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## **NAVIGATING ENERGY TRANSITION: VIETNAM'S PATH TO SUSTAINABILITY AND IMPLICATIONS FOR UKRAINE**

Vietnam has achieved significant milestones in its energy transition, characterized by ambitious renewable energy targets and robust policies aimed at reducing carbon emissions. This paper delves into Vietnam's strategic approach, progress, and the challenges faced in its journey towards a sustainable energy future. By analyzing the diversification of energy sources, modernization of infrastructure, and development of a carbon market, the paper underscores Vietnam's efforts to balance energy security, sustainability, and economic resilience. The study highlights the critical role of comprehensive policy frameworks, technological advancements, and substantial investments in renewable energy. Vietnam's experience serves as a valuable model for Ukraine, offering insights into effective energy transition strategies amidst unique geopolitical and economic challenges. The findings suggest that Vietnam's approach, which integrates policy shifts, infrastructure upgrades, and economic adaptations, can provide a blueprint for Ukraine to achieve its own sustainable energy goals. This paper aims to contribute to the broader discourse on global energy transitions, emphasizing the importance of aligning national strategies with international climate commitments to foster a resilient and low-carbon energy future.

**Keywords:** *Energy Transition, Renewable Energy, Vietnam, Ukraine, Energy Policy, Carbon Market, Infrastructure Modernization*

**JEL classification:** *O14, O33, O44*

В'єтнам досяг значних успіхів у своєму енергетичному переході, який характеризується амбітними цілями щодо використання відновлюваної енергії та жорсткою політикою, спрямованою на скорочення викидів вуглецю. У цьому дослідженні розглядається стратегічний підхід В'єтнаму, прогрес і виклики, з якими він зіткнувся на шляху до сталого енергетичного майбутнього. Аналізуючи диверсифікацію джерел енергії, модернізацію інфраструктури та розвиток вуглецевого ринку, стаття підкреслює зусилля В'єтнаму збалансувати енергетичну безпеку та економічну стійкість. Дослідження підкреслює вирішальну роль комплексної політики, технологічного прогресу та значних інвестицій у відновлювані джерела енергії. Досвід В'єтнаму є цінною моделлю для України, пропонуючи розуміння ефективних стратегій енергетичного переходу в умовах унікальних геополітичних та економічних викликів. Отримані результати свідчать про те, що підхід В'єтнаму, який поєднує зміни в політиці, модернізацію інфраструктури та економічну адаптацію, може стати основою для досягнення Україною її власних цілей сталої енергетики. Ця стаття має на меті зробити внесок у ширший дискурс щодо глобальних енергетичних переходів, наголошуючи на важливості узгодження національних стратегій із міжнародними кліматичними зобов'язаннями для сприяння стійкому та низьковуглецевому енергетичному майбутньому.

**Ключові слова:** *енергетичний перехід, відновлювана енергетика, В'єтнам, Україна, енергетична політика, вуглецевий ринок, модернізація інфраструктури*

**JEL classification:** *O14, O33, O44*

## **1. Introduction**

The concept of Energy Transition refers to the global shift from fossil fuel-based energy systems to sustainable, low-carbon energy alternatives, a transformation critical for addressing climate change and achieving international climate targets such as those outlined in the Paris Agreement. The International Renewable Energy Agency (IRENA) defines energy transition as the systematic move toward a sustainable energy future driven by large-scale renewable energy adoption, enhanced energy efficiency, and innovations in electrification and green hydrogen. These strategies aim to achieve net-zero carbon emissions by mid-century, marking a significant transformation across sectors [7,8].

This transition is not only an environmental necessity but a multidimensional process involving policy shifts, infrastructure upgrades, and economic adaptations. The International Energy Agency (IEA) underscores the importance of a gradual phase-out of fossil fuels coupled with widespread renewable energy deployment to limit global warming within 1.5°C of pre-industrial levels [5]. Similarly, the World Economic Forum (WEF) emphasizes that an effective energy transition requires a balanced approach addressing energy security, affordability, and sustainability to ensure a resilient and equitable transition [23].

