PETROVIETNAM SCIENCE, TECHNOLOGY & INNOVATION PETROVIETNAM

ASSESSMENT OF THE GREENHOUSE GAS AND SULFUR DIOXIDE EMISSION REDUCTIONS RESULTING FROM THE TRANSITION OF GASOLINE AND DIESEL IN VIETNAM

Van Dinh Son Tho[1], Nguyen Ngoc Tu[2, 3]
[1]School of Chemistry and Life Science - Hanoi University of Science and Technology (HUST)
[2]ThuongMai University
[3]Vietnam National Petroleum Group (Petrolimex)
Email: tho.vandinhson@hust.edu.vn
https://doi.org/10.47800/PVSI.2025.06-09

Summary

Vietnam has committed to a national voluntary emission reduction target of 15.8% by 2030 relative to the 2014 baseline, with the goal of achieving net-zero emissions by 2050. Currently, 48 million motorbikes and 2.4 million cars are registered nationwide. Domestic market supplies gasoline and diesel in Grades II, III and V, which differ in their sulfur content. In 2023, total gasoline and diesel consumption reached 15.8 million tons, resulting in the emission of 50 million tons of GHG and 9,800 tons of SO_2. In response, the government issued Decision No. 876/QĐ-TTg to gradually transition the transport sector toward cleaner, greener fuels or electricity, targeting Vietnam's net-zero by 2050. In this paper, the 2030 scenario, which involves switching to ethanol fuel and transitioning gasoline engines to electric vehicles, will be considered and discussed as a strategy to reduce both GHG and SO_2 emissions. The results will be compared to the commitment of the Government.

Key words: Petroleum fuel, gasoline, diesel, ethanol, greenhouse gas, GHG, SO_2 emission, electric vehicles.

1. Introduction

Vietnam, as a developing country, has a high energy demand driven by electricity generation, industrial activities, and transportation. According to the Ministry of Natural Resources and Environment (MONRE), the country's greenhouse gas (GHG) emissions reached 371 million tons of CO_2 equivalent in 2016, with the transport sector accounting for 35.8 million tons [1]. In its efforts to reduce GHG emissions, Vietnam updated its Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) in September 2022, committing to a 15.8% overall emission reduction by 2030. Specifically, the energy sector is assigned a reduction target of 7%, equivalent to 64.8 million tons of CO_2 equivalent [2]. Oh J.Y predicts that road transport alone could emit up to 71.7 million tons of GHG by 2030 [3].To address these challenges, the Government enacted Decision No. 876/QĐ-TTg on Approving the Action Program on Green Energy Transition, Reduction of Carbon and Methane Emissions in the Transport Sector. This program aims for net-zero emissions in transport sector by encouraging the use of electric vehicles (EVs), requiring all road vehicles to use E5 fuel from 2022 to 2030, and accelerating the shift toward public transportation powered by electricity or compressed natural gas (CNG) in urban areas.

In Vietnam, the transport sector remains heavily reliant on gasoline and diesel. To ensure petroleum fuel quality, the national standard QCVN 01:2022/BKHCN was issued to define quality specifications for gasoline, including RON92/95 Grades II, III, and V, as well as for ethanol-blended fuels such as E5 and E10. It also regulates the quality of diesel (DO Grades II, III, and V), including biodiesel blends (e.g., B5 and B10). The sulfur content in Vietnam's petroleum fuels is comparable to that of EURO standards.

Currently, Binh Son and Nghi Son refineries supply petroleum fuels to the domestic market. Binh Son refinery, operating since 2009, has a capacity of 150,000

Date of receipt: 11/3/2025
Date of review and editing: 11/3 - 25/4/2025
Date of approval: 25/4/2025

barrels/day (6.5 MTPA). Binh Son's gasoline and diesel products comply with Grade II criteria of the QCVN 01:2022/BKHCN. Capacity expansion to 171,000 barrels/day and product upgrading to meet Grade V standards under QCVN 01:2022/BKHCN are underway and expected to be completed by the first quarter of 2028. Nghi Son refinery began operations in 2018 with a capacity of 200,000 barrels/day (8.4 MTPA). According to the product specifications, the sulfur content of gasoline and diesel might be controlled at 50 ppm, which is higher than the requirement for Grade V fuel under the QCVN 01:2022/BKHCN standards.

The distribution of petroleum fuels in Vietnam involves both state-owned and private companies. Three major state-owned companies, including Vietnam National Petroleum Group (Petrolimex - PLX), Petrovietnam Oil Corporation (PVOIL), and Military Petrochemical JSC (Mipec), dominate the retail market. These companies actively import fuels from domestic refineries and international sources to meet local market demand.

