wasserstoff ist teurer, als es konventionelle Alternativen sind. Wettbewerbsfähige Kostenstrukturen erfordern gezielte Anreize, vergünstigte Finanzierungsinstrumente und Kooperationen für die Risikominimierung bei frühen Investitionen.

OPPORTUNITIES FOR GREEN HYDROGEN PROJECTS

Vietnam's renewable energy potential, strong industrial base, and strategic regional position offer a compelling case for green hydrogen development. However, realizing this potential will require overcoming regulatory, financial, and infrastructure-related hurdles. German companies that proactively engage—bringing technical expertise and building local partnerships—can help shape Vietnam's hydrogen market while securing long-term commercial and sustainability gains.

- **infrastrukturelle Defizite:** Eine speziell für Wasserstoff ausgelegte Infrastruktur, etwa für Pipelines, Speicherung und Hafenanlagen, befindet sich im Anfangsstadium. Eine strategische Planung sowie die Zusammenarbeit zwischen öffentlichem und privatem Sektor sind entscheidend für den Aufbau eines integrierten Wasserstoffökosystems.

CHANCEN FÜR PROJEKTE MIT GRÜNEM WASSERSTOFF

Vietnams Potenzial im Bereich der erneuerbaren Energien, die starke industrielle Basis und die strategische Lage in der Region sprechen für eine vielversprechende Entwicklung des grünen Wasserstoffs. Um das Potenzial auszuschöpfen, müssen jedoch regulatorische, finanzielle und infrastrukturelle Herausforderungen überwunden werden.

Deutsche Unternehmen, die sich frühzeitig engagieren, technisches Know-how einbringen und lokale Partnerschaften aufbauen, können die Wasserstoffentwicklung in Vietnam mitgestalten und sich dabei langfristige wirtschaftliche und nachhaltige Vorteile sichern.

1

Outline of the current context

1.1 General country information

Vietnam is located in the centre of Southeast Asia, on the eastern part of the Indochina Peninsula. It borders China to the north, Laos and Cambodia to the west, and faces the East Sea (South China Sea) and the Pacific Ocean to the southeast. Coastline length is about 3,260 km, land border length is about 4,510 km. Geographic coordinates: longitude: 102º 08′ – 109º 28′ E, latitude: 8º 02′ – 23º 23′ N. Total area: ~331,000 km². Climate: tropical monsoon, with abundant solar and wind resources. Natural resources: coal, oil, natural gas, hydropower, and significant potential for renewable energy (wind, solar, biomass, and hydrogen production). The average population in 2024 is estimated at 101.3 million people, an increase of 1,034,500, equivalent to an increase of 1.03% compared to 2023.

Gross domestic product (GDP) in the fourth quarter of 2024 is estimated to increase by 7.55% over the same period in the previous year, only lower than the fourth quarters of 2017 and 2018 in the period 2011–2024, maintaining the trend of each quarter being higher than the previous quarter. Within this, the agriculture, forestry and fishery sector grew by 2.99%, contributing 4.86% to the total added value of the whole economy; the industry and construction sector grew by 8.35%, contributing 44.03%; and the service sector grew by 8.21%, contributing 51.11%. Regarding GDP use in the fourth quarter of 2024, final consumption increased by 7.54% compared with the same period in the previous year; asset accumulation increased by 7.98%; Exports of goods and services increased by 11.35%; imports of goods and services increased by 13.49% (Vietnam National Statistics Office, 2025).

FIGURE 1. Location of Vietnam

Source: Vietnam Department of Survey, Mapping, and Geographic Information, 2025

1.2 National energy sector analysis

1.2.1 Evolution of the energy sector

The data on Vietnam's primary energy supply from 2010 to 2020 reveals significant shifts in the energy mix and growth dynamics. Total primary energy supply (TPES) increased from 51,610 KTOE in 2010 to 95,762 KTOE in 2020, marking an average annual growth rate of 6.4%. Among the energy sources, coal showed the most dramatic increase, from 13,850 KTOE in 2010 to 49,752 KTOE in 2020. Crude oil and oil products remained relatively stable, increasing modestly to 23,387 KTOE by 2020. Renewable energy (RE), while increasing in absolute terms, grew at a much slower pace, reaching 14,672 KTOE in 2020. Meanwhile, gas stagnated and slightly declined, and electricity imports/exports remained a marginal contributor (Vietnam Institute of Energy, 2023).

From a growth rate perspective, coal had the highest annual growth rate (13.6% from 2011–2020, and 17.1% from 2016–2020), reflecting its dominant and expanding role in Vietnam's energy supply. In contrast, gas showed a negative growth trend (-0.6% from 2011–2020), indicating declining usage or supply challenges. Renewable energy posted a meagre 1.2% growth over the same decade, while crude oil products saw modest growth (3.8%). Electricity imports and exports fluctuated significantly but remained negligible in the overall mix (Vietnam Institute of Energy, 2023).

The energy mix also shifted considerably. Coal's share in TPES surged from 26.8% in 2010 to 52.0% in 2020, becoming the majority energy source. Meanwhile, the share of crude oil declined from 31.2% to 24.4%, and gas dropped sharply from 16.1% to 8.2%. Renewable energy's contribution fell from 25.1% to 15.3%, indicating that despite its importance in policy discourse, it has been losing ground in actual supply terms (Vietnam Institute of Energy, 2023).

Summary:

- **Coal is the fastest-growing and most dominant energy source**, more than tripling its supply over the decade and accounting for over half of TPES in 2020.
- **Renewable energy and gas are lagging behind**, both in growth rate and proportion of supply, signalling a potential misalignment with global decarbonisation goals.
- **Crude oil and oil products are stabilising**, neither expanding aggressively nor declining significantly.
- The data suggests a c**arbon-intensive energy trajectory**, which may undermine Vietnam's climate commitments unless decisive action is taken to accelerate clean energy investments.
- **COVID-19's impact on 2020** may have slightly distorted growth patterns, particularly in oil products and RE, but the long-term trends are clear.

Vietnam must rebalance its energy mix with stronger renewable deployment and reduced reliance on coal to ensure sustainable, secure, and climate-compatible energy development.

1.2.2 Forecasted evolution

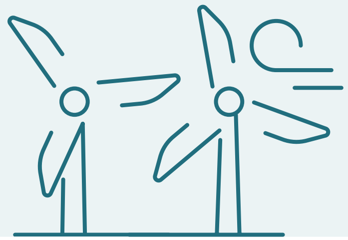
On 15 May 2023, the Vietnamese Government officially approved Power Development Plan VIII (PDP8), laying out a strategic roadmap for the country's power sector from 2021 to 2050. The plan places strong emphasis on renewable energy development, economic efficiency, and energy security, while also enabling export potential through green energy. Vietnam aims to increase the share of renewable energy in electricity production from 30.9–39.2% by 2030 to 67.5–71.5% by 2050. A conditional interim target of 47% by 2030 is also set, contingent on international support through the Just Energy Transition Partnership (JETP).

The orientation favours a significant scale-up of offshore and onshore wind, solar PV, and biomass, alongside the integration of new energy vectors like hydrogen and green ammonia. PDP8 encourages the conversion of conventional fossil fuel plants (coal and LNG) to clean fuels, and promotes flexible sources (such as batteries and pumped hydro) to support grid stability.

TABLE 1. Vietnam's power structure evolution highlights (MW capacity)

Category	2025	2050 target (range)
Total demand (Pmax)	**89,655 - 99,934**	**205,732 - 228,570**
Installed capacity	**183,291 - 236,363**	**774,503 - 838,681**
Onshore and near-shore wind	26,066 – 38,029	84,696 – 91,400
Offshore wind	6,000 – 17,032	113,503 – 139,097
Solar (CSP/ rooftop etc.)	46,459 – 73,416	293,088 – 295,646
Biomass	1,523 – 2,699	4,829 – 6,960
Waste to Energy	1,441 – 2,137	1,784 – 2,137
Geothermal and other RE	45	464
Hydropower	33,924 – 34,667	40,624
Nuclear	4,000 – 6,400	10,500 – 14,000
Storage	10,000 – 16,300	95,983 – 96,120
Coal-fired	31,055	25,798 (fully converted to biomass/ammonia, no longer using coal)
Domestic gas	10,681 – 14,930	7,900 (converted to use LNG)
		7,030 (converted to use hydrogen)
Imported LNG power	22,524	18,200 – 26,123 (converted to co-firing LNG and hydrogen)
		8,576 – 11,325 (converted to use fully hydrogen)
Imported LNG with CCS	0	1,887 – 2,269
Flexible sources (LNG, oil, hydrogen, etc. with high flexible operation)	2,000 – 3,000	21,333 – 38,641
Pumped storage	2,400 – 6,000	20,691 – 21,327
Imported from Laos, China	9,630 – 12,100	14,688

Source: Data based on PDP8, Vietnam Prime Minister, 2025,



Key messages:

- **Massive capacity expansion**: Vietnam's total installed capacity is expected to **quadruple by 2050**, reflecting its fast-growing energy demand and the shift to greener energy sources.
- **Decarbonisation strategy**: Adjusted PDP8 marks a **strategic pivot away from coal**, which will be phased out or converted to run on **biomass and ammonia** (up to 25.8 GW by 2050). This aligns with the country's carbon neutrality goals.
- **Rise of offshore wind: With offshore wind capacity targeted to reach 113.5–139.1 GW**, this technology becomes a **cornerstone of Vietnam's green energy future**, potentially positioning the country as a leader in Asia-Pacific for wind power deployment.
- **Hydrogen integration**: The roadmap envisions a significant **penetration of hydrogen-powered and co-fired plants (up to ~44,5 GW)**, underlining Vietnam's alignment with global trends toward green fuels.
- **Flexible and storage solutions**: The inclusion of **116.6–117.5 GW in battery and pumped storage** by 2050 indicates a recognition of the need for **grid balancing and peak shaving** in a renewable-heavy system.
- **Export-oriented mindset**: Adjusted PDP8 explicitly supports **green energy exports**, aiming for 5,000–10,000 MW export capacity by 2035, emphasising **Vietnam's ambition to become a regional energy hub**.
- **Conditional renewable targets**: The 47% RE share by 2030 depends on **external financing and technology partnerships**, signalling the importance of international cooperation and climate finance in enabling this transition.

1.3 Legislative and regulatory framework

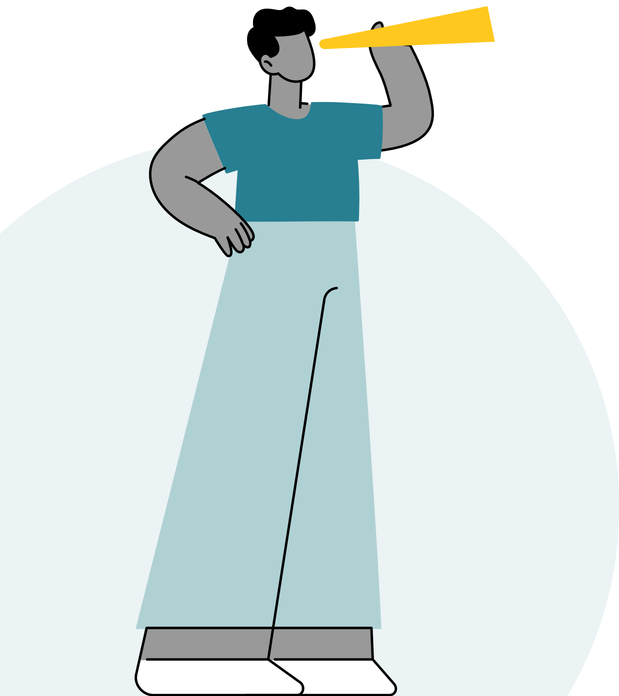
In recent years, Vietnam's legislative and regulatory framework related to renewable energy, power development, and investment incentives has undergone substantial development. Some legal documents related to the electricity sector (renewable energy) are listed below:

- Resolution No. 55-NQ/TW dated 11 February 2020 of the Politburo on Vietnam's National Energy Development Strategy to 2030, with a vision to 2045;
- Electricity Law No. 61/2024/QH15 effective from 1 February 2025 and related decrees and circulars;

Decision No. 500/QD-TTg dated 15 May 2023 of the Prime Minister approving the National Power Development Plan for the period 2021 – 2030, with a vision to 2050.

Vietnam's legislative framework for renewable energy and green hydrogen is rapidly evolving to support its energy transition and climate goals. The Power Development Plan VIII (PDP8), approved in May 2023, sets a clear direction to prioritise renewable energy, with a strong emphasis on offshore wind, solar, and the production of green hydrogen and ammonia for both domestic use and export. Complementing this, the 2024 Electricity Law (Article 4, 20, and 23) defines green hydrogen and ammonia and actively encourages investment in projects combining renewable electricity with storage and green fuel production. Key policy instruments include tax incentives, credit support, and land/sea-use fee exemptions for clean energy projects. Additionally, the Investment Law (2020) lists renewable energy, clean energy, and energy-saving products as priority sectors eligible for incentives. Collectively, these laws form a robust legal foundation for Vietnam's green energy ambitions, aiming to attract private and international capital into a growing and increasingly decarbonised energy system.

On 7 February 2024, the Prime Minister issued Decision No. 165/QĐ-TTg, approving **Vietnam's hydrogen energy development strategy by 2030, with a vision to 2050**. The strategy aligns with the National Energy Master Plan (2021–2030) and broader decarbonisation and energy security objectives.



Key development viewpoints:

1. **Consistency with national strategies**: Develop hydrogen energy in harmony with national planning documents to ensure a flexible and adaptive transition to clean energy.
2. **Value chain integration**: Promote development across the entire hydrogen value chain, from production to end use, to enhance energy security and reduce greenhouse gas (GHG) emissions.
3. **Technology and resource alignment**: Promote hydrogen produced from **renewable sources and carbon capture**, aiming for both domestic use and export, ensuring economic efficiency and sustainability.
4. **Sectoral application**: Foster hydrogen use in **high-emission sectors** such as power generation, transportation, and industry, through tailored policy support and pilot projects.
5. **International cooperation**: Leverage support from multilateral frameworks (e.g. **COP, JETP, AZEC**) to accelerate knowledge transfer and investment into Vietnam's hydrogen ecosystem.

DEVELOPMENT OBJECTIVES AND ORIENTATIONS

a) Hydrogen production

- By **2030**: Achieve an annual production capacity of **100,000–500,000 tonnes**, primarily from renewable energy and carbon capture.
- By **2050**: Scale production to **10–20 million tonnes per year**, reinforcing hydrogen's role in the national and regional energy mix.

b) Hydrogen use

- **Electricity**: Pilot co-firing of **hydrogen with gas and coal**, in preparation for large-scale fuel switching.
- **Transport**: Conduct trials of hydrogen-powered vehicles, with a focus on long-haul and public transit applications.
- **Industry**: Promote the substitution of fossil-derived hydrogen with **green hydrogen** in **cement, steel, petrochemicals,** and fertiliser production.

2

Industrial applications of hydrogen

2.1 Hydrogen uses and most common downstream products

Global hydrogen demand reached 97 million tonnes per annum (MTPA) in 2023 and remains concentrated in traditional uses such as refining and industry applications, mainly ammonia and methanol production and steel manufacturing (IEA, 2024b). The hydrogen used to cover this demand comes almost exclusively from processing of fossil fuels. Considering current (or traditional) and potential new uses of hydrogen as a decarbonisation solution, this demand is expected to increase significantly to 200–600 MTPA by 2050, depending on the analysis and scenario selected, and should be covered primarily by clean hydrogen (produced either by electrolysis powered by renewable energy, so-called green hydrogen, or by the reforming of fossil fuels combined with CCS, referred to as blue hydrogen).

2.2 Hydrogen production methods

Hydrogen can be produced through different processes according to the energy source and technology used, as summarised in Table 2. The hydrogen used to cover the current demand comes almost exclusively from processing of fossil fuels (natural gas and coal) within methane reforming and coal gasification.