In Southeast Asia, Vietnam exemplifies a proactive approach to energy transition, with ambitious goals for renewable energy development outlined in its newest National Power Development Plan for the 2021-2030 Period, with a Vision to 2050 (so called Power Development Plan 8 (PDP8)) and its commitment to net-zero emissions by 2050. By analyzing Vietnam's strategies and identifying its achievements and challenges, this paper aims to extract valuable lessons for Ukraine as it navigates its own energy transition amidst unique geopolitical and economic challenges. Understanding these

insights will enable Ukraine to adopt sustainable energy policies that balance energy security, affordability, and environmental impact effectively.

## **2. Research Methodology**

This paper employs a qualitative research approach, utilizing secondary data analysis to examine Vietnam's energy transition strategies and draw parallels for Ukraine. Data were collected from governmental reports, policy documents, publications from international organizations such as IRENA, IEA, the World Economic Forum and dataset from Our World in Data. Key Vietnamese policies, including Vietnam's National Master Plan for Energy, the Power Development Plan 8, were analyzed to understand the country's energy goals, infrastructure plans, and carbon reduction strategies. This approach highlights Vietnam's progress, challenges, and policy frameworks, illustrating a multi-aspect picture of its transition toward a sustainable energy future.

## **3. Results of Research on Energy Transition in Vietnam**

### **3.1. Goals and Strategic Approach of Vietnam in Energy Transition**

#### **- Overarching goals:**

Vietnam has set ambitious goals within its national energy master plan, national power development plan, and other national climate and energy strategies. These key action plans and broader climate commitments establish a roadmap to achieve sustainable energy and climate targets by 2050. At the highest level, Vietnam is committed to two overarching goals in its energy transition.

The first is to *achieve net-zero emissions by 2050*, a commitment made at COP26 and later formalized in Vietnam's 2022 National Climate Change Strategy. This goal aligns with global efforts to limit temperature rise to 1.5°C [4], positioning Vietnam as a leader in climate responsibility while supporting long-term economic resilience. Meeting this objective requires reducing reliance on coal and other fossil fuels, thereby creating a foundational shift toward a clean energy economy that addresses both climate challenges and economic growth imperatives [20].

Equally important, Vietnam places strong emphasis on *energy security*. Ensuring energy security is the foundation for Vietnam to maintain sustainable and stable development, meeting socio-economic demands. This is a fundamental aspect of any nation's energy policy, particularly during the transition to renewable energy, as it helps Vietnam reduce reliance on imported energy and achieve long-term energy independence. The focus on national energy security is directed towards diversifying energy sources and establishing a resilient and sustainable energy system capable of supporting the country's economic development and defense needs [21]. Additionally, Vietnam values international cooperation as a means to bring advanced technologies, enhance knowledge sharing, and strengthen resilience in the face of global energy challenges [3].

#### **- Intermediate targets**

To accomplish its overarching goals, Vietnam has identified several intermediate targets that are essential for a successful energy transition. One key priority is *diversifying energy sources with an emphasis on expanding renewable energy*, particularly solar and wind, while also supporting the sustainable development of natural gas and biomass [21]. Vietnam's favorable natural

conditions, especially in the central and southern regions, position the country well to harness these resources. The projected energy mix for 2050 reflects a substantial shift away from coal, highlighting renewable energy as a central pillar of Vietnam's long-term strategy [14].

In parallel, Vietnam recognizes the importance of *developing smart and flexible energy infrastructure* to optimize energy storage and management, accommodate a higher share of renewable energy sources [21]. Efforts to modernize the national grid, including investments in Battery Energy Storage Systems (BESS) and various grid improvements, are crucial to managing the variability of renewable sources and ensuring stable integration into the energy system [21]. These enhancements lay the groundwork for reliable and efficient energy supply.

*Building a self-reliant clean energy industry ecosystem* is another critical step in the journey toward energy transition. By fostering local production of renewable energy technologies such as solar panels and wind turbines, Vietnam aims to reduce reliance on imported technology, encourage investment in clean energy, and position itself as a regional leader in sustainable industrial growth [21]. This self-reliance strengthens Vietnam's capacity to sustain its energy transition over the long term.