To mitigate emissions in the road transport sector, Decision No. 49/2011/QĐ-TTg mandates that all manufactured, assembled, and imported vehicles must comply with Euro 5 emission standards as of January 1, 2022. However, Circular No. 16/2022/TT-BKHCN allows the continued utilization of gasoline and diesel fuels that comply with Grade II, III, and IV criteria until 2024. Variations in fuel quality directly impact emissions such as GHG as well as air pollutants like SO_2. This report focuses on quantifying the GHG and SO_2 emissions from the transport sector in recent years and estimating the emission levels for 2030.

According to Wang B. research, if Vietnam deploys 4,490,000 EVs by 2030 pursuant to Decision No. 876/QĐ-TTg, it will reduce GHG emissions by 5.3 million tons, equivalent to a 9% reduction compared to the NDC target for the energy sector [4]. In our view, the most effective approach to reduce emissions is the utilization of biofuels and the transition of gasoline to electric power. Using biofuels is the most convenient solution, as it does not require changing the infrastructure for petroleum fuel distribution. The transition from gasoline engines to electric ones is also a practical solution, particularly for personal motorbikes and cars. Motorbikes, in particular, require minimal charging infrastructure modifications. However, for electric cars, it is essential to develop a robust charging network, such as the one currently being expanded by VinFast.

The objective of this study is to analyze two scenarios: (1) the nationwide adoption of E5 biofuel pursuant to Decision No. 876/QĐ-TTg, and (2) the transition from gasoline vehicles to EVs. The projected GHG reductions for these scenarios are calculated and evaluated against Vietnam's commitments to national climate goals.

2. Methodology

A realistic approach for quantifying GHG emissions is based on national petroleum consumption. This article estimates national petroleum consumption and calculates the corresponding GHG emissions. Additionally, it predicts emissions for the transport sector under different scenarios for 2030. Non-transportation engines also use gasoline and diesel, but their consumption is much lower than that of the transport sector, so their contribution to total emissions is considered negligible. Petroleum consumption data and market share ratios were gathered through interviews with local companies. Additionally, petroleum quality standards were reviewed based on existing literature.

Decision No. 2826/QĐ-BTNMT, issued on October 25, 2022, establishes emission factors for GHG inventories and sets regulatory norms for CO_2, NOx, and CH_4 emissions in the transport sector. CO_2 emissions from road vehicles, railways, and water transport are nearly identical, with only slight variations in NOx emissions. Given that road transportation accounts for the largest share of traffic, its emission norms are used as the basis for calculations. Since the Decision does not specify emission factors for ethanol fuel, data from the Asian Development Bank is referenced [5]. Additionally, due to the sulfur content in petroleum fuels, combustion releases not only GHGs but also sulfur dioxide (SO_2) pollutants. SO_2 emissions are estimated based on the sulfur content in the fuel. For blended fuels, which combine mineral fuels and biofuels, GHG and SO_2 emissions are calculated using a ratio-based method.

3. Results and discussion

3.1. Petroleum fuel consumption in Vietnam

In Vietnam, local distributors purchase petroleum fuels both domestically and internationally to supply the domestic market. According to annual reports, PLX and PVOIL hold 47% and 26% of the retail market share, respectively [6, 7]. PLX supplies three types of gasoline: E5 (5% ethanol blended with RON92-II), RON95-III, and RON95-V, along with two types of diesel: DO-II and DO-V.

Table 1 summarizes the typical properties of its gasoline and diesel products, which comply with TCCS 03:2023/PLX. The results indicate that the three RON gasoline types have similar specific gravity but differ in octane number and sulfur content. Specifically, RON92/95-II contains 500 mg/kg of sulfur, RON92/95-III has 150 mg/kg, and RON92/95-V has 10 mg/kg. Similarly, DO-II has a sulfur content of 500 mg/kg, while DO-V contains only 10 mg/kg. Other fuel distributors, such as PVOIL and Mipec, also supply gasoline and diesel with the same sulfur content, ensuring compliance with the QCVN 01:2022/BKHCN petroleum fuel standards.

Decision No. 2626/QĐ-BTNMT establishes GHG emission norms for fossil fuel combustion. Based on the fuel's heating value and specific gravity, GHG emissions per ton of fuel can be calculated. The result shows that gasoline and diesel emit 3.11 tons CO_2eq/ton and 3.28 tons CO_2eq/ton, respectively (Table 1). These figures are approximately in line with data from the Asian Development Bank [5]. However, Decision No. 2626/QĐ-BTNMT does not specify GHG emission norms for biofuels. To quantify emissions from E5 fuel, ADB's GHG emission norms were used, which estimate 1.93 tons CO_2eq/ton for E100.

In addition to GHG emissions, SO_2 emissions vary depending on fuel quality. The combustion of Grade II and Grade III gasoline or diesel releases approximately 1 kg SO_2/ton and 0.3 kg SO_2/ton, respectively. In contrast, using Grade V gasoline or diesel significantly reduces SO_2 emissions to just 0.02 kg SO_2/ton, a 50-fold decrease compared to Grade II. These results highlight the environmental benefits of using higher-quality fuels.

