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Green Growth or Growth First? Carbon Intensity and Provincial Development Paths in Vietnam

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Abstract
Vietnam has committed to net-zero emissions by 2050 while aiming to reach high-income status by 2045. Whether these two goals can be pursued together depends heavily on what happens inside its provinces, where growth is planned, power plants are sited and industrial parks compete for investment. This paper documents the current situation using newly available satellite- and asset-based emission estimates from Climate TRACE for all 63 pre-2025 provinces (2021–2024), combined with provincial GRDP and population statistics and national series from the Global Carbon Project and the World Bank. The analysis is descriptive and does not estimate causal relationships. At the national level, CO_2 emissions rose almost sevenfold between 2000 and 2025, faster than real GDP, and coal's share of fossil CO_2 climbed from 38% to 58%. Only after 2020 did the economy move into weak decoupling (elasticity 0.22). At the provincial level, the carbon intensity of output differs by a factor of 46, from 8 t CO_2e per billion VND in Bắc Ninh to 368 t in Bình Thuận. Ten provinces emit 51.5% of gross greenhouse gases while producing 34.5% of output. A simple income-by-intensity typology identifies four development paths. Twenty "cleaner growth" provinces generate 62.4% of GRDP with a quarter of emissions. Twelve "growth first" provinces, mostly hosts of coal power, steel, cement and coal mining, account for 51.0% of emissions but only 16.2% of GRDP. The remaining provinces are either carbon-intensive and lagging, often because of rice-paddy methane or resource industries, or low-carbon by default. Emissions rose fastest between 2021 and 2024 in some cleaner-growth provinces where new coal units came online. The results suggest that Vietnam's low-carbon transition is, in practice, a question of a small number of host provinces, and that provincial green-growth targets should distinguish between emissions generated for local value added and emissions generated to supply the national grid.

Keywords: Green Growth, Carbon Intensity, Decoupling, Provincial Development, Regional Inequality, Vietnam

JEL Classification: O13; O44; Q54; Q56; R11

1. Introduction

Few middle-income economies face the trade-off between growth and decarbonisation as directly as Vietnam. Real GDP grew by roughly 6% a year for a quarter of a century, and the government's development strategy aims for high-income status by 2045. At COP26 in 2021, the country also pledged to reach net-zero emissions by 2050. The National Green Growth Strategy for 2021–2030 (Decision 1658/QĐ-TTg) and the National Climate Change Strategy to 2050 (Decision 896/QĐ-TTg) translated that pledge into targets for emission intensity, renewable energy and green investment, and the updated Nationally Determined Contribution set conditional and unconditional reduction targets for 2030 (Government of Viet Nam, 2022c) [13]. In 2025 the government approved a revised Power Development Plan VIII (Decision 768/QĐ-TTg) and a roadmap for a domestic carbon market, with a pilot phase from 2025 to 2028 (Decision 232/QĐ-TTg).

These are national commitments. Yet emissions do not occur in a national average. They occur at specific coal plants in Quảng Ninh and Bình Thuận, at steel mills in Hà Tĩnh and Quảng Ngãi, at cement kilns in Ninh Bình and Hà Nam, and in rice paddies in the Mekong Delta. Provinces also make many of the decisions that shape emissions: They prepare provincial master plans, approve industrial parks, compete for foreign direct investment and propose sites for power projects. The question in the title, whether Vietnam is following a "green growth" path or a "growth first" path, therefore has no single answer. It has 63 answers, or, since the administrative reorganisation of mid-2025, 34.

Until recently, this question could not be examined systematically because Vietnam does not publish greenhouse gas inventories at the provincial level. National inventories, reported to the UNFCCC in biennial update reports, cover a limited number of benchmark years and stop at the national total. A handful of provinces have prepared their own inventories with different methods and years. Studies of the growth–emissions nexus in Vietnam have consequently relied on national time series (Al-Mulali *et al*., 2015; Tang & Tan, 2015) [1, 31], which cannot reveal the spatial structure of emissions or the diversity of development paths.

This paper takes advantage of a new source. Climate TRACE, an independent coalition that combines satellite observation, remote sensing and machine learning, now publishes source-level emission estimates that can be aggregated to first-level administrative units (Lancellotti *et al*., 2025) [21]. We retrieve these estimates for all 63 Vietnamese provinces for 2021–2024 and combine them with provincial GRDP and population statistics. The objective is deliberately descriptive. We do not estimate an environmental Kuznets curve or any causal model. Instead, we ask four questions about the current situation:

1. How has the relationship between growth and emissions evolved at the national level, and has Vietnam begun to decouple?
2. How unequally are emissions distributed across provinces, relative to output and population?
3. Can provinces be grouped into distinct development paths according to their income level and the carbon intensity of their output?
4. Which provinces drove the change in emissions between 2021 and 2024, and what does this imply for provincial green-growth policy after the 2025 merger?