TABLE 2. Production methods of hydrogen

Production process	Energy source	Technology options	Products	CO_2 emissions
Methane reforming	Natural gas	• Steam methane reforming (SMR) • Autothermal reforming (ATR)	H_2, CO, CO_2, N_2	• High CO_2 emissions • Potential combination with CCS to reduce CO_2 emissions
Coal gasification	Coal	• Gasification/reaction with O_2 and steam at high pressure and temperatures	H_2, CO, CO_2, N_2	
Methane pyrolysis	Natural gas	• Thermal decomposition at high temperatures without O_2	H_2, CO, CO_2	
Biomass gasification	Biomass	• Heating with limited oxygen	H_2, CO, CO_2	• Low to zero CO_2 emissions
Electrolysis	Electricity	• Electrolysis (AEC, PEMEC, SOEC, AEMEC)	H_2, O_2	• CO_2 emissions depend on electricity source • Low to zero for renewable energy sources

CCS	carbon capture and storage
AEC	alkaline electrolysis cell
PEMEC	proton exchange membrane electrolysis cell
SOEC	solid oxide electrolysis cell
AEMEC	anion exchange membrane electrolysis cell

Source: Fichtner, 2025

2.3 Hydrogen uses

Hydrogen is a key component of the global energy and industrial landscape, with similar applications worldwide. The data presented in this section reflects the global context of hydrogen and is location-independent.

Hydrogen demand reached 97 MTPA in 2023. The largest consumers of hydrogen are refining (44%), ammonia production (33%), and methanol production (17%). Some 5% of hydrogen is used for direct reduced iron (DRI) in the iron and steel sector, and small amounts are used in other segments such as glassmaking, electronics, and metal processing, accounting for 1 MTPA or 1% of current global hydrogen demand (IEA, 2024b).

TABLE 3. Current uses of hydrogen

Current uses	Main processes/products
Refining[1]	• Hydrocracking, hydrotreating and desulphurisation
Ammonia	• Fertiliser production • Chemical production: e.g. nitric acid, amines, explosives • Refrigeration
Methanol	• Fuel: methyl tertiary butyl ether (MTBE) • Solvent • Antifreeze • Chemical feedstock: e.g. formaldehyde, acetic acid
Chemical industry	• Oxo alcohols • Fatty alcohols • Hydrogen peroxide (H_2O_2) • Cyclohexane (C6H12) • Hydrochloric acid (HCl) • Caprolactam • Phenol production* • Acetone production* via hydrogenation of isopropyl alcohol • 1,4-Butanediol (BDO) • Fine chemicals and pharmaceuticals as reducing agent
Iron and steel	• As reducing agent in direct reduced iron (DRI) • As reducing atmosphere in annealing process in steel roll mills
Glass	• Glass melting as reducing agent to improve quality • Specialty glasses to control optical properties • Alternative fuel or furnaces to replace e.g. natural gas
Electronics	• Chemical vapour deposition, mainly e.g. for semiconductor manufacturing and LED production • Reduction agent
Food industry	• Hydrogenation of oils (fats) and fatty acids
Metal processing	• Pure or in a mixture as shielding gas for welding processes

* The most common production process for phenol and acetone is the cumene process. This process does not require hydrogen directly, but it can be required for refining acetone (removal of impurities).

Source: Fichtner, 2025 based on Bressan, L. et al., 2009, Fuel Cells and Hydrogen Observatory, 2021, Wasserstoff Kompass, 2022, Semiconductor Digest, 2018

1 In refineries, hydrogen is required for hydrocracking and hydrotreating, but it is also generated, mainly during catalytic reformulation: 18 kg of hydrogen/tonne of crude oil (Fuel Cells and Hydrogen Observatory, 2021).

Other minor current uses of hydrogen include aerospace, as a propellant, and energy storage for balancing renewable energy supply and demand.

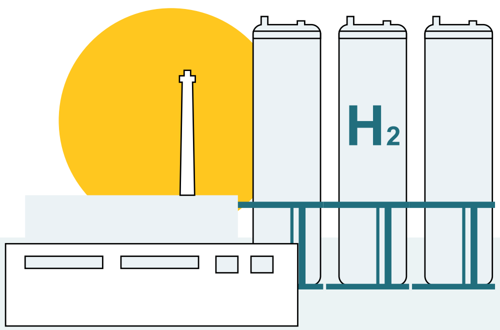
Additionally, hydrogen is produced within different production processes as a by-product.

In 2023, some 25% of hydrogen was produced as a by-product in refineries and petrochemicals production (IEA, 2024b). The main products that generate hydrogen as a by-product are listed in Table 4.

TABLE 4. Hydrogen generation as a by-product

Final product	Use of H_2 by-product	Specific H_2 generation
Ethylene	On site as feedstock for other processes	190 Nm³ H_2/tonne ethylene (11 kg H_2/tonne ethylene)
Styrene		220 Nm³ H_2/tonne styrene (20 kg H_2/tonne styrene)
Chlorine (via chlor-alkali process)	Fuel for heat boilers and/or combined heat and power (CHP) units	270-300 Nm³ H_2/tonne chlorine (24-27 kg H_2/tonne chlorine)
Acetylene	On site as feedstock for other processes	3,400-3,740 Nm³ H_2/tonne acetylene (305-336 kg H_2/tonne acetylene)
Cyanide		2,470 Nm³ H_2/tonne cyanide (222 kg H_2/tonne cyanide)

Source: Fichtner, 2025 based on Fuel Cells and Hydrogen Observatory, 2021

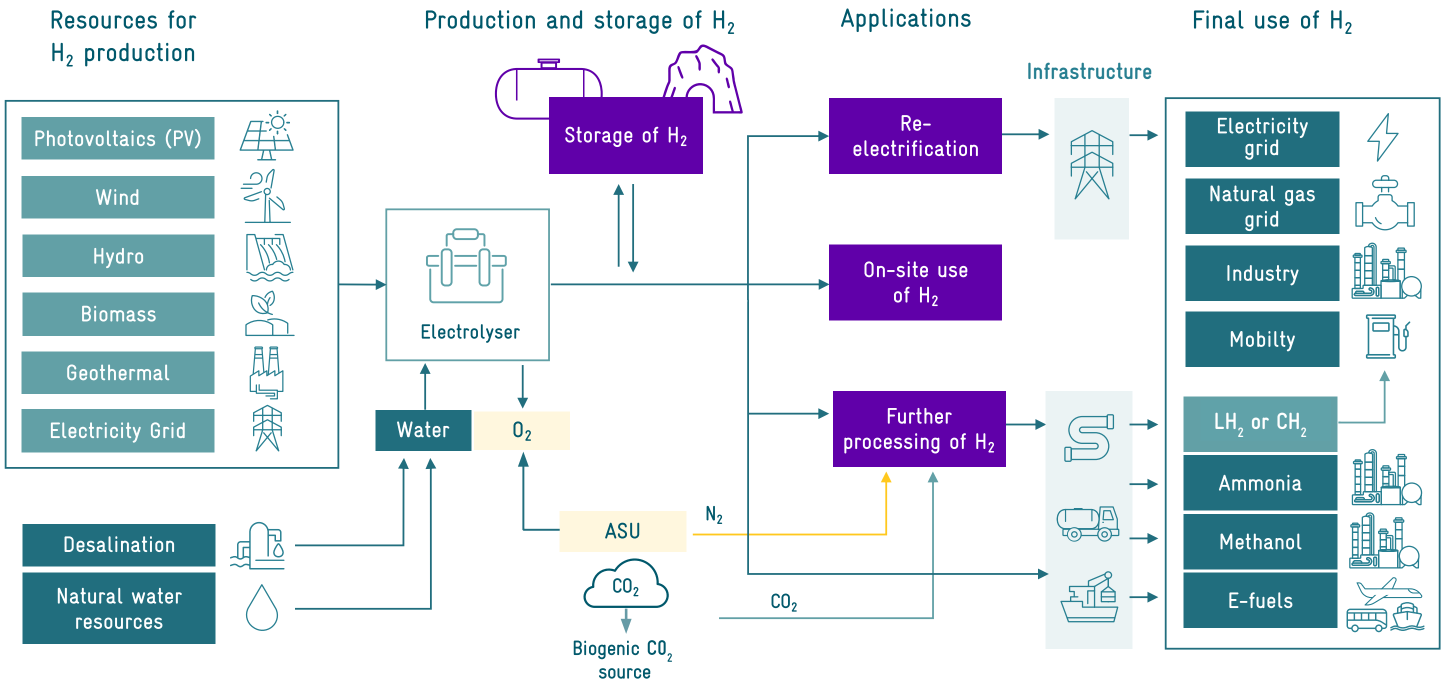


Demand for hydrogen has been concentrated in refining and some industrial applications, but the adoption of clean hydrogen in new applications will play a key role in the energy transition. This will include the replacement of current hydrogen demand with green hydrogen produced via electrolysis (as shown in Figure 2), for example, but also new areas of use such as mobility (road, air, and maritime transport), electricity generation, production of synthetic fuels (e-fuels), and high-temperature heat generation, among others. The switch from conventional production processes to electrolysis for hydrogen generation will require additional feedstocks for derivatives production, including a nitrogen source for ammonia production and a sustainable CO_2 source for methanol and synthetic fuel production.

These applications provide a first indication of how green hydrogen might be used in the future. Which applications gain traction will largely depend on possible alternative technologies with which hydrogen will have to compete, on national and international decarbonisation targets and commitments, and on available energy sources in the individual countries.

Furthermore, the production of hydrogen by electrolysis generates 8 kg oxygen (O_2)/kg H_2 as a by-product. Some typical applications of high-purity liquefied oxygen include water treatment, medical purposes, and industry (metallurgy, pulp & paper, chemical, etc.). Nonetheless, taking into consideration that current technologies for oxygen production (air separation unit, ASU; pressure swing adsorption, PSA) are mature, easily scalable, and applicable to on-site oxygen generation, the use of oxygen generated by electrolysis in an economically feasible way is quite restricted and very location dependent.

FIGURE 2. Value chain of potential applications of green hydrogen



Storage: In tanks or geological.

H_2	Hydrogen
LH_2	Liquefied hydrogen
CH_2	Compressed hydrogen
ASU	Air separation unit

Source: Fichtner, 2025

2.4 Most common hydrogen downstream products

2.4.1 Ammonia and fertilisers

Ammonia production is the second-largest current use of hydrogen, accounting for 33% of total hydrogen demand. Ammonia is a key precursor in industry and is mainly used for nitrogen-based fertilisers (around 70–80%), and other industrial applications such as plastic and explosive production.

Ammonia is synthetised via the Haber-Bosch (HB) process, in which hydrogen (H_2) reacts with nitrogen (N2) to form ammonia (NH_3) under high pressures and high temperatures. A schematic of the conventional HB process as well as a green hydrogen-based process is shown in Annex 1. Conventional ammonia production is based on steam methane reforming (SMR), a process using steam where nitrogen is sourced directly from air. In the green ammonia option, an electrically driven system, an external source of nitrogen is required (e.g. from air through an ASU) and the compressors that are steam-driven in the conventional process are mainly electrically driven. Little to no steam is used in this green ammonia production process. Ammonia is a key ingredient in nitrogen fertilisers and as such is critical for crop growth.

It should be noted that the production processes of some of the fertilisers require a carbon source, which needs to be sustainable in order to obtain green fertilisers. Possible solutions are direct air capture (DAC), carbon capture and use (CCU) from unavoidable industrial sources, or biomass treatment processes. Globally, only few industrial or commercial-scale projects are currently available for sustainable carbon sourcing.

2.4.2 Methanol

Methanol production is another major current use of hydrogen, accounting for 17% of hydrogen demand. Methanol is a widely used chemical, with its main uses including the production of basic chemicals (e.g. formaldehyde, acetic acid; 52%), olefins (e.g. polyethylene; 31%) and fuels/fuel additives (e.g. dimethyl ether - DME; 17%) (Methanol Institute, 2024).

In the case of green methanol, the hydrogen is generated by electrolysis and an additional source of carbon is required for the synthesis process. The sourcing of sustainable carbon and the deployment of technologies such as DAC or CCU at large scale might be limiting factors. Further related information can be found in Annex 2.

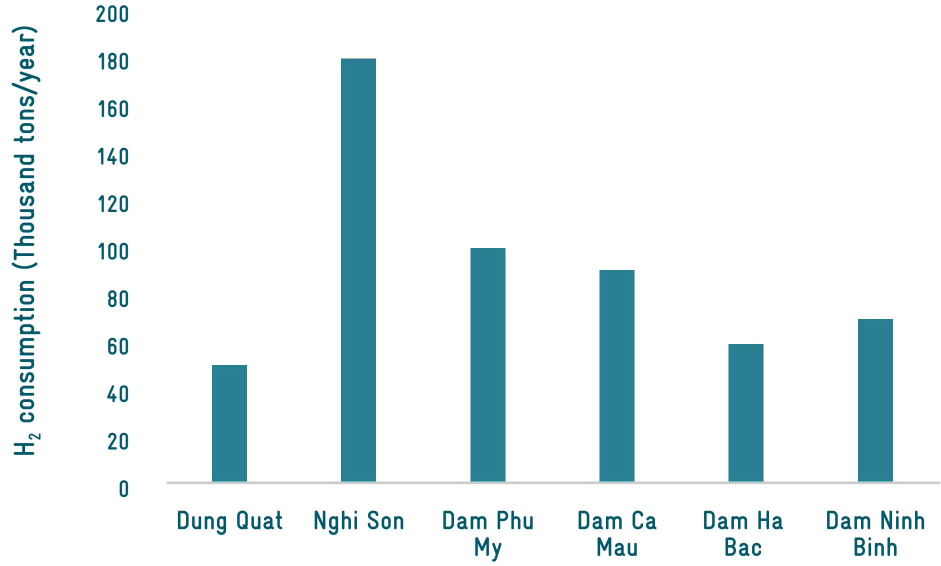
2.5 National overview of hydrogen

2.5.1 Overview of the national industry

Currently, hydrogen production and consumption in Vietnam are mainly concentrated in the form of grey and brown hydrogen, used primarily in petrochemical refining, fertiliser manufacturing, and a few other specific industrial sectors. Hydrogen is generally produced and consumed on site without large-scale distribution or trading.

Figure 3 illustrates current hydrogen consumption across key industrial facilities. Nghi Sơn Refinery is the largest consumer, with an estimated demand of around 180,000 tonnes per year, followed by Phu My Fertiliser Plant and Ca Mau Fertiliser Plant with over 100,000 tonnes each. Other notable users include Dung Quat Refinery, Ha Bac Fertiliser Plant, and Ninh Binh Fertiliser Plant, with consumption levels ranging from 50,000 to 70,000 tonnes/year.

FIGURE 3. Current hydrogen consumption across key industrial facilities



Source: Ministry of Industry and Trade, 2024

2.5.2 The fertiliser industry

Agriculture is an important economic sector in Vietnam's economy, accounting for 11.86% of the country's GDP and 26.5% of the workforce (Vietnam National Statistics Office, 2025). Current demand for fertiliser in Vietnam is therefore very high (Vietnam uses three times more fertiliser than the world average) (Hoang, 2024). Notably, the imbalance in production structure leads to a surplus in some fertiliser groups while there is a shortage in others.

Table 5 shows that Vietnam's total annual fertiliser demand is approximately 11 million tonnes, while domestic production capacity slightly exceeds this at 11.37 million tonnes per annum. The largest demand is for NPK fertiliser (4 million tpa) and urea fertiliser (2 million tpa), both of which are met with sufficient local production. There are production gaps for potassium and SA fertilisers, which have zero domestic production capacity, despite a combined demand of 1.8 million tonnes per year. Conversely, phosphate and organic fertilisers show a surplus in production capacity compared to domestic needs. This indicates a generally balanced fertiliser market with specific import dependencies for select product types.

TABLE 5. Fertiliser demand and production capacity in Vietnam

No.	Type of fertiliser	Demand (tpa)	Domestic production capacity (tpa)
1	Urea	2,000,000	2,660,000
2	DAP	900,000	810,000
3	Phosphate	1,800,000	2,300,000
4	NPK	4,000,000	5,000,000
5	Potassium	950,000	0
6	SA	850,000	0
7	Organic and microbial	500,000	600,000
	Total	**11,000,000**	**11,370,000**

Source: Thuc, 2024

Table 6 provides an overview of 14 major fertiliser production plants in Vietnam, detailing their locations, product types, and production capacities.