Based on the gasoline and diesel volumes of PLX and PVOIL from 2021 to 2023 and their respective market shares, the country's total gasoline and diesel consumption can be estimated, as shown in Figure 1. During this period, gasoline consumption increased from 5.5 million tons in 2021 to 8.3 million tons in 2023 and diesel consumption rose

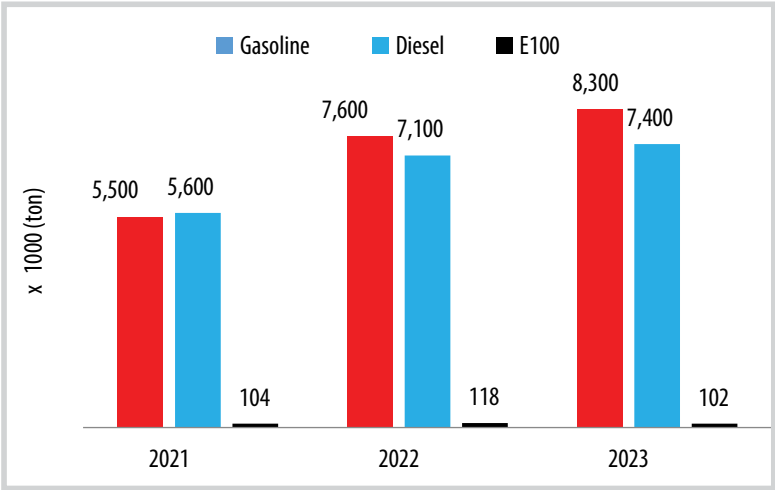

Figure 1. *Sales volume of gasoline, diesel, and ethanol in 2021, 2022, and 2023.*

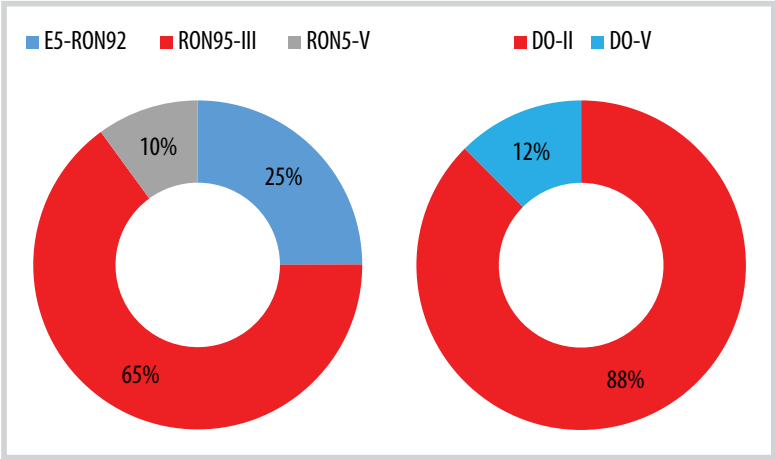

Figure 2. *Proportion of gasoline and diesel quality grades in 2023.*

Table 1. *Quality specification of gasoline and diesel and their emission factor*

Fuel	Specific gravity 15°C (kg/m³)	Sulfur content (mg/kg)	GHG (ton CO_2eq/ton)	SO_2 emission (kg/ton)
Fossil fuel TCCS 03:2023/PLX				
RON92/95-II	730	500	3.11	1.0
RON92/95-III	730	150	3.11	0.3
RON92/95-V	730	10	3.11	0.02
DO-II	820 - 860	500	3.28	1.0
DO-V	Max 845	10	3.28	0.02
Biofuel [5]				
Ethanol	0.79	-	1.93	-

from 5.6 million tons to 7.4 million tons. Despite the high demand for petroleum fuels, ethanol adoption remained limited, with E100 consumption averaging approximately 100,000 tons per year during this period. Figure 2 illustrates the proportion of PLX's fuel types in 2023. RON95-III accounted for over 65% of gasoline sales, E5 contributed 25%, and RON95-V made up 10%. Meanwhile, DO-II dominated diesel sales with an 88% share, while DO-V accounted for the remaining 12%.

In general, the retail price of Grade V fuel is always higher than that of Grade III fuel. For example, on December 28, 2023, the retail prices of Zone 1 were as follows: E5 at 21,180 VND/liter, RON95-III at 22,140 VND/liter, RON95-V at 22,700 VND/liter, DO-II at 19,780 VND/liter, and DO-V at 20,760 VND/liter [8]. The price difference between RON95-III and RON95-V was 560 VND/liter, while the gap between DO-II and DO-V was 630 VND/liter. For petroleum fuel, the end-users tend to prefer competitively priced products. It suggests that RON95-III and DO-II were priced competitively, which resulted in the highest sales volume recently. Although the E5 was priced 960 VND/liter lower than RON95-III, possibly due to concerns of biofuel quality, the sales volume of E5 remained significantly lower than that of RON95-III. Despite Vietnam's efforts to promote E5 and low-sulfur fuels since 2007, sales volumes for E5 and Grade-V fuel remain relatively low.