Moreover, Vietnam is working to *establish a carbon market* as part of its emissions reduction strategy. This plan includes developing a domestic carbon credit trading system, designed to incentivize businesses to reduce greenhouse gas emissions by monetizing their carbon reductions. The carbon market not only creates financial incentives for clean energy activities, but also aligns Vietnam with global sustainability standards. The long-term vision is to integrate Vietnam's carbon market with international trading platforms, thereby facilitating Vietnam's journey toward achieving net-zero emissions by 2050 [2].

Finally, *promoting energy conservation and efficiency* remains a focus in Vietnam's strategy, as the government strives to minimize energy losses and optimize usage across all socio-economic sectors [19]. Initiatives to encourage the adoption of energy-efficient technologies, particularly in high-demand urban areas, are intended to lower overall energy consumption and enhance output efficiency in industrial, residential, and commercial sectors. These conservation measures support a balanced energy demand, contributing to substantial reductions in greenhouse gas emissions.

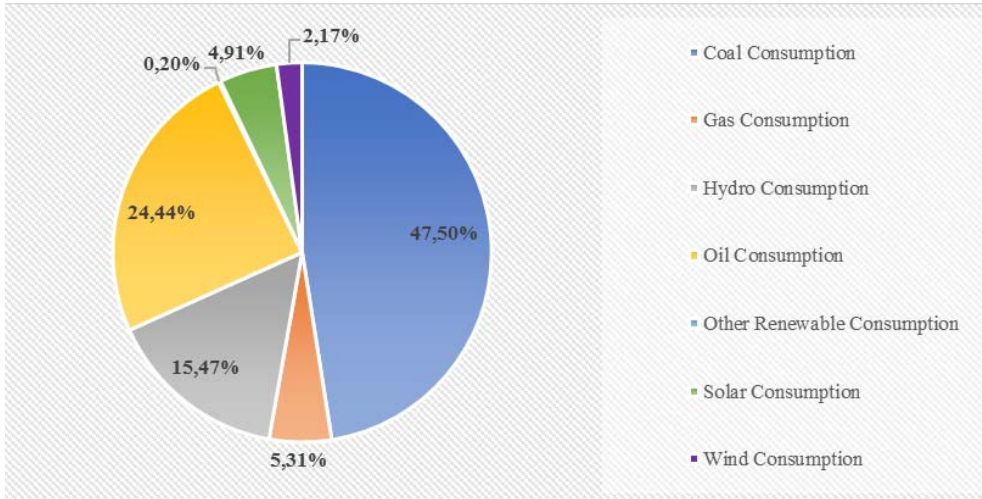
Vietnam's energy transition strategy reflects a comprehensive approach, balancing economic growth with environmental sustainability. By focusing on both overarching and intermediate targets, Vietnam is laying the foundation for a self-reliant, resilient, low-carbon energy future that aligns with its global climate commitments and sustainable development objectives.

## **3.2. Current Status of Vietnam's Energy Transition**

### **3.2.1. Vietnam's Energy Mix: Early Shifts Towards Renewables Amidst Fossil Fuel Dependence**

Over the past 20 years, Vietnam's energy consumption has surged from 285 TWh in 2003 to 1,359 TWh in 2023 [11]. The energy consumption growth rate in 2023 reached 9.24% compared to the previous year. To meet this expanding energy demand, Vietnam has developed a diversified energy portfolio encompassing fossil fuels (coal, oil, and natural gas), hydropower, and renewable sources like wind, solar, and biomass.