- The most commonly produced fertilisers are urea, ammonia, DAP (diammonium phosphate), super phosphate, NPK, and fused magnesium phosphate.
- Urea and ammonia production is concentrated in large plants such as Ca Mau, Phu My, Ha Bac, and Ninh Binh, each with total annual capacities ranging from 800,000 to 1.2 million tonnes across products.
- DAP production is led by Dinh Vu and Lao Cai Vinachem plants (330,000 tpa each), while Duc Giang also contributes with 150,000 tpa.
- The Lam Thao super phosphate plant is the largest producer of super phosphate and NPK combined (1.55 million tpa total).
- Fused magnesium phosphate production is present in four plants (e.g. Van Dien, Ninh Binh), with individual capacities up to 500,000 tpa.
- Production is geographically spread across key industrial zones in provinces such as Ninh Binh, Bac Giang, Ca Mau, Ba Ria Vung Tau, Lao Cai, Phu Tho, and Thanh Hoa.

This network reflects a diverse and regionally distributed fertiliser production base that supports both domestic demand and export potential.

IMPORT AND EXPORT

According to the data from the General Department of Customs in 2024, Vietnam exported approximately **1.73 million tonnes** of fertilisers valued at **USD 709.91 million**, averaging **USD 411.1/tonne**. The top export destination was **Cambodia**, accounting for **34.3% of volume** and **33.9% of export revenue**, followed by **South Korea** (220,174 tonnes, USD 89 million) and the **Philippines** (109,381 tonnes, USD 46.35 million).

On the import side, Vietnam brought in over **5.25 million tonnes** of fertilisers worth **USD 1.71 billion**, at an average price of **USD 325.7/tonne**. **China** remained the largest supplier, making up **44.9% of volume** and **43.2% of value** (2.36 million tonnes, USD 739.65 million), followed by **Russia** and **South Korea**, with 547,705 tonnes and 230,346 tonnes respectively.

RELEVANCE OF GREEN HYDROGEN IN THE FERTILISER SECTOR

Only certain fertilisers principally require hydrogen for their production. Urea, via ammonia, is the primary candidate, while DAP, AN, AS and chemical NPK typically rely partially or indirectly on ammonia. According to the Report on Development Strategy of the Chemical Industry (Vietnam Ministry of Industry and Trade, 2021), **the total NH_3 demand for Vietnam's fertilizer sector by 2035 is estimated at about 2,083,660 tonnes per year.**

From this, we estimate that the **total green hydrogen demand as a substitute for the fertilizer sector will be around 370,000 tonnes per annum**.

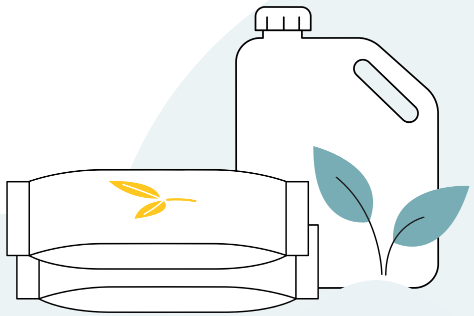


TABLE 6. Summary of major fertiliser plants, products, and capacities in Vietnam

No.	Plant	Location	Product	Capacity (tpa)	Source
1	Ninh Binh fertiliser plant	Lot D7, Khanh Phu Industrial Park, Khanh Phu commune, Yen Khanh district, Ninh Binh province	Urea	560,000	Vietnam Chemicals Agency, 2025
			Ammonia	320,000	
2	Ha Bac fertiliser plant	Tran Nguyen Han Street, Tho Xuong ward, Bac Giang city, Bac Giang province	Urea	500,000	
			Ammonia	300,000	
3	Ca Mau fertiliser plant	Lot D, Ward 1 Industrial Park, Ngo Quyen Street, Ward 1, Ca Mau city, Ca Mau province	Urea	800,000	
			Ammonia	450,000	
			NPK	300,000	
4	Phu My fertiliser plant	Phu My 1 Industrial Park, Phu My ward, Phu My town, Ba Ria Vung Tau province	Urea	800,000	
			Ammonia	540,000	
			NPK	250,000	
5	Dinh Vu DAP – Vinachem fertiliser plant No.1	Lot N5.8 Dinh Vu Industrial Park, Cat Hai and Dong Hai 2 wards, Hai An district, Hai Phong city	DAP	330,000	Vietnam Chemicals Agency, 2025
6	Lao Cai DAP – Vinachem fertiliser plant No.2	Tang Loong Industrial Park, Tang Loong town, Bao Thang district, Lao Cai province	DAP	330,000	
7	Duc Giang - Lao Cai Chemicals plant	Tang Loong Industrial Park, Tang Loong town, Bao Thang district, Lao Cai province	DAP	150,000	
8	MICCO Thai Binh ammonium nitrate plant	Thai Tho Industrial Cluster, Thai Tho commune, Thai Thuy district, Thai Binh province	Ammonium nitrate	200,000	Thai Binh News, 2022
9	Lam Thao super phosphate plant	Lam Thao town, Lam Thao district, Phu Tho province	Super phosphate	800,000	Vietnam National Chemical Group, 2022
			NPK	750,000	
10	Apromaco Lao Cai super phosphate plant	Tang Loong town, Bao Thang district, Lao Cai province	Super phosphate	200,000	Vietnam National Chemical Group, 2022
			NPK	150,000	
11	Long Thanh super phosphate plant	Go Dau Industrial Park, Phuoc Thai commune, Long Thanh district, Dong Nai province	Super phosphate	200,000	Vietnam National Chemical Group, 2022
			NPK	50,000	
12	Van Dien fused magnesium phosphate plant – Thanh Tri	Tam Hiep commune, Thanh Tri district, Ha Noi city	Fused magnesium phosphate	300,000	Van Dien FMP JSC, 2019
			NPK	150,000	
13	Ninh Binh fused magnesium phosphate plant	Ninh An commune, Hoa Lu district, Ninh Binh province	Fused magnesium phosphate	300,000	Vietnam National Chemical Group, 2014
			NPK	150,000	
14	Lao Cai fused magnesium phosphate plant	Tan Thuong commune, Van Ban district, Lao Cai province	Fused magnesium phosphate	100,000	CECO, 2023

Source: Authors' own compilation, Vietnam Institute of Energy, 2025

2.5.3 The oil and gas industry

The oil and gas industry is one of Vietnam's economic pillars, contributing about 9–10% of GDP and accounting for 9–9.5% of total state budget revenue (Ngo, 2024). Most of the consumed oil products in Vietnam are processed in two main refineries: Dung Quat and Nghi Son, with capacities of 6.5 million tonnes and 10 million tonnes of crude oil per year, respectively (Authors' own compilation, Vietnam Institute of Energy, 2025). In addition, the Dung Quat Refinery Expansion Project is being developed with a capacity of 1.1 million tonnes per year (Vietnam Prime Minister, 2023).

With regard to the gas subsector, most of the natural gas used in the country comes from four main gas fields: Cuu Long, Nam Con Son, Malay – Tho Chu, and Song Hong. Most of the supplied natural gas is used as fuel in power generation, as feedstock in fertiliser production, and in different industrial processes (Authors' own compilation, Vietnam Institute of Energy, 2025). According to Vietnam's National Energy Master Plan for the 2021–2030 period, with a vision to 2050, natural gas output is expected to grow from 7.2 billion cubic metres (bcm) in 2021 to reach 5.5 to 15 bcm/year for the 2021–2030 period and 10 to 15 bcm/year for the 2031–2050 period.

TABLE 7. Summary of major refineries, products, and capacities in Vietnam

No.	Plant	Location	Crude oil processing capacity (ktpa)	Product	Capacity (ktpa)
1	Dung Quat Refinery	Dung Quat Economic Zone, Binh Thuan and Binh Tri communes, Binh Son district, Quang Ngai province	6,500	Propylene	110 – 150
				LPG	280 – 300
				Gasoline 90/92/95	2,000 – 2,500
				Kerosene/Jet A1	400 – 410
				Diesel oil	2,500 – 3,000
				Fuel oil	2,500 – 3,000
2	Nghi Son Refinery	Nghi Son economic zone, Tinh Gia district, Thanh Hoa province	10,000	LPG	37.80
				Benzene	246.19
				Paraxylene	684.48
				Jet A1	591.90
				RON 92 gasoline	1151.21
				RON 95 gasoline	1151.21
				Premium diesel	2202.56
				Regular diesel	1468.14
				Polypropylene	372.41
				Solid sulphur	257.64

Source: Vietnam Petroleum Institute, 2023

RELEVANCE OF GREEN HYDROGEN IN THE OIL AND GAS SECTOR

A large amount of hydrogen is produced and consumed on site in refinery plants. Refineries use hydrogen in the hydrogen treating processes to meet feed specifications for downstream units and commercial product specifications. Hydrogen consumption varies depending on the crude slate and upgrading intensity (especially hydrocracking and desulphurisation). Assuming 20–35 kg H_2 per tonne of crude oil processed (based on global benchmarks), hydrogen demand for the Dung Quat and Nghi Son refineries amounts to roughly 162.5 and 250 ktpa respectively. This indicates huge potential for green hydrogen deployment in the oil and gas sector.

2.5.4 The steel and metallurgy industry

Vietnam is among Southeast Asia's leading steel producers, with a total crude steel capacity of approximately 25 million tonnes per annum (tpa). The sector includes both integrated steel mills using blast furnace-basic oxygen furnace (BF-BOF) technology and electric arc furnace (EAF) facilities relying on steel scrap or direct reduced iron (DRI). In 2024, the Vietnamese steel industry produced 21.98 million tonnes and consumed 21.41 million tonnes of crude steel, including export. Regarding finished steel, Vietnam imported about 17.713 million tonnes and exported about 12.62 million tonnes of finished steel of all kinds (Vietnam Steel Association, 2025).

Table 12 in Annex 3 provides a list of steel companies and their production capacities in Vietnam. Vietnam produces both long (reinforcing bars, wire rods, and angles) and flat steel (hot-rolled coils, cold-rolled coils, and galvanised steel) products (World Steel Association, 2023). Estimates indicate Vietnam has over 50 rolling mills, mostly concentrated in Ba Ria-Vung Tau, Hai Phong, Hai Duong, and Quang Ngai provinces (Vietnam Steel Association, 2023).

RELEVANCE OF GREEN HYDROGEN IN THE STEEL SECTOR

At present, hydrogen use in Vietnam's steel industry is minimal. The dominant BF-BOF and EAF technologies rely on coking coal and pulverised coal injection in BF-BOF, and electricity and steel scrap in EAF. However, hydrogen is a strategic target for future decarbonisation:

- In BF-BOF, hydrogen could partially replace coal in the blast furnace to lower CO_2 emissions.
- In EAF-DRI, green hydrogen can be used to produce direct reduced iron (DRI), reducing the need for fossil gas or coal-derived reducing agents.
- Rolling mills: hydrogen can be used in annealing furnaces or protective atmospheres, but quantities are minor.

Based on current steel production capacities and typical hydrogen consumption rates, the **estimated green hydrogen potential in Vietnam's steel sector** is as follows:

TABLE 8. Estimated green hydrogen potential in Vietnam's steel sector

Application	Hydrogen demand (tonnes per annum)
BF-BOF (partial replacement)	789,750 tpa
EAF-DRI (full replacement of NG)	781,275 tpa
Rolling mills (annealing furnaces)	75,000 tpa
Total potential demand	**1,646,025 tpa (~1.65 million tpa)**

Source: Authors' own compilation, IE (2025), GIZ (2025)

These figures represent **technical potential** under full substitution scenarios and assume green hydrogen is used as the primary reducing or heating agent. Actual adoption will depend on technology, economics, and policy support.

Vietnam's steel sector is robust, export-oriented, and rapidly modernising. While current production is carbon-intensive, hydrogen presents a promising long-term pathway.

2.5.5 The glass industry

Although hydrogen is not always essential for glass production, it plays a role in specific processes. In modern float glass manufacturing, hydrogen is commonly used to prevent oxidation. Hydrogen is either normally procured from an external supplier via compressed tanks or supplied through a pipeline via a nearby facility. In Vietnam, glass has long been an indispensable material in construction. According to the Vietnam Glass Association, the total designed capacity of construction glass plants is about 5,900 tonnes/day, equivalent to 415 million m^2 of standardised glass/year, of which construction glass produced by float technology (float glass) is 3,370 tonnes/day (equivalent to 235 million m^2 of standardised glass/year) and construction glass produced by rolling technology (rolled glass) is 850 tonnes/day (equivalent to 60 million m^2 of standardised glass/year), while ultra-clear construction glass is 1,680 tonnes/day (equivalent to 120 million m^2 of standardised glass/year).

Table 9 provides a summary of major float glass plants in Vietnam, including their locations and daily production capacities.

These plants support Vietnam's growing construction, automotive, and solar PV sectors, with a mix of standard and ultra-clear glass production. The industry is geographically distributed, with clusters in Ninh Binh, Central Vietnam, and Southern industrial zones.

RELEVANCE OF GREEN HYDROGEN IN THE GLASS SECTOR

At present, some floating glass companies use hydrogen in the float glass process in Vietnam. If we assume all the float glass plants in Vietnam start to use hydrogen to prevent oxidation, the total estimated hydrogen demand would be **approximately 196.5 tonnes per year.** This is based on their combined production capacity and typical usage rates of ~0.15 kg H_2 per tonne of glass (taken as an average number; the actual usage of hydrogen depends on the type of furnace, glass composition, and the desired glass quality).

TABLE 9. Summary of major float glass plants, products, and capacities in Vietnam

No.	Plant	Location	Capacity (tpa)	Source
1	CFG Ninh Binh Float Glass Plant	Khanh Cu Industrial Park, Khanh Cu commune, Yen Khanh district, Ninh Binh province	1,200	Ha Long – CFG Float Glass Co., Ltd, 2025
2	CFG Chu Lai Float Glass Plant	Bac Chu Lai Industrial Park, Tam Hiep commune, Nui Thanh district, Quang Nam province	900	
3	Vietnam Float Glass Plant (VFG)	Que Vo Expansion Industrial Park, Phuong Lieu ward, Que Vo town, Bac Ninh province	500	Vietnam Float Glass Co., Ltd, 2025
4	Viglacera Float Glass Plant (VIFG)	Tan Dong Hiep ward, Di An city, Binh Duong province	420	Viglacera Float Glass Co., Ltd, 2025
5	Trang An Float Glass Plant	Lot C5, Ninh Phuc Industrial Park, Khanh Phu commune, Yen Khanh district, Ninh Binh province	300	Ninh Binh Provincial People's Committee, 2018
6	Phu My Ultra-Clear Float Glass Plant (PFG)	Phu My II Expansion Industrial Park, Phu My ward, Phu My city, Ba Ria – Vung Tau province	600	Phu My Ultra Clear Float Glass Co., Ltd, 2025

Source: Authors' own compilation, Vietnam Institute of Energy, 2025

2.5.6 Other sectors

Although there are a number of other sectors where hydrogen is used worldwide, these sectors do not emerge as significant candidates for hydrogen production in Vietnam. There is little evidence that small quantities of hydrogen are used or have the potential to be used.

FOOD SECTOR

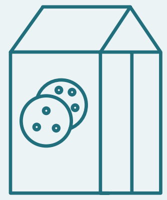
Vietnam's food processing industry includes four main groups: processing and preserving meat and meat products; processing and preserving aquatic products; processing of milk and dairy products; and processing and preserving vegetables and fruits. One potential area of hydrogen use in the food industry is the processing of vegetable oils, margarine, and shortening. For vegetable oil products, Vietnamese plants all use refining technology, which does not use hydrogen. Hydrogen is mainly used in margarine and shortening production lines, with insignificant volume.