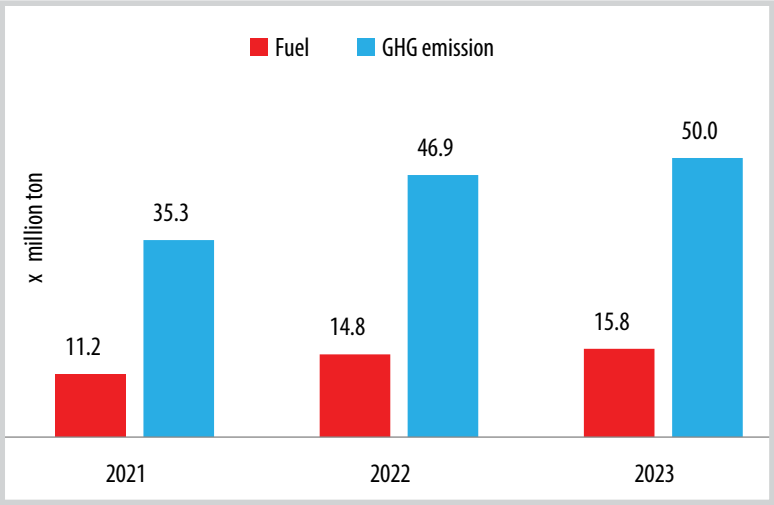

Figure 3. *Estimate petroleum fuel volume consumption and GHG emissions.*

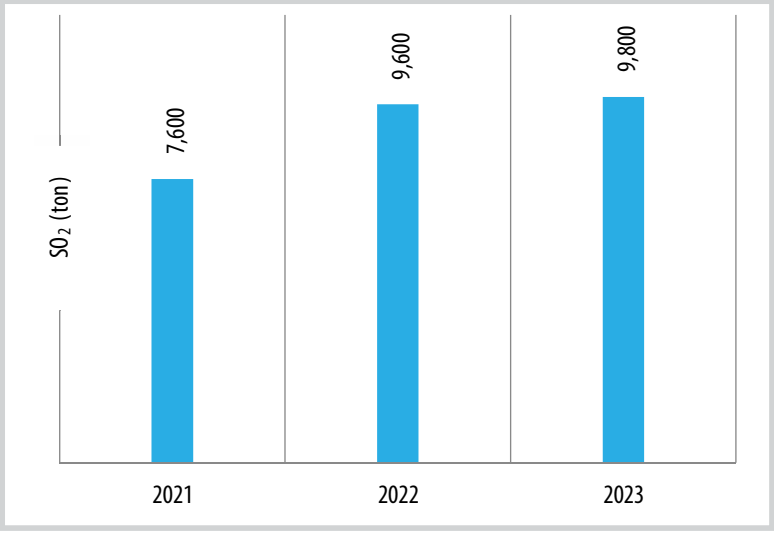

Figure 4. *SO_2 emission from petroleum fuel combustion in transportation.*

To encourage the adoption of E5, in-depth studies on consumer behavior during the shift from gasoline to E5 are essential. Identifying the psychological barriers, consumption habits, and the public's willingness to accept alternative fuels is crucial and needs further study.

By combining sales volume and GHG emission factors for petroleum and ethanol fuels, total GHG emissions were quantified, and the results are shown in Figure 3. The findings indicate that approximately 11.2 million tons of gasoline and diesel were consumed in 2021, rising to 14.8 million tons in 2022 and 15.8 million tons in 2023. Correspondingly, GHG emissions increased from 35.3 million tons in 2021 to 46.9 million tons in 2022, reaching approximately 50 million tons in 2023. Vietnam currently supplies gasoline and diesel with varying sulfur content. Based on the national fuel consumption and sulfur levels in different fuel grades, SO_2 emissions were estimated. The results reveal that approximately 7,600 tons of SO_2 were released into the atmosphere in 2021, increasing to 9,600 tons in 2022 and 9,800 tons in 2023 (Figure 4). Although Vietnam mandated that vehicle manufacturers comply with Euro 5 emissions standards starting in 2022, the local market continues to supply Grade II and Grade III fuels at lower prices than Grade V fuels. As a result, SO_2 emissions of vehicles are unlikely to meet Euro 5 targets as the Government had anticipated.