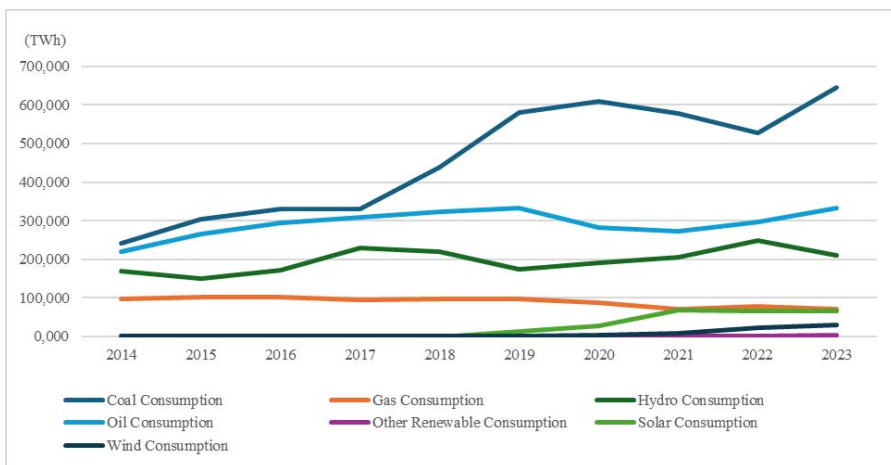
Analyzing Vietnam’s current energy mix reveals that coal remains the dominant energy source, comprising 47.5% of total consumption in 2023 (Figure 1). Oil follows at 24.44%, with natural gas at 5.31%. Together, these three fossil fuels underscore Vietnam’s substantial reliance on non-renewable resources.



**Fig. 1. Vietnam’s Energy Consumption Breakdown in 2023**

Source: Compiled by the authors using data sourced from [11]

Over the past decade, fossil fuel consumption has shown a steady upward trend, particularly coal (Figure 2). In 2023, coal consumption reached approximately 645.36 TWh, marking a 22.19% increase over the previous year. This growth outpaced the overall energy sector’s 9.24% increase, reflecting Vietnam’s continued reliance on coal. Electricity generation from coal has also risen, achieving 125.74 TWh in 2023 [11].



**Fig. 2: Trends in Vietnam’s Energy Consumption by Source (2014-2023)**

Source: Compiled by the authors using data sourced from [11].

Coal production remains crucial in Vietnam's mining industry, providing an ever-growing supply to meet rising domestic demand [10] and emphasizing coal's enduring role in Vietnam's energy landscape.

This reliance on coal, however, aligns with Vietnam's plan to phase out coal entirely by 2050 through decommissioning or fuel transitions. In the interim, coal is projected to retain a high share in the power sector, peaking around 2030, before gradually being replaced and completely phased out by 2050 [21]. After 2030, Vietnam will cease the development of new coal-fired power plants. Existing plants over 20 years old will transition to biomass or ammonia, while those exceeding 40 years that cannot convert to alternative fuels will be decommissioned [24].

Within the national energy structure, hydropower remains the largest renewable source, contributing 15.47%, while wind and solar account for 4.91% and 2.17%, respectively (Figure 1). Although these shares are smaller, wind and solar have seen notable growth since 2019, reflecting Vietnam's commitment to expanding renewable energy to gradually reduce fossil fuel dependence.

Vietnam's installed renewable capacity has grown remarkably, from 10,241 MW in 2011 to 46,012 MW in 2023, spurred by favorable policies and investment incentives beginning in 2019. By 2023, Vietnam has the highest renewable capacity in Southeast Asia and ranks fourth in Asia, trailing only China, India, and Japan [9].

The rapid growth in renewable energy since 2019, driven primarily by solar and wind, demonstrates a shift in Vietnam's energy strategy (Table 1). While hydropower has long been a backbone of the nation's electricity generation, supporting economic growth with affordable power, its development potential has largely been exhausted. As a result, hydropower's share in Vietnam's energy mix, and particularly in the renewable sector, is declining. From 2014 to 2018, hydropower represented over 90% of the renewable mix; however, with the expansion of other renewables, its share dropped to 49.2% by 2023, and the total installed capacity of hydropower is projected to fall below 10% by 2050. Solar power has risen significantly, reaching 17,077 MW by 2023, comprising 37.11% of total renewable capacity. Wind power has also expanded considerably, achieving 5,888 MW in 2023, which is 12.8% of the renewable capacity. Biomass energy has seen relatively modest growth, maintaining a minor share of less than 2% throughout this period.