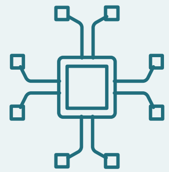
SEMICONDUCTOR SECTOR

Vietnam's semiconductor industry is growing rapidly thanks to strong investment from large corporations and government incentives. Currently, Vietnam is mainly involved in back-end processes such as packaging and testing, but is gradually expanding into design and wafer fabrication. Revenue in the semiconductor market reached USD 18.7 billion in 2024 (Vietnam Ministry of Information and Communications, 2025). Information about the technology of the semiconductor plants in Vietnam is not made public. However, because the semiconductor plants mainly perform packaging and testing, not wafer production, it is likely that the use of hydrogen in these plants is limited.

PHARMACEUTICAL SECTOR

Hydrogen and ammonia are basic and important raw materials in the pharmaceutical chemical industry (APIs – active pharmaceutical ingredients). Hydrogen will react through hydrogenation to convert intermediates or active ingredients into a more stable form. Used in the synthesis of antibiotics, vitamins, and steroids, ammonia is a precursor to the production of amino acids, antibiotics, pain relievers, and sedatives. Currently, pharmaceutical chemical factories in Vietnam have not applied hydrogen or hydrogen derivatives such as ammonia to the production process because the country depends on imported raw materials, so consumption demand is still very limited. However, according to the Pharmaceutical Industry Strategy to 2030, Vision 2045, and the National Hydrogen Strategy, when Vietnam develops 3 – 5 large-scale API factories hydrogen demand is estimated to increase significantly.





2.6 Industrial clusters

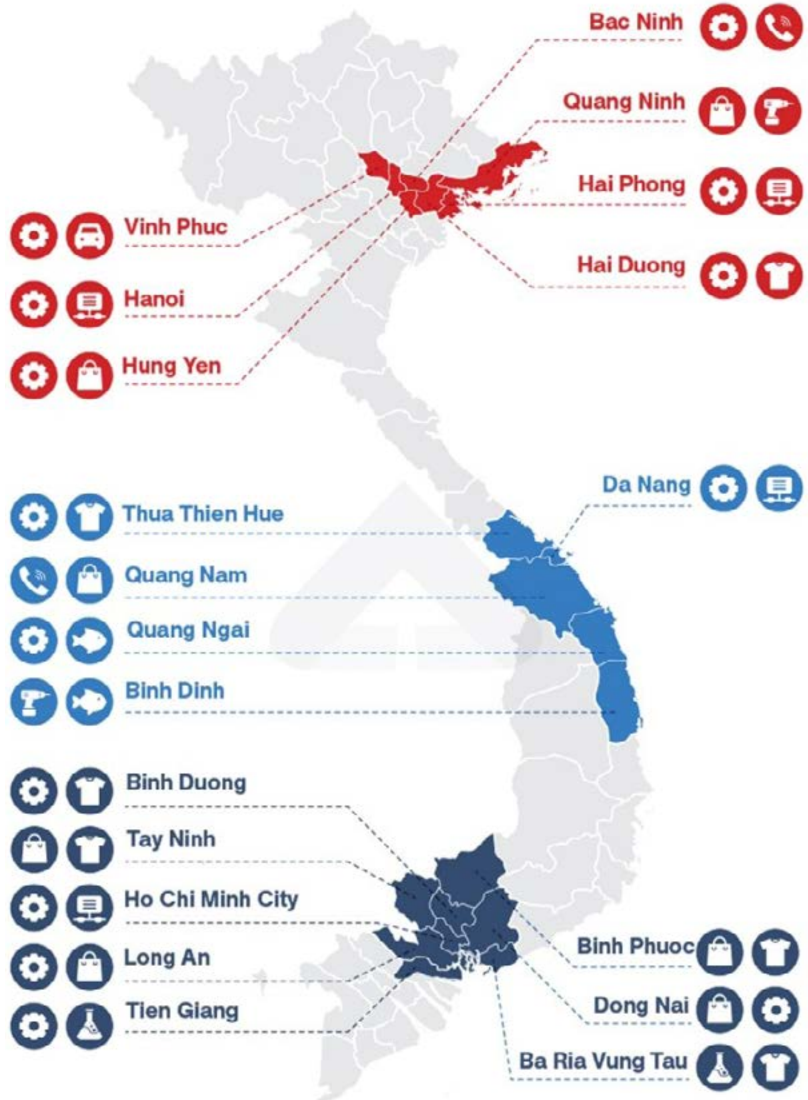
Economic zones and industrial parks play a very important role in the business-friendly environment that Vietnam currently has. It is considered an ideal destination for investors to set up a factory. The country has divided its key economic zones into three areas:

Key economic zones:

- **Northern Zone**: includes Hanoi, Bac Ninh, Hai Duong, Hai Phong – major hubs for electronics, machinery, and pharmaceuticals.
- **Central Zone**: spans Da Nang, Quang Ngai, Binh Dinh – focused on petrochemicals, construction, and automotive.
- **Southern Zone**: includes Ho Chi Minh City, Binh Duong, Dong Nai, Ba Ria - Vung Tau – leading in garments, chemicals, electronics, steel, and agri-food.

Strong clusters for the chemical industry exist in the north (e.g. Bắc Ninh, Hải Phòng, Hải Dương) and the south (e.g. Bình Dương, Đồng Nai, Hồ Chí Minh City), which offer robust production across fertilisers and basic and specialty chemicals. Central Vietnam focuses on large-scale BF-BOF integrated plants, while the northern and southern regions host EAF rolling mills and long-product facilities. Float glass companies are spread out through the northern, central and southern regions of Vietnam. As these are the most suitable potential off-takers of green hydrogen, the focus is on these three types of industries.

FIGURE 4. Key economic zones in Vietnam



Source: Asia Briefing Co., Ltd, 2022

3

Green hydrogen potential in Vietnam and use cases

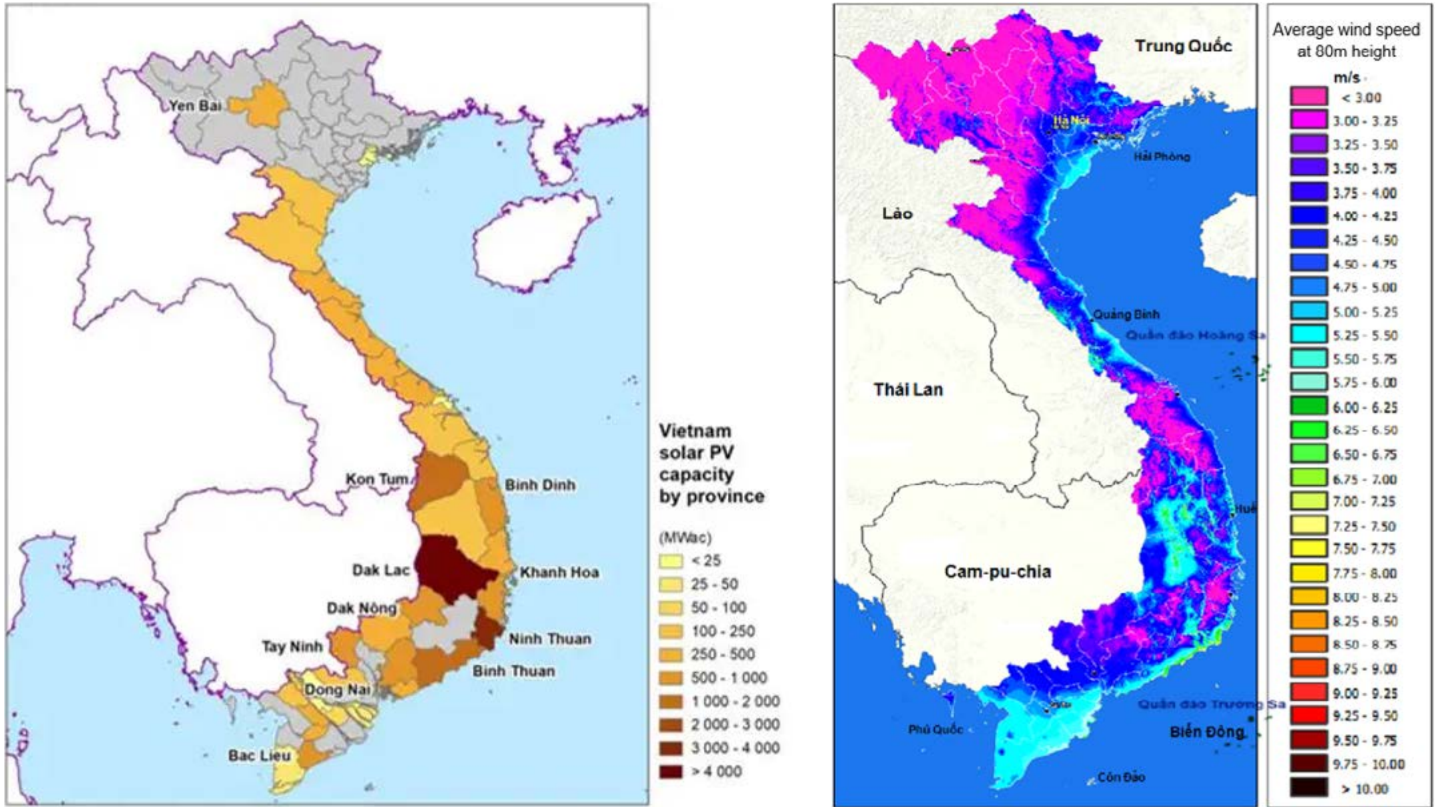
Vietnam is equipped with all the right resources to become a global leader in green hydrogen production, consumption, and even export, which is mainly thanks to its renewable energy resources, strategic geographic location, and well-established trade routes.

3.1 Renewable resource potential within Vietnam

Vietnam possesses substantial renewable energy potential, particularly in solar and wind power. The country's southern and south-central regions benefit from high solar radiation levels, making them ideal for solar energy development. Additionally, Vietnam's long coastline offers excellent wind power opportunities, particularly for offshore projects. This abundant renewable resource base positions Vietnam as a promising hub for clean energy development, including green hydrogen production, as the country transitions toward a low-carbon economy.

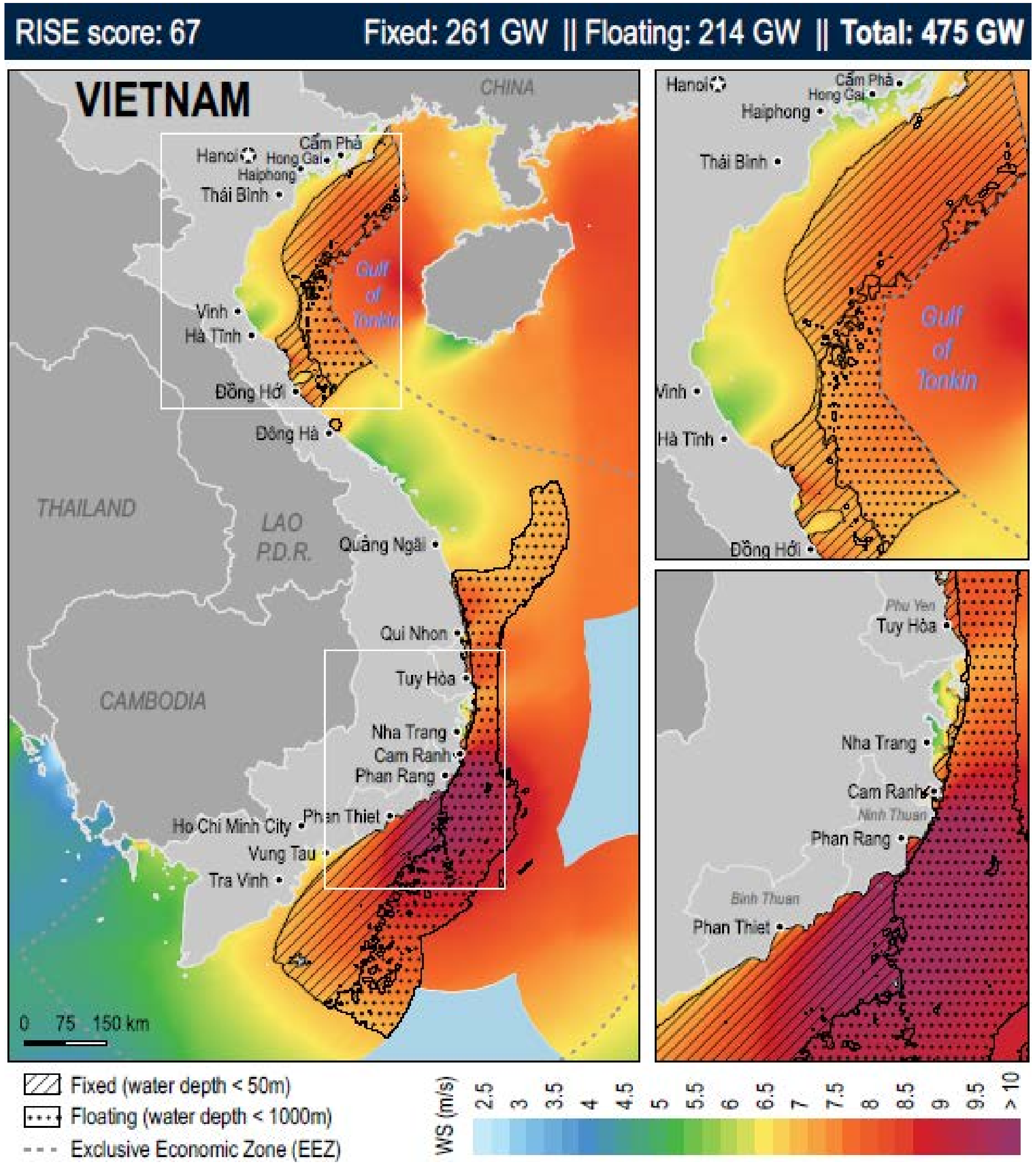
Vietnam has substantial solar photovoltaic (PV) potential, estimated at 963,000 MW. This vast potential is significantly greater than Vietnam's current solar capacity of 16,600 MW. The country's solar resources are particularly strong in the south, with high solar radiation and long sunlight hours (B&Company, 2024), (Nguyen V. K., 2025).

FIGURE 5. Technical potential of Vietnam's solar and onshore wind energy



Source: Rystad Energy SERA Tracker, 2019, Vietnam Energy Online, 2021

FIGURE 6. Technical potential of Vietnam's offshore wind energy



Source: World Bank, 2020

Vietnam possesses substantial onshore wind potential, estimated to be at least 24 GW with average wind speeds exceeding 6 m/s, and an additional 404 GW at lower speeds (5-6 m/s). The south-central and coastal regions are particularly promising, with some areas experiencing average wind speeds of 7 m/s or higher. However, the development of wind power in Vietnam, both onshore and offshore, faces challenges, including establishing a suitable regulatory framework and ensuring timely project development (Khang Duc Investment and Construction JSC, 2020), (Rodl & Partner, 2023).

Vietnam possesses substantial offshore wind potential, estimated at over 1,000 GW within its exclusive economic zone (EEZ) according to a report from the Ministry of Natural Resources and Environment. This vast resource, particularly along the central and southern coasts, could play a significant role in Vietnam's energy future. The country has set ambitious targets, aiming for 6 GW of installed offshore wind capacity by 2030 and 70–91.5 GW by 2050, as outlined in its Power Development Plan 8, according to the Global Wind Energy Council.

Vietnam faces several challenges in scaling up renewable energy, particularly onshore and offshore wind and solar PV. These include limited grid capacity and frequent curtailment due to transmission bottlenecks, slow permitting and land acquisition processes, and regulatory uncertainty affecting investor confidence. Additionally, offshore wind projects face high upfront costs and a lack of specialised infrastructure and local supply chains. Ensuring long-term policy stability and upgrading grid infrastructure are essential to unlocking the country's full renewable energy potential.

3.2 Potential use cases in Vietnam

Hydrogen plays a key role in Vietnam's diverse sectors such as chemicals, fertilisers, steel, glass, and oil refining. Its applications can be broken down into small- and large-scale use cases, each with distinct requirements in terms of electrolyser capacity and industry-specific hydrogen demand profiles.