The paper contributes in three ways. It provides, to our knowledge, the first complete province-by-province picture of greenhouse gas emissions relative to output for Vietnam. It proposes a simple and transparent typology of provincial development paths that can be updated as new data arrive. It also re-expresses the results for the 34 new provincial units created in 2025, which is the territorial basis on which future provincial plans and emission-reduction responsibilities will be set.

The remainder of the paper is organised as follows. Section 2 reviews the literature on green growth, decoupling and subnational emissions. Section 3 describes the data and indicators. Section 4 presents the national trajectory and Section 5 the provincial landscape. Section 6 discusses the findings and Section 7 draws out policy implications. Section 8 concludes.

2. Literature review

2.1 Growth and emissions: From the Kuznets curve to decoupling

The modern debate on growth and the environment began with the environmental Kuznets curve (EKC). Grossman and Krueger (1995) [16] and Panayotou (1993) [26] observed that several local pollutants first rise and then fall as income per capita increases, and suggested that structural change, technological progress and stronger demand for environmental quality might eventually reverse the damage caused by early industrialisation. Later surveys were more cautious. Dinda (2004) [4] and Stern (2004) [30] showed that the evidence for an EKC is weak for carbon dioxide, which is a global pollutant whose damage is not felt locally, and that many estimated turning points lie far beyond observed income levels. Results are also sensitive to model specification and to the countries in the sample.

Because of these problems, much recent work has moved from the EKC to the more modest concept of decoupling. The OECD (2002) [24] distinguishes relative decoupling, in which emissions grow more slowly than output, from absolute decoupling, in which emissions fall while output rises. Tapio (2005) [32] refined this into an elasticity-based classification that is now widely used in applied work (Wang & Su, 2020; Wu *et al*., 2019) [34, 37]. Globally, energy supply and industry remain the main drivers of emission growth (Lamb *et al*., 2021) [20]. A systematic review by Haberl *et al*. (2020) [17] found many cases of relative decoupling but few episodes of absolute decoupling large and fast enough to meet climate targets, mostly in high-income countries and often helped by consumption shifting abroad.

2.2 Green growth versus growth first

The term "green growth" was popularised by the OECD (2011) [25] and the World Bank (2012) [35]. In its optimistic version, environmental policy and economic growth are complements: Investment in clean energy and efficiency raises productivity, avoids costly lock-in and creates new export industries (Jacobs, 2013) [19]. Critics argue that the absolute decoupling required to meet the Paris targets has not been observed at the necessary speed and that green growth risks becoming a slogan that justifies business as usual (Hickel & Kallis, 2020) [18].

For developing countries, the debate has a specific form. Many governments, including Vietnam's until recently, have followed an implicit "grow first, clean up later" strategy, in which cheap and reliable coal power supports export manufacturing and rapid job creation. The risk of this strategy is carbon lock-in: Long-lived assets such as coal plants, steel mills and cement kilns commit an economy to high emissions for decades and create local interests that resist change (Unruh, 2000; Seto *et al*., 2016) [33, 28]. The question is not only whether growth can become green, but whether assets built during a growth-first phase can be retired or converted without stranding local economies.

2.3 Why the subnational scale matters

National averages hide large differences between regions. Studies of China, where provincial energy and emission accounts are available (Shan *et al*., 2018) [29], show that carbon intensity can differ several-fold between provinces with similar income levels and that decoupling progresses at very different speeds (Wu *et al*., 2019) [37]. Feng *et al*. (2013) [7] further showed that a large part of the emissions recorded in China's less developed interior provinces is generated to produce goods and electricity consumed in the richer coastal provinces. This mirrors, within a single country, the international finding that production-based accounts allocate emissions to producer regions rather than to final consumers (Davis & Caldeira,

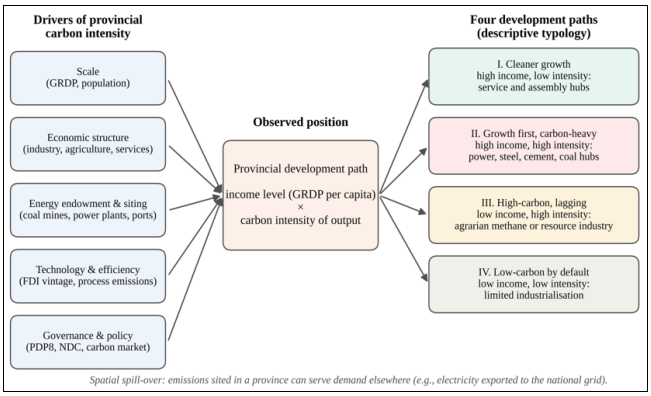
2010; Peters *et al*., 2011) [3, 27].

Two lessons from this literature are relevant here. The first is that a province's carbon intensity reflects its role in the national division of labour as much as the efficiency of its own firms. A province that hosts coal plants supplying the national grid will look carbon-intensive even if its residents consume little electricity. The second is that provincial governments have real leverage over emissions through land allocation, investment approval and infrastructure planning, so understanding provincial heterogeneity is a precondition for designing responsibilities fairly.