Table 1

Vietnam's Renewable Energy Capacity by Source

Year	Hydropower		Wind energy		Solar energy		Bioenergy		Total renewable energy (MW)
	MW	%	MW	%	MW	%	MW	%	
2014	5,745	98.41	53	0.33	5	0.03	195	1.22	15,999
2015	6,628	97.87	136	0.80	5	0.03	220	1.29	16,990
2016	7,849	97.69	160	0.88	5	0.03	256	1.40	18,271
2017	7,809	97.34	205	1.12	8	0.04	274	1.50	18,296
2018	7,989	96.13	237	1.27	105	0.56	382	2.04	18,713
2019	0,326	77.93	375	1.44	4,994	19.15	389	1.49	26,084
2020	20,817	54.23	518	1.35	16,661	43.40	390	1.02	38,386
2021	21,847	50.81	4,118	9.58	16,661	38.75	373	0.87	43,000
2022	22,535	50.42	5,065	11.33	16,698	37.36	393	0.88	44,691
2023	22,639	49.20	5,888	12.80	17,077	37.11	408	0.89	46,012

Source: Compiled by the authors using data sourced from [9]

These shifts illustrate Vietnam's transition from reliance on hydropower to a more diversified renewable energy mix, aligning with its goals for carbon reduction and energy security. The rapid expansion of solar and wind power underscores Vietnam's commitment to sustainably meeting rising energy demands. Although overall growth has recently slowed, the country remains on track to achieve its target of 67.5% - 71.5% renewable energy in the power mix by 2050 [21]. To reach its 2030 carbon emissions peak target, an additional 56 GW of renewable capacity—split between 39 GW of solar and 17 GW of wind—is necessary [15]. This transition is critical for reducing Vietnam's reliance on energy imports and securing a sustainable energy supply in line with its net-zero emissions objectives.

### **3.2.2. Vietnam's infrastructure overhaul toward a resilient, low-carbon energy system**

Vietnam's energy infrastructure faces critical challenges in supporting its ambitious energy transition. The current grid, primarily designed for stable power sources like coal and hydropower, struggles to integrate variable renewables such as solar and wind. As renewable capacity expands, grid congestion and curtailment issues have become frequent [10]. In response, a new 500 kV transmission line has boosted transmission capacity from the South to the North by approximately 2,500 MW. Efforts are also underway to modernize and synchronize the grid, with a focus on integrating renewable energy sources to stabilize supply and meet the country's expanding needs [15].

Moreover, the country's energy storage infrastructure remains significantly underdeveloped. With minimal battery energy storage systems (BESS), Vietnam lacks the ability to balance renewable energy supply and demand effectively, leaving the grid vulnerable to fluctuations. The IEA underscores that large-scale energy storage investments are essential for ensuring grid stability as renewable contributions grow [6].

In addition to storage challenges, Vietnam's shift from coal to liquefied natural gas (LNG) as a transitional fuel brings new infrastructure demands. While PetroVietnam recently established the country's first LNG import terminal [13], meeting projected demand will require further investments in LNG terminals, storage, and pipelines, especially in high-consumption regions like the south [17].

Lastly, offshore wind presents a promising renewable resource but requires extensive infrastructure, including subsea cables and strengthened grid connections for long-distance, high-voltage transmission. PDP8 highlights the need for international collaboration and expertise to build and connect these offshore facilities efficiently.

### **3.2.3. The Early Development of the Carbon Market in Vietnam**

Vietnam is actively developing a carbon market to support its energy transition goals and achieve net-zero emissions by 2050. Under Decree 06/2022/ND-CP, the government has outlined a roadmap for establishing a domestic carbon market, including piloting a mechanism for greenhouse gas emission quota trading and carbon credits from 2025, with the official launch of a carbon credit exchange planned for 2028 [17]. The objective is to create a market mechanism that incentivizes businesses to reduce emissions and invest in clean energy.

Currently, Vietnam participates in international carbon credit mechanisms such as the Clean Development Mechanism (CDM) and the Joint Crediting

Mechanism (JCM), with numerous projects implemented in renewable energy and energy efficiency sectors [1]. Through these projects, Vietnam has generated a significant amount of carbon credits, contributing to global emissions reductions while generating financial revenue from selling these credits.