3.2.1 Small-scale use cases (electrolyser capacity: 1+ MW)

Small-scale green hydrogen projects target industries with moderate hydrogen needs or decentralised production requirements. These systems emphasise on-site or nearby generation to reduce logistics costs and integrate smoothly into existing operations.

Electrolysers will generally be powered by local wind or solar PV installations, complemented by battery or hydrogen storage to balance supply variability and demand fluctuations. In most cases, the hydrogen is used directly at the point of production, ensuring high efficiency and operational reliability.

Common small-scale applications include electronics, specialty glass manufacturing, welding, and rolling steel. The following are the best candidates for green hydrogen in Vietnam:

- Rolling steel mills
- Electronics industry
- Float glass industry

3.2.2 Large-scale use cases (electrolyser capacity: 10 MW and above)

Large-scale green hydrogen projects cater to industries with high and steady hydrogen demand, leveraging economies of scale through sizable electrolyser systems and access to prime wind and solar resources.

These projects are typically anchored by expansive renewable energy installations and co-located large-scale electrolysers, supported by dedicated infrastructure for power transmission, water supply, wastewater treatment, and hydrogen storage and distribution to industrial users or export terminals. Significant hydrogen storage capacity is crucial – either to buffer production variability and maintain process continuity or to align with the intermittent schedules of maritime transport for export.

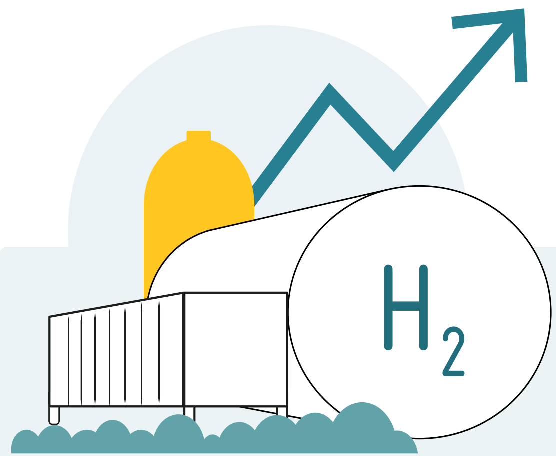
Unlike smaller setups that often use containerised electrolysers, large-scale systems are housed in purpose-built facilities. In areas with limited freshwater, integrated desalination units may be necessary to ensure a reliable water supply.

Key applications include ammonia and fertiliser production, chemical manufacturing (e.g. methanol), and oil refining, with future potential in sectors like steel and cement.

In Vietnam, the key potential applications for large-scale green hydrogen include the following:

- Chemical industry (including ammonia, methanol and fertiliser production)
- Crude oil refining
- Cement
- Iron & steel production

Green hydrogen therefore offers much potential for both small-scale and large-scale projects in Vietnam.



3.2.3 Techno-economic calculations of the use cases

To provide a preliminary indication of the techno-economic feasibility for projects of varying scales, three different scenarios were assessed for direct hydrogen use in central southern to southern Vietnam, where a transition to green hydrogen in various industries could be considered in the short term. For these selected cases, the analysis examined the levelised cost of hydrogen and ammonia based on different renewable energy mixes of PV and wind, necessary to fulfil a given annual hydrogen demand. Different electrolyser sizes were used. The main results of these three cases are summarised in the following table. These results are based on model renewable profiles at the location (Lat. - 11.68894 and Long. - 108.96092). It should be noted that the results can vary significantly if industries in other parts of the country are chosen, for example with different nearby wind resources, or if utility-scale projects with significantly larger component sizing are planned. One more important thing to note is that the cases were calculated over a project lifetime of 25 years, and financial parameters such as inflation and escalation were included. Current costs of grey H_2 in Vietnam were given as USD 6.47/kg (average from local suppliers), assuming it is supplied from an external source via compressed gas tanks, and the price of grey ammonia was given as USD 0.57/kg (average from local suppliers).

TABLE 10. Results of the techno-economic calculations for the three hydrogen use cases

	Small-scale H_2 (wind & PV)	Small- scale H_2 (PV only)	Large-scale H_2 (wind & PV)
Demand (H_2) in tonnes/a	45	45	450
Installed RE (capacity) in MW	2.5 MW PV, 0.5 MW wind	2.6 MW PV	21 MW PV, 4 MW wind
Electrolyser size in MW	0.8	0.9	6.9
Weighted average cost of capital (WACC) (%)	10.2	10.2	10.2
Total investment in million USD	4.81	3.96	38.23
Oxygen sales in million kg	0.34	0.33	3.4
Excess RE sales/consumed in GWh	1.5	1.1	13.3
LCOH grey (USD/kg)	10.22	10.22	10.22
LCOH proposed case/green (USD/kg)	9.66	9.81	7.49
Project IRR in %	10.7	10.6	12.4
Net present value (NPV) in million USD	0.17	0.15	7.65

Source: Analyses performed by GIZ, 2025

Based on the techno-economic analysis of green hydrogen production in Vietnam, the following conclusions can be drawn:

- **Cost and competitiveness**: The proposed levelised cost of hydrogen (LCOH) for all three cases – ranging from USD 9.66/kg to USD 7.49/kg – is slightly lower than the current grey hydrogen benchmark of USD 10.22/kg (overall 25 years including inflation and escalation). This suggests that green hydrogen production is already approaching cost competitiveness, particularly in the large-scale configuration.
- **Scale efficiency**: The large-scale (wind & PV) case benefits significantly from economies of scale, achieving the lowest LCOH (USD 7.49/kg), highest internal rate of return (IRR) of 12.4%, and the most favourable net present value (USD 7.65 million). This makes it the most financially viable option among the evaluated scenarios. However, initial investments are the highest in this scenario.
- **Small-scale viability**: Both small-scale cases – wind & PV, and PV only – also demonstrate positive NPVs (USD 0.17 million and USD 0.15 million, respectively) and IRRs above 10%, indicating that small-scale green hydrogen projects can be viable with the right market conditions and end-use alignment.
- **By-product revenue**: In all scenarios, oxygen sales contribute to improved project returns, with the large-scale case generating 3.4 million kg of oxygen annually – ten times more than small-scale setups.
- **Renewable energy utilisation**: The large-scale configuration maximises renewable energy use (13.3 GWh), further enhancing project efficiency and enabling higher capacity utilisation of installed infrastructure.

Given that current hydrogen use in Vietnam is dominantly linked to oil refining and ammonia-based fertiliser production, a complementary techno-economic analysis was conducted for three ammonia use cases that align with the hydrogen use cases presented above. The results are summarised in the following table:

TABLE 11. Results of the techno-economic calculations for the three ammonia use cases

Case	Small-scale H_2 (wind & PV)	Small-scale H_2 (PV only)	Large-scale H_2 (wind & PV)
Demand (NH_3) in tonnes	270	270	2,700
Installed RE (capacity) in MW	2.5 MW PV, 0.5 MW wind	2.6 MW PV	21 MW PV, 4 MW wind
Electrolyser size in MW	0.8	0.9	6.9
WACC (%)	10.2	10.2	10.2
Total investment in million USD	5.65	4.81	43.3
LCOA grey (USD/kg)	0.89	0.89	0.89
LCOA proposed case (USD/kg)	2.31	2.31	1.71
Oxygen sales in million kg	0.34	0.33	3.4
Excess RE sales/ consumed in GWh	1.5	1.1	13.3
Project IRR (%)	5.1	4.0	6.8
NPV in million USD	-1.88	-1.84	-9.83
Finance gap (USD/kg)	1.42	1.42	0.82

Source: Analyses performed by GIZ, 2025

Based on the techno-economic assessment of green ammonia production in Vietnam, the following key insights emerge:

- **Cost competitiveness**: All three cases reflect a significant cost gap between the proposed levelised cost of ammonia (LCOA) for green ammonia and the current grey ammonia benchmark (USD 0.89/kg). The proposed LCOA ranges from USD 2.31/kg for small-scale setups to USD 1.71/kg for large-scale, making green ammonia currently uncompetitive without financial support.
- **Economies of scale**: The large-scale wind & PV case benefits substantially from economies of scale, achieving the lowest LCOA (USD 1.71/kg), the highest IRR (6.8%), and the smallest finance gap (USD 0.82/kg). This underlines the potential of scaling up as a key strategy to approach cost parity.
- **Financial viability**: All cases yield **negative net present values (NPVs)**, ranging from USD -1.84 million in small-scale PV-only cases to USD -9.83 million in large-scale cases, highlighting the need for support schemes or cost reductions to ensure project bankability.
- **Revenue support from oxygen and RE sales**: While not sufficient to close the financial gap, oxygen sales (up to 3.4 million kg for large-scale cases) and excess renewable energy sales (up to 13.3 GWh) provide modest revenue streams and improve project economics.
- **Small-scale challenges**: Both small-scale cases require a finance gap subsidy of USD 1.42/kg, reflecting their limited ability to compete without significant policy or financial incentives.

The techno-economic analysis for green hydrogen and ammonia production in Vietnam under current assumptions confirms a consistent trend: larger-scale projects offer significantly better cost performance compared to small-scale setups. This is primarily due to economies of scale, more efficient infrastructure utilisation, and optimised use of renewable resources. However, these benefits come with higher capital requirements and increased financial risk, especially in a nascent market environment.

For green hydrogen, while small-scale projects show limited financial viability with modest internal rates of return (IRRs) and near-zero net present values (NPVs), large-scale configurations demonstrate stronger investment potential with an IRR of 12.4% and a clearly positive NPV of USD 7.65 million. Similarly, green ammonia projects, though all cases currently require financial support to bridge the cost gap with grey ammonia, benefit from scale: large-scale setups exhibit lower levelised costs of ammonia (USD 1.71/kg) and a smaller finance gap.

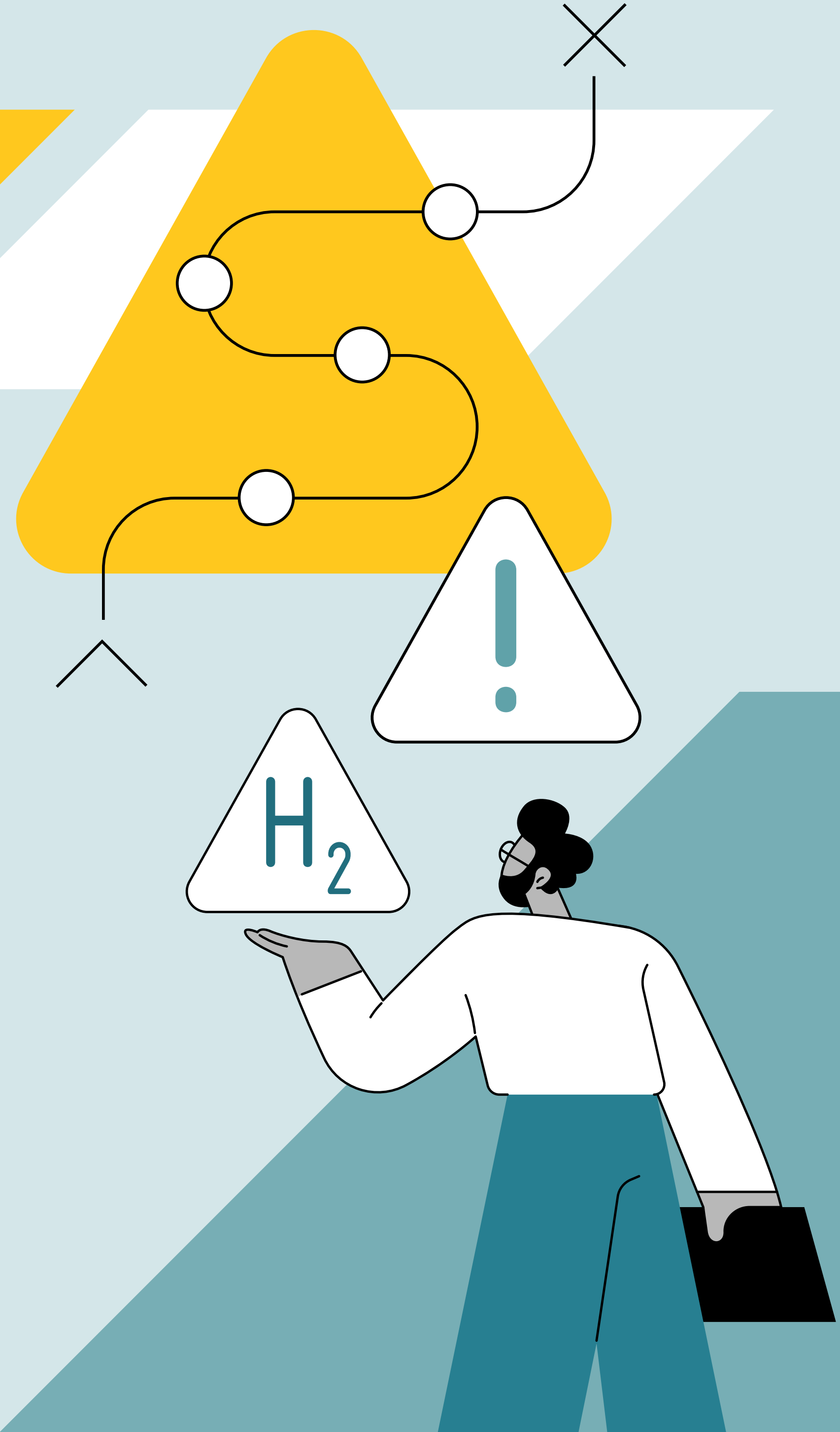
That said, project viability is highly sensitive to local conditions – including the renewable generation profile, grid constraints, water availability, and the demand profile of the hydrogen or ammonia off-taker. For instance, constant energy profiles assumed here may not fully reflect real-world operational variability, especially for intermittent renewable sources. While oxygen and excess renewable energy sales can provide supplementary revenues, these alone are insufficient to fully offset investment costs, especially for small projects.

Furthermore, the assumption that all excess electricity can be sold at industrial rates (USD 94/MWh) may not hold true across all regions or industries, potentially requiring battery storage or load-matching strategies. Additional benefits – such as utilisation of electrolyser waste heat, or integration with existing hydropower assets via PPAs – could improve economics if tailored to specific project locations. More information on the assumptions can be found in Annex 6.

In summary, while green hydrogen and ammonia production in Vietnam is technically feasible, it is economically viable primarily at larger scale, and even then, dependent on favourable renewable conditions, industrial integration, and targeted policy or financial support.

4

The way forward



4.1 Opportunities and supporting framework

4.1.1 International integration

Vietnam's commitment to international environmental agreements positions it well to engage in the global hydrogen (H_2) supply chain. Transitioning to H_2 offers opportunities for collaboration, technology transfer, and access to preferential funding. However, Vietnam will also face competition from more advanced countries like Germany and South Korea, which have a head start in H_2 development. Strategic integration can help Vietnam leverage global expertise and partnerships in hydrogen production, storage, and distribution.

4.1.2 Regulations, conventions, and international commitments on the transition to H_2 fuel

Global commitments made at COP26 have created momentum for renewable energy and hydrogen (H_2) adoption. Many countries are launching H_2 projects, offering Vietnam opportunities for cooperation and export if it can scale up production, storage, and transport. Participation in these commitments can also enable access to advanced technologies. However, proving the 'green' origin of H_2 remains a key challenge, as tracking specific renewable sources within the power grid is often costly and complex.

4.1.3 Global awareness of environmental protection and sustainable development

Environmental awareness, once centred in developed countries, is now growing in developing nations, including Vietnam, despite ongoing challenges related to cost and industrial practices. Vietnam's Power Development Plan VIII and its COP26 commitments reflect rising public and governmental support for clean energy. As global interest in hydrogen (H_2) and renewables grows, Vietnam has an opportunity to align with green economy trends, attract international funding, and achieve both environmental and economic benefits through strategic investment in H_2 production and use.

4.1.4 New technologies supporting the transition to H_2 fuel

Hydrogen technologies are advancing rapidly across production, storage, distribution, and use. Vietnam has the chance to adopt these innovations to improve efficiency, lower costs, and support a sustainable H_2 transition. Growing progress in wind, solar, hydropower, and biomass offers strong renewable inputs for H_2 production. As electrolysis and related technologies evolve, the shift to green hydrogen is accelerating. Experts recommend that Vietnam should focus on proven, efficient global technologies that align with local conditions to ensure effective implementation.