3.2. GHG and SO_2 emissions of the baseline scenario for the 2025 - 2030 period

Oh J.E. estimated that Vietnam's gasoline and diesel consumption could reach 9.33 million tons and 10.62 million tons, respectively, by 2025, and further increase to

at least 12.33 million tons of gasoline and 15.10 million tons of diesel by 2030 [3]. The Baseline scenario calculates GHG and SO_2 emissions for 2025 and 2030, assuming that the market will continue consuming three types of gasoline (E5-RON92-II, RON95-III, and RON95-V) with the same proportions as in 2023. Based on the volume of E5-RON92-II for 2025 and 2030, the volume of E100 is expected to reach approximately 128,000 tons in 2025 and increase to 170,000 tons by 2030. GHG emissions from gasoline and diesel consumption for these years were quantified. The results indicate that with a total petroleum consumption of 20 million tons in 2025, emissions could reach 63.7 million tons of CO_2eq. By 2030, fuel consumption is projected to rise to 27.4 million tons, resulting in an estimated 87.7 million tons of GHG emissions (Figure 5).

The amount of SO_2 emissions can be quantified as mentioned above, reaching 13,400 tons in 2025 and 18,700 tons in 2030. However, if the country uses the Grade V petroleum fuel according to QCVN 01:2022/BKHCN standard, the SO_2 emissions would be markedly reduced to approximately 400 tons in 2025 and 550 tons in 2030. These findings highlight that a substantial reduction in SO_2 emissions can be achieved if Grade V petroleum fuels are strictly enforced nationwide in the future.

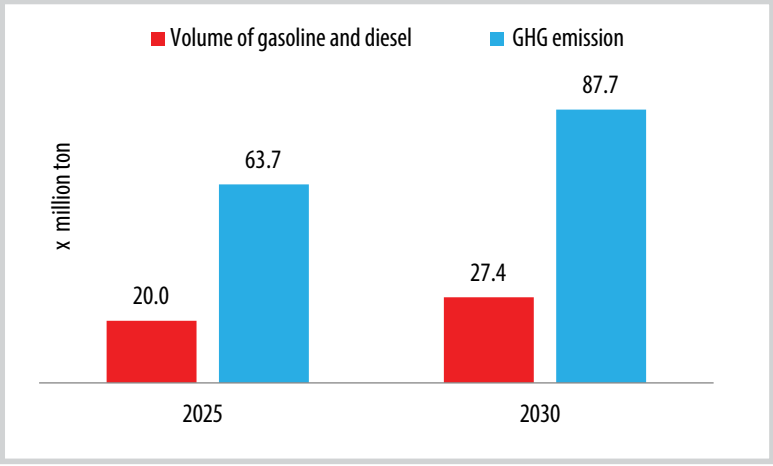

Figure 5. *Estimate petroleum consumption and GHG emissions for 2025 and 2030.*

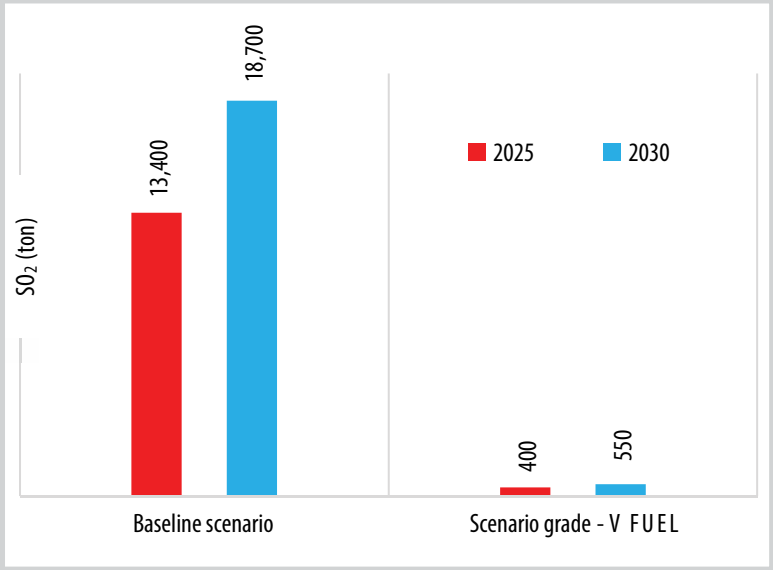

Figure 6. *Comparison of SO_2 emission in the Baseline scenario and the mandatory use of Grade-V gasoline and diesel.*

3.3. First scenario for mandatory E5

Vietnam has four ethanol plants with a total annual capacity of 280,000 tons. These plants began operation in 2012, however, due to low ethanol consumption, some were temporarily shut down. During 2021 - 2023, ethanol fuel consumption remained low at only 100,000 tons, so there is just one plant currently in operation to supply the domestic market. According to Decision No. 876/QĐ-TTg, which enforces the nationwide adoption of E5 fuel in the coming years, ethanol consumption is expected to increase (First scenario). Under this scenario, three types of ethanol-blended gasoline E5-RON92-II, E5-RON95-III, and E5-RON95-IV will be supplied to the domestic market. Ethanol consumption is projected to reach 531,000 tons in 2025 and increase to 702,000 tons by 2030. Compared to the total capacity of the four local ethanol plants, this would meet only 40% of market demand by 2030.