Despite its potential, the domestic carbon market is still in its formative stage and requires further development of regulatory frameworks and management mechanisms to ensure transparency and effectiveness. Vietnam also faces challenges in terms of technical capacity and resources to manage and operate a carbon market efficiently. Building the infrastructure and capacity for the carbon market will help Vietnam attract international investment, drive the energy transition, and reduce greenhouse gas emissions.

#### **4. Discussion on Insights for Ukraine's Energy Transition**

Vietnam's experience with energy transition provides several valuable insights for Ukraine as it embarks on its own path toward a sustainable energy future. Vietnam's approach has been characterized by clear and comprehensive policies, aligning national goals with international climate commitments. Notably, initiatives like the Power Development Plan 8 set out specific targets for renewable energy expansion and emissions reduction, creating a roadmap that supports both energy independence and environmental sustainability. For Ukraine, a similar policy framework could help build investor confidence, foster predictable growth in the renewable sector, and reduce reliance on imported fuels.

Vietnam has also shown the importance of prioritizing infrastructure that supports renewable energy integration. Investments in grid modernization and energy storage systems, for instance, enable a stable, flexible energy network capable of accommodating the variability inherent in solar and wind power. By investing in grid adaptability and exploring alternative fuels, such as biomass for older coal plants, Ukraine could bolster its capacity to integrate renewables efficiently while maintaining energy stability during the transition phase.

Financially, Vietnam's development of a carbon market provides an effective model for incentivizing emissions reduction and attracting private investment. By monetizing carbon reductions, Vietnam has not only fostered business engagement but also aligned corporate interests with its climate goals. Introducing a similar carbon market in Ukraine could drive renewable energy investment, create new revenue streams, and enable integration with broader European Union energy standards, ultimately fostering economic resilience within the clean energy sector.

Finally, Vietnam's focus on energy security—minimizing dependency on energy imports while diversifying its sources—offers a strategic advantage relevant to Ukraine's geopolitical context. By fostering energy efficiency and promoting conservation measures, Vietnam has reduced overall demand, further reinforcing its resilience. Ukraine, by prioritizing these areas, could increase its energy autonomy, stability, and resilience in the face of supply vulnerabilities. In sum, Vietnam's comprehensive energy transition efforts provide a practical framework that Ukraine can adapt to its unique circumstances, setting the stage for a sustainable and resilient energy future.



## 5. Conclusion

Vietnam's journey towards a low-carbon energy future underscores the importance of comprehensive policy planning, strategic investments in infrastructure, and innovative financing models. By focusing on renewable energy expansion, grid modernization, and the establishment of a carbon market, Vietnam has laid a solid foundation for achieving its net-zero targets by 2050. For Ukraine, Vietnam's experience offers valuable insights on aligning energy security with sustainability, balancing short-term economic needs with long-term climate goals. Adapting these strategies could support Ukraine in building a resilient energy system, enhancing its independence, and fostering economic growth through clean energy innovation. Together, these efforts illustrate a shared global commitment to sustainable development and energy transformation.

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Vietnam has achieved significant milestones in its energy transition, characterized by ambitious renewable energy targets and robust policies aimed at reducing carbon emissions. This paper delves into Vietnam's strategic approach, progress, and the challenges faced in its journey towards a sustainable energy future. By analyzing the diversification of energy sources, modernization of infrastructure, and development of a carbon market, the paper underscores Vietnam's efforts to balance energy security, sustainability, and economic resilience. The study highlights the critical role of comprehensive policy frameworks, technological advancements, and substantial investments in renewable energy. Vietnam's experience serves as a valuable model for Ukraine, offering insights into effective energy transition strategies amidst unique geopolitical and economic challenges. The findings suggest that Vietnam's approach, which integrates policy shifts, infrastructure upgrades, and economic adaptations, can provide a blueprint for Ukraine to achieve its own sustainable energy goals. This paper aims to contribute to the broader discourse on global energy transitions, emphasizing the importance of aligning national strategies with international climate commitments to foster a resilient and low-carbon energy future.

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