4.1.5 Reducing the cost of H_2 production, storage, and distribution globally

Advancements in hydrogen technology and global cost reductions present Vietnam with the opportunity to access H_2 at competitive prices. Vietnam also holds a strategic edge in producing green hydrogen from offshore wind, using seawater electrolysis and existing gas pipelines for transport. As production and distribution become more cost-effective, private sector investment across the hydrogen value chain is likely to grow.

4.1.6 Market and societal changes positively impacting the transition to H_2 fuel

Experts note a positive shift in Vietnam's awareness and actions toward clean energy adoption. This creates a timely opportunity to meet rising domestic and international demand for hydrogen. As H_2 is expected to replace fossil fuels across sectors like industry, transport, and power, Vietnam must also address consumer habits, lower costs, and support technology development to enable efficient hydrogen use.

4.2 Green hydrogen financing opportunities for German companies

The green hydrogen sector requires substantial financial investments to overcome high initial costs and infrastructure challenges. Several funding mechanisms exist to support hydrogen projects globally, particularly in emerging markets. These mechanisms are designed to reduce investment risks, facilitate project development, and encourage public-private partnerships. Refer to Annex 5 for mechanisms that may be useful in this context.

4.3 Stakeholder mapping and institutional overview for green hydrogen development

Vietnam's green hydrogen landscape involves a wide range of actors across government, industry, and academia, with strong potential for international collaboration, particularly with German partners.

PUBLIC SECTOR

Ministries such as MOIT, MONRE, and MOST lead energy policy, planning, and regulation, while institutions like the Institute of Energy and Vietnam Academy of Science and Technology support hydrogen strategy and research. Their focus includes green hydrogen certification, R&D collaboration, and integration with carbon markets.

STATE-OWNED ENTERPRISES

- **EVN** leads power generation, transmission, and renewable integration with pilot opportunities in hydrogen-to-power and co-firing.
- **PetroVietnam (PVN)** explores green and blue hydrogen production, ammonia synthesis, and offshore wind-to-hydrogen systems.
- **Vinacomin** is assessing coal gasification for hydrogen and CCUS applications.
- **Petrolimex** focuses on hydrogen logistics, fuelling infrastructure, and solar-powered stations.
- **Vinachem** has strong potential for integrating green hydrogen in ammonia and chemical production and export.

ACADEMIA AND RESEARCH

VAST, the Institute of Energy, VNU, and HUST drive R&D, policy development, and training. These institutions are active in international collaborations and pilot project design.

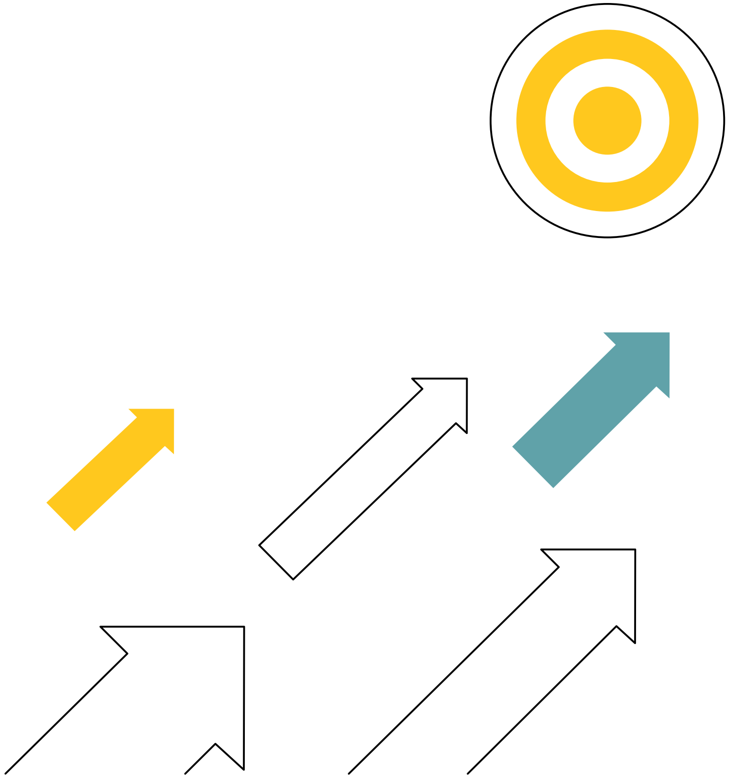
PRIVATE SECTOR

- **VinGroup** invests in hydrogen vehicles and energy systems.
- **TGS, Trung Nam**, and others are developing large-scale hydrogen and ammonia projects, often linked to renewable assets.
- Partnerships with German firms such as Siemens, Linde, Thyssenkrupp, and Fraunhofer are encouraged for technology transfer and infrastructure development.

Vietnam's coordinated policy push (e.g. Hydrogen Strategy 2024) and dynamic industrial ecosystem offer fertile ground for scaling green hydrogen through public-private partnerships and international cooperation. Detailed information can be found in Annex 4.

4.4 Next steps for German companies

Vietnam presents a significant opportunity for green hydrogen development, driven by its abundant renewable energy resources, strategic location, and increasing policy interest. Despite challenges such as high production costs, economic instability, and infrastructure gaps, Vietnam's strong industrial base and growing international investment interest make it a potential leader in the hydrogen market.

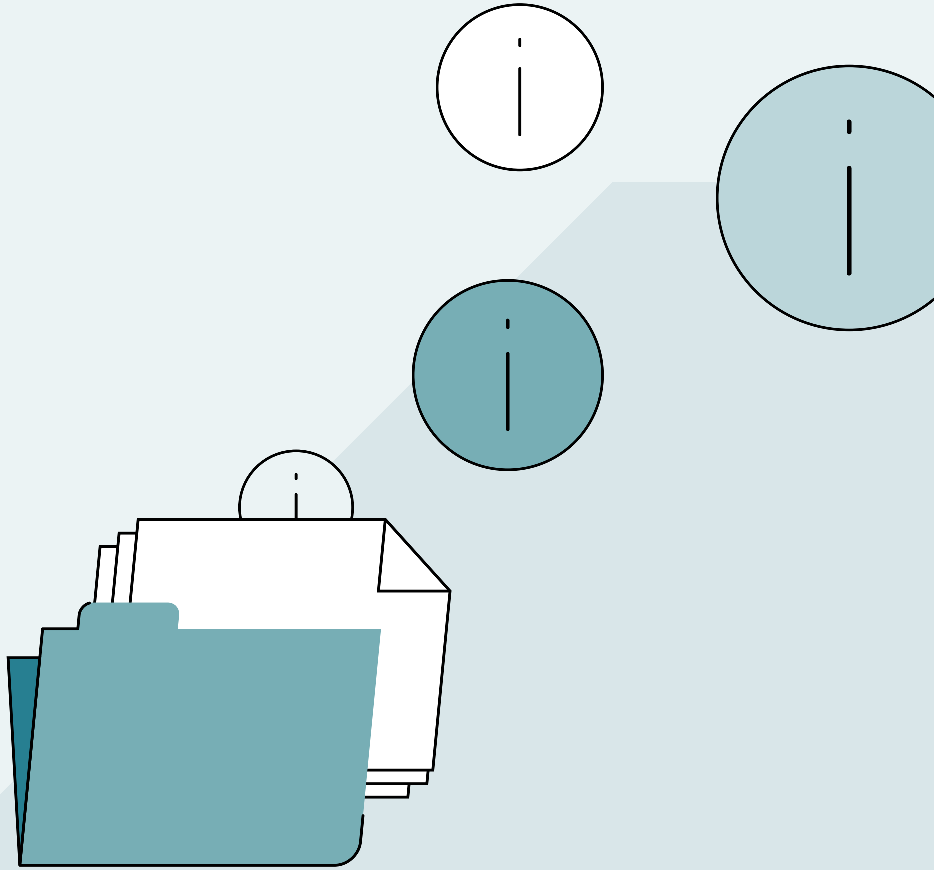


For German companies considering green hydrogen projects in Vietnam, the following steps are recommended:

1. **Engage with local stakeholders**: Build partnerships with key institutions such as the Ministry of Energy and the Energy Secretariat and with local energy regulators to stay informed about the latest policies, incentives, and investment opportunities.
2. **Leverage international financing**: Explore financing opportunities from sources like H_2Global, GEF, and multilateral funds supporting renewable energy projects. Look into programmes that might help mitigate risks and reduce the financing costs for green hydrogen ventures.
3. **Assess infrastructure and market potential**: Evaluate Vietnam's renewable energy capacity, especially in wind and solar. Consider pilot projects in sectors such as fertilisers, steel, and oil refining to generate initial demand for green hydrogen. Assess the potential for export routes, particularly via existing trade corridors.
4. **Monitor regulatory developments**: Stay updated on developments regarding Vietnam's hydrogen strategy and any changes in the political landscape, including the government's approach to energy and deregulation.
5. **Participate in R&D and Innovation**: Collaborate with Vietnamese universities, research institutions, and industrial players to explore new hydrogen technologies, ensuring that projects align with both local needs and international safety and efficiency standards.

By taking these steps, German companies can position themselves at the forefront of Vietnam's growing green hydrogen market, contributing to the country's transition to a more sustainable energy future while capitalising on the emerging opportunities.

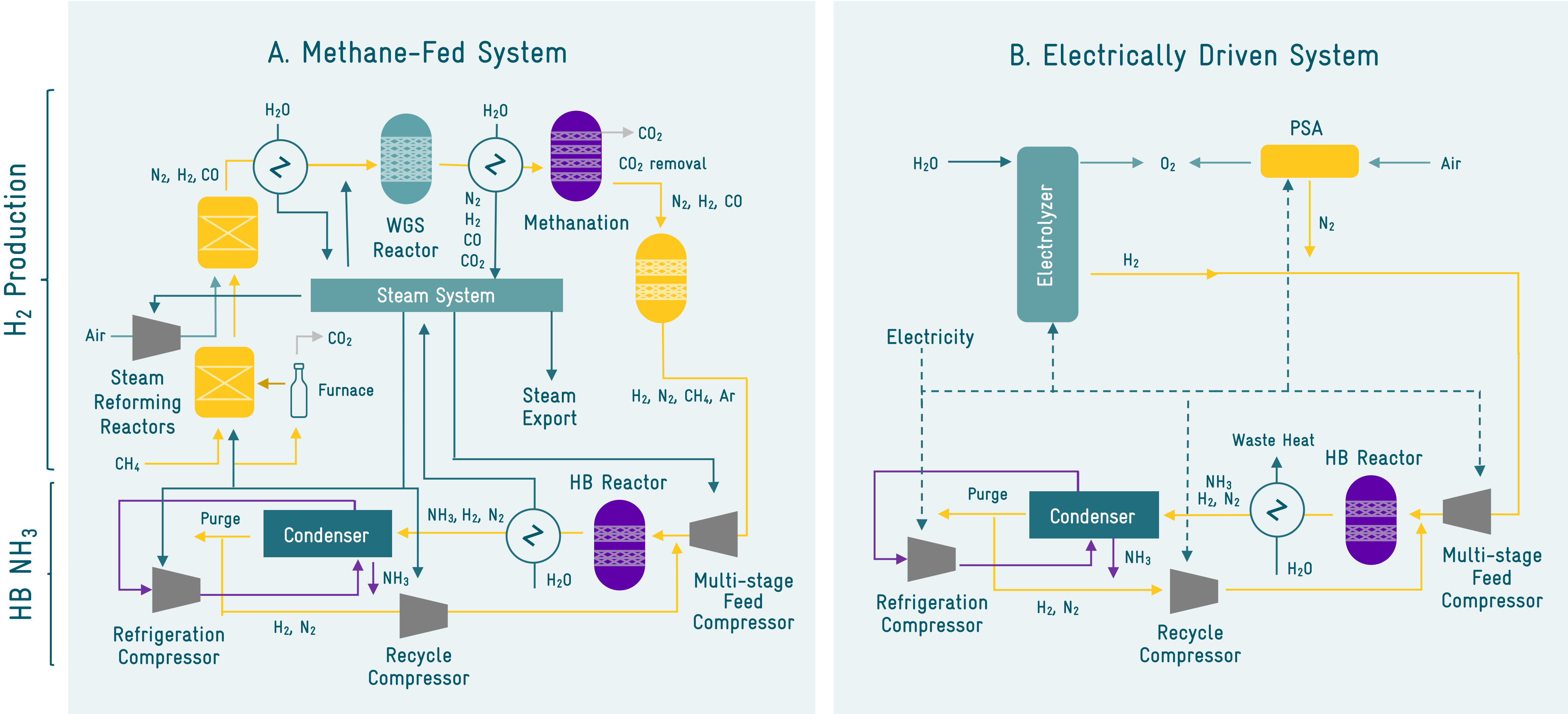
Annexes



Annex 1 Hydrogen downstream products – ammonia and fertiliser

The Haber-Bosch process is a cornerstone of industrial chemistry, enabling large-scale ammonia production primarily for nitrogen-based fertilisers. Figure 7 compares the conventional Haber-Bosch process (A), which relies on fossil fuels, with the green Haber-Bosch process (B), designed to utilise renewable energy sources and reduce carbon emissions. Conventional methods are energy-intensive and contribute significantly to global CO_2 emissions, while green alternatives aim to integrate hydrogen from water electrolysis and renewable electricity, minimising environmental impact.

FIGURE 7. Schematic of conventional (A) and green (B) Haber-Bosch process



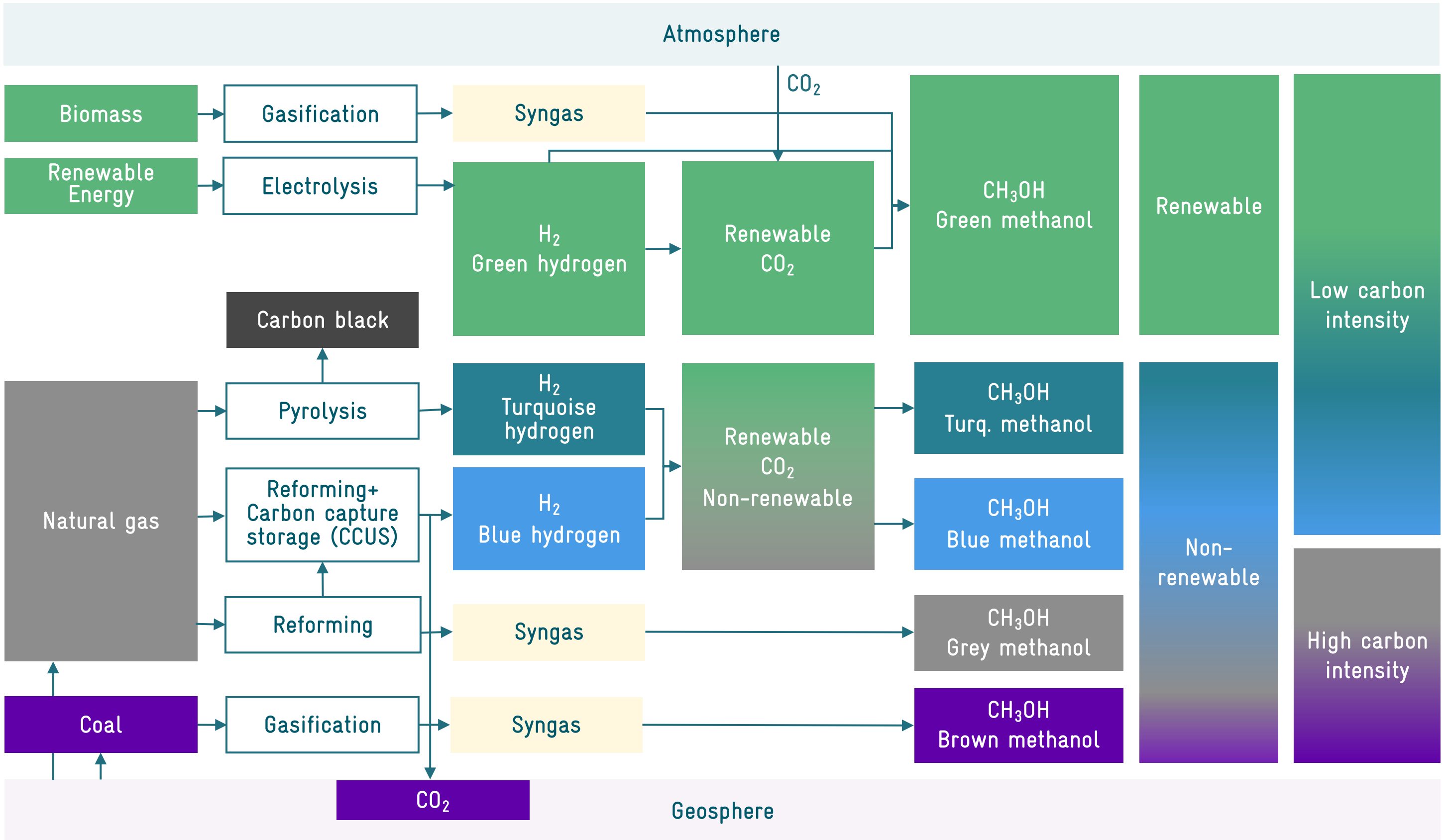
Source: Smith, 2019

Annex 2 Hydrogen downstream products – methanol

Today's methanol production depends mainly on natural gas consumption to produce hydrogen as well as the necessary CO_2 (see Figure 8). The mixture of hydrogen, CO_2, and CO generated in a steam methane reforming (SMR) reactor is passed over a catalyst at high pressure and moderate temperatures, with two key reactions:

$CO + 2H_2 \rightarrow CH_3OH$ and
$CO_2 + 3H_2 \rightarrow CH_3OH + H_2O$

FIGURE 8. Pathways of methanol production



Source: Fichtner, 2025, based on IRENA, 2021

Annex 3 Steel industries in Vietnam

Table 12 gives an overview of the key players in Vietnam's steel industry, including their locations and production capacities.