As mentioned above, Vietnam's gasoline and diesel consumption could reach 20 million tons and 27.4 million tons, respectively, by 2025 and 2030, and the data will be considered as Baseline scenarios for our report. Table 2 presents the GHG emissions for the Baseline and First scenarios for 2025 and 2030, focusing solely on gasoline consumption. In the Baseline scenario, the gasoline volume will be 9.33 million tons in 2025 and increase to 12.33 million tons in 2030. As a result, GHG emissions are projected to be 28.9 million tons in 2025, rising to approximately 38.1 million tons by 2030. Under the First scenario, with the increase of ethanol fuel from 531,000 tons to 702,000 tons for the period of 2025 - 2030, the GHG emissions are expected to decrease slightly to 28.4 million tons in 2025 and 37.5

Table 2. *Comparison of the Baseline and First scenario for GHG reduction in 2025 and 2030*

	2023	2025	2030
Baseline scenario			
E100 volume (thousand tons)	102	133	154
Gasoline volume (million tons)	8.3	9.33	12.33
GHG (million tons CO_2)	26.0	28.9	38.1
First scenario			
E100 volume (thousand tons)		531	702
Gasoline volume (million tons)		8.8	11.6
GHG (million tons CO_2)		28.4	37.5

million tons by 2030. This suggests that full implementation of Decision No. 876/QĐ-TTg, obligating the use of E5 fuel, could reduce GHG emissions by 500,000 tons in 2025 and 600,000 tons in 2030 compared to the Baseline scenario. Furthermore, this decision would not only contribute to GHG reduction but also provide an opportunity to reopen ethanol plants in Vietnam.

Vietnam has pledged to reduce GHG emissions by 15.8% below business-as-usual (BAU) levels by 2030, as outlined in its updated NDC-2022. The energy sector must reduce emissions of 7%, equivalent to 64.8 million tons of GHG. The transport sector accounts for 20.2% of the final energy consumption of the nation [9]. The NDC-2022 does not specify a reduction target for the transport sector, so it is assumed a reduction of 7%, corresponding to a decrease of 13 million tons of GHG by 2030. By implementing the E5 gasoline mandate policy, as proposed in the First scenario, it will only reduce 600,000 tons by 2030 and will contribute approximately 4.6% of the target.

3.4. Secondary scenario for transition from gasoline vehicles to EV

Wang B. reported promising figures for the vehicle transition in Vietnam. By 2025, electric vehicle registrations are projected to include 1,163,000 electric motorbikes (e-bikes), 60,000 electric cars (e-cars), and 470 electric buses (e-buses). By 2030, these registered numbers are expected to grow to 1,159,000 e-bikes, 297,000 e-cars, 2,440 e-buses, 10 inter-provincial passenger cars, and 2,500 electric trucks. With 4,490,000 EVs and an emission factor of 0.52 tons CO_2/MWh in 2030, it will reduce 5.3 million tons of GHG, equivalent to a 9% reduction compared to the NDC target for the energy sector and up to a 41% reduction for the transport sector [4]. These optimistic situations are based on strong policy and financial support for transition initiatives by both the public and private sectors.

According to DEA report, Vietnam had approximately 2.4 million gasoline cars and around 48.3 million motorbikes by 2022. Motorbikes accounted for 71% of gasoline consumption, while cars used 29% [10]. Based on the nation's gasoline consumption of 7.8 million tons in 2022, motorbikes consumed approximately 5.5 million tons, while car engines used around 2.3 million tons. The data indicates that motorbikes significantly contribute to GHG emissions.

The adoption of e-bikes is increasing recently, and in particular, it does not require the modification of the electric charging system, as they can be conveniently charged at home overnight. However, for e-cars, developing the necessary charging infrastructure is crucial to support market growth. Companies like VinFast are already investing and establishing the foundation for the broader adoption of EVs. Moreover, economic factors such as investment costs, government incentives, and especially access to charging infrastructure considerably influence the transition to EVs. Within the scope of this paper, we do not examine these issues. Instead, we provide a relative comparison of emissions from EV and gasoline vehicles, based on average growth rates of EVs in recent years.