TABLE 12. Summary of major steel plants, products, and capacities in Vietnam

No.	Plant	Location	Crude steel capacity (tpa)	Note	Source
1	Formosa Ha Tinh Steel Plant	Vung Ang Industrial Park, Ky Long ward, Ky Anh town, Ha Tinh province	7,500,000	BF-BOF	People's Army Newspaper, 2023
2	Hoa Phat Dung Quat Steel Plant	Dung Quat Economic Zone, Binh Dong commune, Binh Son district, Quang Ngai province	5,200,000	BF-BOF	Hoa Phat Iron and Steel JSC, 2021
3	Hoa Phat Hai Duong Steel Plant	Hiep Son commune, Kinh Mon district, Hai Duong province	2,500,000	BF-BOF	Hoa Phat Iron and Steel JSC, 2021
4	Pomina 3 Steel Plant	Phu My Industrial Park, Phu My ward, Phu My city, Ba Ria – Vung Tau province	1,000,000	BF-EAF	Pomina Steel JSC, 2025
5	POSCO Steel Plant	Phu My II Industrial Park, Phu My ward, Phu My city, Ba Ria – Vung Tau province	1,000,000	EAF	GEM Wiki, 2025
6	Vietnam – Japan High-Tech Steel Plant (VJS)	Nam Cau Kien Industrial Park, Hoang Lam ward, Thuy Nguyen city, Hai Phong city	1,000,000	EAF	VJS Group, 2025
7	Tung Ho Steel Plant	Phu My II Industrial Park, Phu My ward, Phu My city, Ba Ria – Vung Tau province	1,000,000	EAF	GEM Wiki, 2025
8	Vina Kyoei Steel Plant	Phu My Industrial Park, Phu My ward, Phu My city, Ba Ria – Vung Tau province	900,000	EAF	Vina Kyoei Steel JSC, 2025
9	Shengli Steel Plant	Cau Nghin Industrial Park, An Bai town, Quynh Phu district, Thai Binh province	600,000	EAF	Shengli Vietnam Special Steel, 2025
10	Vietnam – Italia Steel Plant	Pho Noi A Industrial Park, Giai Pham commune, Yen My district, Hung Yen province	552,000	EAF	Vietnam – Italy Steel JSC, 2025
11	Pomina 2 Steel Plant	Phu My Industrial Park, Phu My ward, Phu My city, Ba Ria – Vung Tau province	500,000	EAF	Pomina Steel JSC, 202
12	VNSTEEL -Southern Steel Plant	Phu My Industrial Park, Phu My ward, Phu My city, Ba Ria – Vung Tau province	500,000	EAF	Pomina Steel JSC, 202
13	Asean Steel Plant	Hoa Phu Industrial Park, Hoa Phu commune, Buon Ma Thuot city, Dak Lak province	500,000	EAF	ASEAN Steel JSC, 2025
14	Thai Nguyen Iron and Steel Plant	Cam Gia ward, Thai Nguyen city, Thai Nguyen province	450,000	EAF	Thai Nguyen Iron and Steel JSC, 2025
15	Hoa Phat Hung Yen Steel Plant	Pho Noi A Industrial Park, Giai Pham commune, Yen My district, Hung Yen province	400,000	EAF	Hoa Phat Iron and Steel JSC, 2021
16	Pomina 1 Steel Plant	Song Than 2 Industrial Park, Di An town, Binh Duong province	300,000	EAF	Pomina Steel JSC, 2025
17	Dinh Vu Iron and Steel Plant	Lot C1, Dinh Vu Economic Zone, Dong Hai 2 ward, Hai An district, Hai Phong city	200,000	EAF	People's Public Security Online, 2007
18	Tuyen Quang Iron and Steel Plant	Long Binh An Industrial Park, Doi Can ward, Tuyen Quang city, Tuyen Quang province	195,000	BF-BOF	Tuyen Quang Provincial e-Portal, 2018
19	VNSTEEL – VICASA Steel Plant	Bien Hoa 1 Industrial Park, An Binh ward, Bien Hoa city, Dong Nai province	150,000	EAF	VNSTEEL – VICASA Steel JSC, 2025
20	VNSTEEL – Thu Duc Steel Plant	Truong Tho ward, Thu Duc city, Ho Chi Minh city	150,000	EAF	VNSTEEL – Thu Duc Steel JSC, 2019)

Source: Authors' own compilation, Vietnam Institute of Energy, 2025

Annex 4 Stakeholder mapping

In the field of state management and regulation, the Ministry of Industry and Trade performs the function of managing, supervising, and coordinating activities in the energy sector.

1. GOVERNMENT MINISTRIES AND REGULATORY AGENCIES

Ministries (MOIT, Ministry of Agriculture and Environment, Ministry of Science and Technology, Ministry of Construction etc.).

- Role: Primary regulator for Vietnam's energy sector, including hydrogen development.

2. STATE-OWNED ENTERPRISES (SOES) AND ENERGY COMPANIES

2.1. Vietnam Electricity (EVN)

Role:

- Power generation: EVN and GENCOs manage and operate hundreds of hydropower, coal-fired thermal power, gas-fired power, and renewable energy plants. Their total capacity amounts to ~30,000 MW.
- Transmission: manage the transmission system from 110kV to 500kV nationwide, through NPT.

2.2. PetroVietnam (PVN)

Role:

- Oil and gas exploration and exploitation (upstream): domestic and international oil and gas exploitation (Russia, Venezuela, Algeria, Malaysia...).
- Oil processing and refining (midstream): operation of Dung Quat Oil Refinery, liquefied petroleum gas (LPG), liquefied natural gas (LNG).

2.3. Vietnam National Coal and Mineral Industries Group (Vinacomin)

Role:

- Coal mining and processing: Vinacomin is the largest coal producer in Vietnam, with 21 underground and open-pit coal mining companies, with a total mining capacity of about 47–50 million tonnes/year.
- Mineral mining and processing: the group is involved in the exploration, exploitation, and processing of minerals such as bauxite, copper, zinc, and other precious metals.

2.4.Petrolimex

Role:

- Petroleum business: import, storage, distribution, retailing of domestic petroleum.
- Import fuel: gasoline, DO, FO, aviation fuel (Jet A1), LPG, expanding LNG.
- Logistics & petroleum warehousing: owns a system of petroleum depots, oil tankers, pipelines, and tank trucks.

2.5. Vietnam Chemical Group (VINACHEM)

Role:

- Fertilisers – agricultural chemicals: production of nitrogen fertilisers, DAP, SA, NPK, H_2SO_4 acid
- Basic chemicals – inorganic: ammonia, nitric acid, caustic soda, chlorine, HCl, Na_2CO_3...
- Organic chemicals – solvents: ethanol, methanol, industrial solvents

Annex 5 Green hydrogen financing opportunities for German companies

German instruments for investment in the international market

- **H_2-Global** (H_2Global Stiftung, 2025): A reverse auction-based mechanism to support green hydrogen market development, offering 10-year purchase agreements. No project size or investment limitations; non-EU hydrogen producers can participate, meeting EU sustainability standards.
- **PtX Development Fund** (KfW, 2025): Set up by the German Government and KfW Group. Provides non-reimbursable grants for large-scale projects in emerging economies, with no specific investment thresholds. Eligible countries include Brazil, Colombia, Egypt, India, Kenya, Morocco, and South Africa (PtX Development Fund, 2025). As of now, Vietnam is not listed among the eligible countries. However, eligibility criteria and target countries may evolve in future funding rounds.
- **International Hydrogen Ramp-up Programme (H_2Upp)** (BMWK, 2025): Supports early-stage public-private partnerships for pilot projects, with a minimum public contribution of EUR 100,000 and total project costs of at least EUR 200,000. Companies must contribute at least 50%. Applications wereopen until March 2025 (PtX Hub, 2025), though the overall programme is expected to continue until 2026 (BMWK, 2024).
- **UFK Untied Loan Guarantees** (UFK-Garantien.de, 2025): Provides loan guarantees to reduce political and economic risks in target countries. Green hydrogen projects may be eligible if they align with Germany's energy strategy.

European instruments for investment in the international market

- **Green Hydrogen Trust Fund (GHF)** (European Investment Bank, 2025): The European Investment Bank (EIB) established this fund to support large-scale green hydrogen infrastructure projects with substantial investments (millions USD), requiring a 30–40% contribution from applicants. Vietnam may be eligible based on specific criteria.
- **Clean Hydrogen Partnership** (European Union, 2025) (CHP) primarily supports the development and commercialisation of clean hydrogen technologies. No fixed limitations on project size or investment, but large, impactful projects are prioritised. Third countries may participate through specific agreements.

Annex 6 Techno-economic calculations

Parameter	Value	Description
Cost of debt	10%	Annual interest rate on debt financing
Cost of equity	12%	Required return on equity capital
Inflation rate	2.22%	Annual general inflation in the country
Equity/debt gearing	25%	Capital structure ratio
WACC	10.50%	Weighted average cost of capital
Grace period	1 year	Period for the construction of the plant on the loan being given
Grid price increase above index/ inflation rate	5%	Increase in the price of the grid above inflation
Hydrogen price increase above index/inflation rate	2%	Increase in the price of hydrogen above inflation
Oxygen price	USD 0.17/kg	Price per kg of oxygen sold
Hydrogen price	USD 6.45/kg	Average price of grey hydrogen per kg in the country (obtained in gas tanks)
Ammonia price	USD 0.56/kg	Average price of grey ammonia per kg in the country
Corporate tax rate	20%	Direct tax levied on the income or capital of corporations

Parameter	Value	Description
Depreciation scheme	Linear	Systematic way to account for the decline in value of an asset over its useful life
Wind – specific investment cost (for around 1 MW)	USD 2,273/kW	
PV – specific investment cost (for around 1 MW)	USD 555/kW	
Wind – specific investment cost (for around 10 MW)	USD 1,759/kW	
PV – specific investment cost (for around 10 MW)	USD 500/kW	
Cost of grid electricity	USD 94/MWh	Cost of electricity purchased from the grid
Ammonia synthesis unit costs (for large scale cases)	USD 1,458/ tNH_3	Ammonia unit cost per tonne of annual ammonia capacity
Ammonia synthesis unit costs (for small scale cases)	USD 2,525/ tNH_3	
Air separation unit cost	USD 168/tN_2	Air separation unit cost per tonne of annual nitrogen capacity

Source: Compiled by GIZ, 2025

Bibliography

APROMACO. (2024). *APROMACO strengthens NPK production capacity*. Retrieved February 2025, from.vn: https://apromaco.vn/apromaco-tang-cuong-nang-luc-san-xuat-npk/

ASEAN Steel JSC. (2025). *Introduction to ASEAN Steel JSC*. Retrieved February 2025, from aseansteel.com.vn: https://aseansteel.com.vn/about/gioi-thieu-chung.html

Asia Briefing Co., Ltd. (2022). *Industrial parks in Vietnam: Where to implement your next/future factory?* Retrieved March 2025 from https://www.sourceofasia.com/industrial-parks-in-vietnam-where-to-implement-your-next-future-factory

B&Company. (2024). *The Potential for Developing Rooftop Solar Power in Vietnam*. Retrieved April 2025, from https://b-company.jp/the-potential-for-developing-rooftop-solar-power-in-vietnam/#:~:text=The%20plan%20outlines%20that%20Vietnam's,to%20increase%20to%20967%2C100%20MW

BMWK. (2024). *International Hydrogen Ramp-Up Programme (H_2Uppp)*. Retrieved January 2025, from https://www.giz.de/en/downloads/giz-2024-en-BMWK-H_2uppp-imageflyer-RampUp.pdf

BMWK. (2025). *International Hydrogen Ramp-up Programme H_2Uppp*. Retrieved January 2025, from https://www.bmwk.de/Redaktion/EN/Hydrogen/Foerderung-International-Beispiele/10-international-hydrogen-ramp-up-programme-h2uppp.html

Bressan, L. et al. (2009). *Hydrogen generation for modern refineries*. Retrieved March 2025, from https://www.digitalrefining.com/article/1000044/hydrogen-generation-for-modern-refineries

CECO. (2023). *100,000 tpa Fused Phosphate Fertilizer Plant of Lao Cai Fused Phosphate Fertilizer Joint Stock Company*. Retrieved April 2025, from ceco.com.vn: https://ceco.com.vn/du-an/nha-may-san-xuat-phan-lan-nung-chay-cong-suat-100-000-t-n-cua-cong-ty-co-phan-phan-lan-nung-chay-lao-cai/#:~:text=ch%E1%BA%A3y%20L%C3%A0o%20Cai-,-Nh%C3%A0%20m%C3%A1y%20s%E1%BA%A3n%20xu%E1%BA%A5t%20ph%C3%A2n%20l%C3%A2n%20nung%20ch%

European Investment Bank. (2025). *Green Hydrogen Fund*. Retrieved January 2025, from https://www.eib.org/en/products/mandates-partnerships/donor-partnerships/trust-funds/green-hydrogen-fund

European Union. (2025). *Clean Hydrogen Partnership*. Retrieved February 2025, from European Partnership for Hydrogen Technologies: https://www.clean-hydrogen.europa.eu/index_en

Exchange-rates.org. (2025). Last retrieved from https://www.exchange-rates.org/

Fichtner. (2025). *Hydrogen Sector Analyses for Argentina*. Retrieved May 2025, from https://www.giz.de/en/downloads/giz2025-en-argentina-PDP-sector-analysis.pdf

Fuel Cells and Hydrogen Observatory. (2021). *Chapter 2 - 2021 Hydrogen supply and demand*. Retrieved January 2025, from https://observatory.clean-hydrogen.europa.eu/sites/default/files/2023-05/Chapter-2-Hydrogen-Supply-and-Demand-2021.pdf

GEM Wiki. (2025). *POSCO Vietnam Phu My steel plant*. Retrieved March 2025, from gem.wiki: https://www.gem.wiki/POSCO_Vietnam_Phu_My_steel_plant#cite_note-autoref_0-2

GEM Wiki. (2025). *Tung Ho Steel Phu My plant*. Retrieved May 2025, from gem.wiki: https://www.gem.wiki/Tung_Ho_Steel_Phu_My_plant

H_2Global Stiftung. (2025). *Shaping the global energy transition*. Retrieved January 2025, from https://www.h2-global.org/

Ha Long - CFG Float Glass Co., Ltd. (2025). *Introduction to CFG power plants*. Retrieved May 2025, from cfg.com.vn: http://www.cfg.com.vn/he-thong-nha-may.html

Hoa Phat Iron and Steel JSC. (2021). *Hoa Phat becomes the largest steel producer in Vietnam*. Retrieved March 2025, from hoaphatdungquat.vn: https://hoaphatdungquat.vn/hoa-phat-tro-thanh-nha-san-xuat-thep-lon-nhat-viet-nam/#:~:text=T%E1%BB%95%20h%E1%BB%A3p%20luy%E1%BB%87n%20c%C3%A1n%20th%C3%A9p,th%C3%A9p%20l%E1%BB%9Bn%20nh%E1%BA%A5t%20th%E1%BA%BF%20gi%E1%BB%9Bi.