Currently, the transition to cleaner public bus transportation is also progressing rapidly. According to Wang B., public transportation contributes only 1% of total transport sector emissions. The government plans to replace 1,470 of the 6,180 city buses with e-buses by 2025 (23.8%), and 2,440 of the 12,750 city buses by 2030 (19.1%) [4]. With a total of 12,750 e-buses in operation by 2030 and based on the fuel consumption of diesel buses, the power consumption of e-buses, and transport distances, our calculations show that switching from diesel to e-buses will reduce 221,000 tons of CO_2.

Diesel engines contribute substantially to GHG emissions including ships, railways, heavy-duty trucks...

Table 3. *GHG emissions of gasoline engine and EV*

	Unit	Power consumption	GHG (kg CO_2/km)	GHG Decrease rate (%)
Emission factor of grid 0.6766 kg CO_2/kWh for 2025				
Gasoline motorbike	liter/100 km	1.92	0.043	
E-bike	kWh/100 km	1.76	0.012	72.5
Gasoline car	liter/100 km	5.68	0.128	
E-car	kWh/100 km	14.20	0.096	25.0
Emission factor of grid 0.52 kg CO_2/kWh for 2030 [4]				
Gasoline motorbike	liter/100 km	1.92	0.043	
E-bike	kWh/100 km	1.76	0.009	78.9
Gasoline car	liter/100 km	5.68	0.128	
E-car	kWh/100 km	14.20	0.074	42.3

Due to the limitation of the technology and high investment costs, these transport modes have not been deployed in Vietnam. Wang B. reports the assumption that, by 2025, only 10 diesel trucks will be replaced by e-truck; by 2030, the replacement will include only 10 e-vehicles for passenger transportation and 2,500 medium-duty e-trucks [4]. Therefore, by 2030, diesel vehicles will unlikely be replaced by EVs. Based on the above assumption, we have not included e-diesel in our assessment, as their contribution to GHG reduction is negligible for 2030. Instead, the study focuses on the transition of gasoline engine scenarios.

The Second scenario considers the transition from gasoline engines to EVs for motorbikes and cars by 2030. Considering the number of vehicles registered and gasoline consumption in 2022, it is estimated that each motorbike consumes an average of 114 kg of gasoline per year, resulting in the emissison of 354 kg of CO_2 annually. In comparison, a car engine consumes an average of 958 kg of gasoline per year, emitting approximately 2,977 kg of CO_2 annually. According to the Dinh S.T. research, the fuel consumption rates are 1.92 liters per 100 km for motorbikes and 5.68 liters per 100 km for gasoline cars [11], which corresponds to an average annual travel distance of 8,200 km for each motorbike and 23,000 km for a gasoline car. Currently, the Government is encouraging the transition from gasoline vehicles to EVs to reduce emissions in urban areas. The average power consumption of EVs is shown in Table 3 [11]. According to Decision No. 2826/QĐ-BTNMT, the emission factor for the grid is 0.6766 kg CO_2/kWh. Calculations of GHG emissions for 2025 indicate that e-bikes reduce emissions by 72.5% compared to motorbikes, corresponding to a reduction of 256 kg CO_2/vehicle/year. Similarly, the substitution of gasoline cars with EVs will result in a reduction of 586 kg CO_2/vehicle/year, equivalent to a 25% decrease. For 2030, the emission factor of the grid might be 0.52 kg CO_2/kWh, resulting an increase in the reduction of GHG emissions for EVs as mentioned in Table 3.

In 2019, approximately 163,000 e-bikes were registered, and in 2020 increased to 273,000 e-bikes, representing a growth rate of 8.54% [12]. It is forecasted that 240,000 e-bikes will be registered by 2025, contributing to a reduction of 61,540 tons of GHG emissions that year. In recent years, the adoption of e-cars has accelerated, with 8,364 vehicles registered in 2022 and 15,700 vehicles in 2023. It is anticipated that the number of e-cars will grow by 25.8% during 2023 - 2032 [14], reaching approximately 33,000 registered EVs by 2025. Each e-car is expected to reduce emissions by 586 kg of CO_2 annually compared to a gasoline car. With the transition of 33,000 e-cars, it will reduce approximately 24,540 tons of GHG emissions in 2025. With the total number of EVs that might reach approximately 2.9 million e-bikes and 87,000 e-cars by 2025, the estimated GHG reduction will be 808,000 tons.

For the Second scenario of the transition from gasoline engine to EV, with an e-bike growth rate of 8.54% and an e-car growth rate of 25.8%, it is estimated that by 2030, there will be 290,000 registered e-bikes and 55,000 registered e-cars. A total of 4.3 million e-bikes and 320,000 e-cars might be put in operation by 2030 and combined with the lower emissions of the grid, the GHG emissions are expected to be reduced by approximately 1.6 million tons, contributing around 12.3% of the NDC's commitment for the transport sector.