Hoang, T. (2024). *Vietnam uses 3 times more fertilizer than the world average*. Retrieved May 2025, from https://www.vietnam.vn/en/viet-nam-su-dung-phan-bon-gap-3-lan-trung-binh-the-gioi

IEA. (2024b). *Global Hydrogen Review 2024*. Retrieved February 2025, from https://iea.blob.core.windows.net/assets/89c1e382-dc59-46ca-aa47-9f7d41531ab5/GlobalHydrogenReview2024.pdf

IRENA. (2021). *Innovation Outlook: Renewable Methanol*. Retrieved March 2025, from https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Jan/IRENA_Innovation_Renewable_Methanol_2021.pdf

KfW. (2025). *Welcome to the PtX Platform of KfW Banking Group*. Retrieved January 2025, from https://www.kfw-entwicklungsbank.de/Our-topics/PtX/PtX-platform/

Khang Duc Investment and Construction JSC. (2020). *Wind energy potential of Viet Nam*. Retrieved May 2025, from https://khangducconst.com/en/news/industry-news/wind-energy-potential-of-viet-nam/

Methanol Institute. (2024). *Methanol Price and Supply/Demand*. Retrieved February 2025, from Methanol Institute: https://www.methanol.org/methanol-price-supply-demand/

Ministry of Industry and Trade. (2024). *VIETNAM'S HYDROGEN ENERGY DEVELOPMENT STRATEGY AND LNG POWER DEVELOPMENT PLAN IN LINE WITH THE NATIONAL ENERGY MASTER PLAN*. Hanoi: Ministry of Industry and Trade. Retrieved February 2025, from https://vepg.vn/wp-content/uploads/2024/05/1_EN_MOIT-Presentation-on-LNG-and-Hydrogen_23-May_KE2.pdf

Ngo, T. L. (2024). *Economic picture in 2024: Oil and Gas industry continues to be a pillar, making great contributions to the economy*. Retrieved March 2025, from https://www.vietnam.vn/en/buc-tranh-kinh-te-nam-2024-nganh-dau-khi-tiep-tuc-la-tru-cot-dong-gop-lon-cho-nen-kinh-te

Nguyen, V. K. (2025). *Vietnam's solar strategy for trade-tense times*. Retrieved May 2025, from https://www.rmit.edu.vn/news/all-news/2025/may/vietnam-solar-strategy-for-trade-tense-times#:~:text=Vietnam%20possesses%20an%20estimated%20solar,renewables%20future%20seems%20blindingly%20bright.

Ninh Binh Provincial People's Committee. (2018). *On the adjustment of the Trang An Float Glass Plant Project at Khanh Phu Industrial Park by Duong Giang Co., Ltd*. Retrieved March 2025, from Ninh Binh Provincial People's Committee: http://qppl.ninhbinh.gov.vn/vbpq_ninhbinh.nsf/e146230f06fe15f947256f9600295f10/DB9DA12607D7980F4725830B00050315/$file/649_20180912020949698690.PDF

People's Army Newspaper. (2023). *The green hue at Vietnam's largest steel plant*. Retrieved February 2025, from media.qdnd.vn: https://media.qdnd.vn/phong-su-anh/sac-xanh-o-nha-may-thep-lon-nhat-viet-nam-57625

People's Public Security Online. (2007). *A "upstream" investment strategy is needed for Hai Phong's steel industry*. Retrieved March 2025, from cand.com.vn: https://cand.com.vn/Kinh-te/Can-chien-luoc-dau-tu-thuong-nguon-cho-nganh-thep-Hai-Phong-i36348/

Phu My Ultra Clear Float Glass Co., Ltd. (2025). *Introduction to PFG*. Retrieved May 2025, from pfg.com.vn: https://pfg.com.vn/gioi-thieu

Pomina Steel JSC. (2025). *Subsidiaries*. Retrieved May 2025, from pomina-steel.com: http://www.pomina-steel.com/cong-ty-truc-thuoc.html

PtX Development Fund. (2025). *Guidelines and Criteria*. Retrieved January 2025, from https://www.ptx-fund.com/guidelines-criteria

PtX Hub. (2025). *H_2Uppp extends Call for Proposals for PtX Projects*. Retrieved January 2025, From H_2Uppp extends Call for Proposals for PtX Projects: https://ptx-hub.org/h2uppp-extends-call-for-proposals-for-ptx-projects/

Rodl & Partner. (2023). *Overview of the status of Vietnam's wind power project*. Retrieved March 2025, from https://www.roedl.com/insights/newsflash-asean/2022-04/vietnam-overview-status-wind-power-project#:~:text=This%20rapid%20expansion%20is%20technically%20feasible:%20Vietnam,at%20lower%20wind%20speeds%20of%205%2D6%20m/s.&text=In%20response%2C%20Vietnam's%20

Rystad Energy SERA Tracker. (2019). Retrieved May 2025, from solarmagazine.com: https://solarmagazine.com/solar-profiles/vietnam/

Semiconductor Digest. (2018). *EUV lithography adds to increasing hydrogen demand at leading-edge fabs*. Retrieved January 2025, from https://assets.linde.com/-/media/global/global-gases/global-industrial-gases/documents/industries/electronics/sst---march-2018---euv-lithography-adds-to-increasing-hydrogen-demand-at-leading-edge-fabs_tcm17-477308.pdf

Shengli Vietnam Special Steel. (2025). *Introduction to Shengli Vietnam Special Steel JSC*. Retrieved March 2025, from shenglivn.com: https://shenglivn.com/about

Smith, C. (2019). *Current and future role of Haber–Bosch ammonia in a carbon-free energy landscape*. Retrieved March 2025, from Royal Society of Chemistry: https://pubs.rsc.org/en/content/articlehtml/2020/ee/c9ee02873k

Thai Binh News. (2022). *Thai Binh Mining Chemicals Company - Micco: Safe and Efficient Production*. Retrieved June 2026, from baothaibinh.com.vn: https://baothaibinh.com.vn/tin-tuc/50/162302/cong-ty-hoa-chat-mo-thai-binh-micco-san-xuat-an-toan-hieu-qua

Thai Nguyen Iron and Steel JSC. (2025). *Production Units*. Retrieved May 2025, from tisco.com.vn: https://tisco.com.vn/en/gioi-thieu/don-vi-san-xuat.html

Thuc, V. V. (2024). *Vietnam Fertilizer Market Report 2024*. Retrieved March 2025, from kirincapital.vn: https://kirincapital.vn/wp-content/uploads/2024/11/BAO-CAO-NGANH-PHAN-BON-2024.pdf

Tuyen Quang Provincial e-Portal. (2018). *Tuyen Quang Iron and Steel Company Limited: Gradually improving environmental protection efforts, moving towards sustainable development based on technology*. Retrieved April 2025, from tuyenquang.gov.vn: https://www.tuyenquang.gov.vn/vi/post/17972?id=17972&type=tintuc

UFK-Garantien.de. (2025). *Untied Load Guarantees at a glance*. Retrieved January 2025, from https://www.ufk-garantien.de/en/products/guarantees/for-untied-loan-guarantees/ntied-loan-guarantees.html

Van Dien FMP JSC. (2019). *Introduction to Van Dien FMP*. Last retrieved from vandienfmp.vn: https://vandienfmp.vn/introduction-van-dien-fmp/

Vietnam - Italy Steel JSC. (2025). *Introduction to Vietnam - Italy Steel JSC*. Retrieved February 2025, from vis.com.vn: https://vis.com.vn/general-introduction

Vietnam Chemicals Agency. (2025). *Vietnam Fertilizer Industry: Focusing on in-depth development*. Retrieved March 2025, from cuchoachat.gov.vn: http://cuchoachat.gov.vn/tin-tuc-su-kien/nganh-phan-bon-viet-nam-tap-trung-phat-trien-theo-chieu-sau.html

Vietnam Department of Survey, Mapping, and Geographic Information. (2025). *Administrative map of Vietnam at scale 1/9,000,000 (published in 2025)*. Retrieved April 2025, from https://www.bandovn.vn/vi/page/mau-ban-do-hanh-chinh-nuoc-cong-hoa-xa-hoi-chu-nghia-viet-nam-181

Vietnam Energy Online. (2021). *Assessment of wind power development situation in Vietnam*. Retrieved February 2025, from nangluongvietnam.vn: https://nangluongvietnam.vn/danh-gia-tinh-hinh-phat-trien-dien-gio-o-viet-nam-27091.html

Vietnam Float Glass Co., Ltd. (2025). *Introduction to VFG*. Retrieved April 2025, from vfg.vn: http://vfg.vn/about-vfg

Vietnam Institute of Energy. (2023). *Report on the National Energy Master Plan for the 2021-2030 period, with a vision to 2050*. (Accessed 2025)

Vietnam Ministry of Industry and Trade. (2021). *Report on the development strategy of Vietnam's chemical industry to 2030, with a vision to 2040*. Retrieved March 2025, from vibonline.com.vn/: https://vibonline.com.vn/wp-content/uploads/2021/10/Bao-cao-chien-luoc-lay-y-kien.pdf

Vietnam Ministry of Information and Communications. (2025). Retrieved April 2025, from znews.vn: https://znews.vn/doanh-thu-cong-nghiep-ban-dan-tai-viet-nam-dat-gan-19-ty-usd-post1529810.html

Vietnam National Chemical Group. (2014). *Ninh Binh Phosphate Fertilizer: Supporting New Rural Development*. Retrieved March 2025, from vinachem.com.vn: https://www.vinachem.com.vn/nd/tin-tap-doan/phan_lan_ninh_binh_dong_hanh_cung_nong_thon_moi.html

Vietnam National Chemical Group. (2021). *Dinh Vu DAP: Meeting Domestic Fertilizer Market Demand*. Retrieved March 2025, from vinachem.com.vn: https://www.vinachem.com.vn/nd/tin-thi-truong-sp-vnc/dap-dinh-vu-dap-ung-du-nhu-cau-phan-bon-cho-thi-truong-trong-nuoc.html

Vietnam National Chemical Group. (2022). *Lam Thao Superphosphate: 60 Years of Sustainable Development*. Retrieved April 2025, from vinachem.com.vn: https://www.vinachem.com.vn/nd/tin-tap-doan/supe-lam-thao-60-nam-phat-trien-ben-vung.html

Vietnam National Chemical Group. (2022). *Long Thanh Superphosphate Plant: Proud 30-Year Journey*. Retrieved March 2025, from vinachem.com.vn: https://www.vinachem.com.vn/nd/tin-tap-doan/nha-may-super-phot-phat-long-thanh-tu-hao-hanh-trinh-30-nam.html

Vietnam National Statistics Office. (2025). Retrieved April 2025, from nso.gov.vn: https://www.nso.gov.vn/du-lieu-va-so-lieu-thong-ke/2025/01/thong-cao-bao-chi-tinh-hinh-kinh-te-xa-hoi-quy-iv-va-nam-2024/

Vietnam Prime Minister. (2023). Decision No. 482/QD-TTg of the Prime Minister on approving the adjustment of the investment policy of the Dung Quat Oil Refinery Upgrading and Expansion Project of Binh Son Refining and Petrochemical Joint Stock Company.

Vietnam Prime Minister. (2025). Decision No. 768/QD-TTg approving the Adjustment of the National Power Development Plan for the 2021-2030 period, with a vision to 2050. Retrieved May 2025, from https://vanban.chinhphu.vn: https://vanban.chinhphu.vn/?pageid=27160&docid=213388

Vietnam Steel Association. (2023). *VSA Technical Report*. (Accessed 2025)

Vietnam Steel Association. (2025). *Vietnam steel market situation in December 2024 and 2024*. Last retrieved from https://vsa.com.vn/tinh-hinh-thi-truong-thep-viet-nam-thang-12-2024-va-ca-nam-2024/

Viglacera Float Glass Co., Ltd. (2025). *Instroduction to VFIG*. Retrieved May 2025, from vifg.com.vn: https://vifg.com.vn/

Vina Kyoei Steel JSC. (2025). *Introduction to Vina Kyoei Steel*. Retrieved March 2025, from vinakyoeisteel.com.vn: https://www.vinakyoeisteel.com.vn/gioi-thieu

VJS Group. (2025). *Introduction to VJS Group*. Retrieved March 2025, from vjsgroup.com: https://vjsgroup.com/general-introduction

VNSTEEL - Thu Duc Steel JSC. (2019). *History of VNSTEEL - Thu Duc Steel JSC*. Retrieved April 2025, from thepthuduc.com.vn: https://thepthuduc.com.vn/gioi-thieu/2/lich-su-hinh-thanh-phat-trien.html

VNSTEEL - VICASA Steel JSC. (2025). *VNSTEEL - VICASA history*. Retrieved May 2025, from vicasasteel.com: https://vicasasteel.com/gioi-thieu/lich-su-cong-ty

VNSTEEL Southern Steel Co., Ltd. (2025). *Introduction to VNSTEEL Southern Steel Co., Ltd*. Retrieved March 2025, from thepmiennam.com.vn: https://www.thepmiennam.com.vn/en-US/introduction

Wasserstoff Kompass. (2022). *Wasserstoff im Stahlsektor - Factsheet*. Retrieved Jannuary 2025, from https://www.wasserstoff-kompass.de/fileadmin/user_upload/img/news-und-media/dokumente/Fact_sheet_Stahl.pdf

World Bank. (2020). *Vietnam Offshore Wind Technical Potential. Washington DC: THE WORLD BANK*. Retrieved May 2025, from http://documents1.worldbank.org/curated/en/340451572465613444/pdf/Technical-Potential-for-Offshore-Wind-in-Vietnam-Map.pdf

World Steel Association. (2023). *Country Profile – Vietnam*. (Accessed 2025)

As a federally owned enterprise, GIZ supports the German Government in achieving its objectives in the field of international cooperation for sustainable development.

Published by
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Project Development Programme (PDP)
Köthener Str. 2–3
10963 Berlin, Germany
T +49 30 – 40 81 90 – 219/285
F +49 30 – 40 81 90 – 109

E pep@giz.de
I www.giz.de/en

Programme/project description
Project Development Programme (PDP)

Authors
Institute of Energy
Hanoi City, Vietnam

Responsible/Editor
Anja Wucke, Adil Aslam and Tung Vo Thanh

Design/Layout
DITHO Design GmbH, Cologne

On behalf of
German Energy Solutions Initiative of the
German Federal Ministry for Economic Affairs and
Energy (BMWE), Berlin
Department VB4 German Energy Solutions Initiative, Market Entry
Programme Berlin

Berlin, 2025

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Sitz der Gesellschaft / Registered offices
Bonn und Eschborn / Bonn and Eschborn

Friedrich-Ebert-Allee 36 + 40
53113 Bonn, Deutschland / Germany
T +49 228 44 60-0
F +49 228 44 60-17 66

Dag-Hammarskjöld-Weg 1 - 5
65760 Eschborn, Deutschland / Germany
T +49 61 96 79-0
F +49 61 96 79-11 15

E info@giz.de
I www.giz.de/en