4. Conclusion

Vietnam has committed to reducing GHG emissions by 15.8% by 2030 with the transport sector expected to cut approximately 13 million tons of GHG. Vietnam uses various fuel types, including gasoline and diesel of

different quality grades. By 2025, the country is expected to consume 20 million tons of gasoline and diesel, resulting in emissions of 63.7 million tons of GHG and 13,400 tons of SO_2. Looking ahead to 2030, if the entire nation adopts grade-V fuels, total fuel consumption is expected to reach 27.4 million tons, leading to GHG emissions of 87.7 million tons and SO_2 emissions of 550 tons.

Currently, green solutions for transportation, including the transition to EVs, the use of biofuels, and CNG, are being implemented. If the E5 policy is implemented (First scenario), ethanol consumption is projected to reach about 700,000 tons by 2030, contributing to a reduction of 600,000 tons of GHG emissions in comparison to the Basic scenario. With the Second scenario of the transition of gasoline vehicles to EVs, it is expected that 4.3 million e-bikes and 320,000 e-cars will be in operation by 2030, leading to a reduction of 1.6 million tons of GHG emissions. By combining the E5 policy with the EV transition pathway, total GHG emissions could be reduced by 2.2 million tons, equivalent to a 16.9% reduction compared to the NDC commitment for the transport sector by 2030. This indicates that additional solutions are required to achieve a reduction target of 13 million tons of GHG emissions, equivalent to replacing approximately 4 million tons of gasoline and diesel with cleaner fuel.

To promote the use of E5 or the transition of gasoline engines to EVs, it is essential to conduct in-depth research on consumer behavior, economic factors, and the accessibility of charging infrastructure. A systematic study of these factors is necessary to provide more accurate forecasts of the shift from gasoline vehicles to EVs in the Vietnamese market.

References

[1] Ministry of Natural Resources and Environment, *Report on National GHG inventory for 2016*, 2020.

[2] Vietnam, *Nationally determined contribution (NDC)*, 2022.

[3] Jung Eun Oh, Maria Cordeiro, John Allen Rogers, Khanh Nguyen, Daniel Bongardt, Ly Tuyet Dang, and Vu Anh Tuan, "Addressing climate change in transport: Volume 1: Pathway to low-carbon transport", 2019.

[4] Tarek Keskes, Chiara Odetta Rogate, Zayra Romo, Shigeyuki Sakaki, and Bowen Wang, "Viet Nam - Recommendations to the national roadmap and action plan for the electric-mobility transition: Executive Version (English)". [Online]. Available: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099102224045529146.

[5] ADB, "Guidelines for estimating greenhouse gas emissions of Asian development bank projects: Additional guidance for transport projects", 2016. [Online]. Available: https://www.adb.org/sites/default/files/institutional-document/219791/guidelines-estimating-ghg-emissions-transport.pdf.

[6] Petrolimex, *Báo cáo phát triển bền vững*, 2023.

[7] PVOIL, *Báo cáo thường niên*, 2020 - 2022.

[8] Ministry of Industry and Trade of the Socialist Republic of Vietnam, Information on fuel price management. [Online]. Available: https://moit.gov.vn/tin-tuc/thong-bao/thong-tin-dieu-hanh-gia-xang-dau-ngay-28-12-2023.html.

[9] IEA, "Where does Vietnam get its energy?". [Online]. Available: https://www.iea.org/countries/viet-nam/energy-mix.

[10] Danish Energy Agency, "Viet Nam energy outlook report: Pathways to net-zero", 2024. [Online]. Available: https://ens.dk/sites/ens.dk/files/Globalcooperation/1._eor-nz_english_june2024_0.pdf.

[11] Dinh-Son Tran, Huong Le, and Zifei Yang, "Two-wheelers in Vietnam: A baseline analysis of fleet characteristics and fuel consumption in 2019 and 2020", 2022. [Online]. Available:https://theicct.org/publication/2w-lvs-vietnam-asia-baseline-feb22/.

[12] Huong Le, Francisco Posada, and Zifei Yang, "Assessment of electric two-wheelers development in Vietnam: An overview", 2022. [Online]. Available: https://theicct.org/wp-content/uploads/2022/10/asia-pacific-lvs-NDC-TIA-E2W-mkt-growth-Vietnam-nov22.pdf.

[13] Dinh Van Hiep, Nam Hoai Tran, Nguyen Anh Tuan, Tran Manh Hung, Ngo Viet Duc, and Hoang Tung, "Assessment of electric two-wheelers development in establishing a national E-mobility roadmap to promote sustainable transport in Vietnam", *Sustainability*, Volume 15, Issue 9, 2023. DOI: 10.3390/su15097411.

[14] BMI, "Vietnam EV profile: VinFast to provide a strong boost to BEV sales", 2023. [Online]. Available: https://www.fitchsolutions.com/bmi/autos/vietnam-ev-profile-vinfast-provide-strong-boost-bev-sales-03-08-2023.