2.4 Evidence on Vietnam and the research gap

Most studies of Vietnam use national time series. Al-Mulali *et al*. (2015) [1] found no clear support for an EKC in Vietnam and stressed the role of fossil energy consumption. Tang and Tan (2015) [31] linked rising CO_2 emissions to energy use and income growth. Vietnam's national greenhouse gas inventories show that energy overtook agriculture as the largest source of emissions in the early 2000s, and that its share kept rising as coal power expanded (MONRE, 2020) [22]. Subnational work remains rare and usually focuses on single provinces or cities, using inventory tools that are not comparable across locations.

The gap is therefore clear. There is no consistent, nationwide picture of how emissions relate to output at the provincial level, and no classification of provincial development paths that could inform the allocation of mitigation responsibilities after the 2025 administrative reform. The present paper aims to fill this descriptive gap.



Source: Author

Fig 1: Analytical framework: Drivers, observed position and provincial development paths

Fig 1 summarises the framework used to organise the analysis. Five groups of drivers, namely scale, economic structure, energy endowment and siting, technology, and governance, jointly determine where a province sits in the space defined by income per capita and carbon intensity of output. That observed position is then used to classify provinces into four development paths. The framework is a heuristic for description, not a model to be estimated.

3. Data and Approach

3.1 Data sources

Table 1 lists the data used. All series are publicly available and were retrieved in November 2026.

Table 1: Data sources and indicators

Indicator	Coverage	Source
Fossil CO_2 emissions, total and by fuel (coal, oil, gas, cement, flaring)	Vietnam, 2000–2025	Global Carbon Project, Global Carbon Budget, via Our World in Data
Real GDP (constant 2015 US$) Real GDP (constant 2015 US$))|Vietnam,2000-2025|WorldBank,WorldDevelopmentIndicators(NY.GDP.MKTP.KD)|┤ |Electricitygenerationbysource(	Vietnam, 2000–2025	World Bank, World Development Indicators (NY.GDP.MKTP.KD)
Electricity generation by source)|Vietnam,2000-2025|WorldBank,WorldDevelopmentIndicators(NY.GDP.MKTP.KD)|┤ |Electricitygenerationbysource(	Vietnam, 2010–2025	Ember and Energy Institute, via Our World in Data
Greenhouse gas emissions (CO_2e) by sector: Power, manufacturing, fossil-fuel operations, mineral extraction, transportation, buildings, agriculture, waste, fluorinated gases, forestry and land use |Vietnam,2000-2025|WorldBank,WorldDevelopmentIndicators(NY.GDP.MKTP.KD)|┤ |Electricitygenerationbysource(	63 provinces, 2021–2024	Climate TRACE emissions inventory (API version 7)
GRDP per capita and population)|Vietnam,2000-2025|WorldBank,WorldDevelopmentIndicators(NY.GDP.MKTP.KD)|┤ |Electricitygenerationbysource(	63 provinces, 2022	General Statistics Office (GSO, 2023)

The provincial emission data come from Climate TRACE, which estimates emissions for individual assets (power plants, steel and cement plants, mines, road segments, buildings, rice paddies, landfills) and for residual sector totals, and assigns them to administrative areas. For each province and year we retrieved the aggregate CO_2-equivalent emissions for ten sectors: Power, manufacturing, fossil-fuel operations, mineral extraction, transportation, buildings, agriculture, waste, fluorinated gases, and forestry and land use.

3.2 Indicators

Forestry and land use is excluded from the main measure for two reasons. Its values swing between large sources and large sinks from year to year (for example, Son La moves from a net source to a sink of 13.6 Mt in 2024), and it reflects land-cover dynamics rather than economic activity. We therefore define **gross emissions** as the sum of the remaining nine sectors. We further define the **energy–industrial core** as the sum of power, manufacturing, fossil-fuel operations and mineral extraction.

The main indicators are:

- **Carbon intensity of output:** Gross emissions divided by GRDP, in tonnes of CO_2e per billion VND (2022 current prices).
- **Emissions per capita:** Gross emissions divided by population, in tonnes of CO_2e per person.
- **Sectoral shares:** The share of the energy–industrial core and of agriculture in gross emissions.
- **Change in emissions:** The percentage change in gross

emissions between 2021 and 2024.

The year 2022 is used for all ratios because it is the latest year for which complete and consistent GRDP per capita and population data are available for all 63 provinces. Provincial GRDP is obtained as GRDP per capita multiplied by population; the sum over provinces (9,612 trillion VND) is close to, though as usual slightly above, the national GDP figure.

At the national level, decoupling is assessed with the Tapio (2005) [32] elasticity, $e = (\%\Delta CO_2) / (\%\Delta GDP)$, computed over five-year periods. With positive GDP growth, $e > 1.2$ indicates expansive negative decoupling (emissions grow faster than output), $0.8 \leq e \leq 1.2$ expansive coupling, $0 \leq e < 0.8$ weak (relative) decoupling and $e < 0$ strong (absolute) decoupling.

3.3 A descriptive typology of development paths

Provinces are classified by two medians: The median GRDP per capita (66.6 million VND in 2022) and the median carbon intensity (45.1 t CO_2e per billion VND). This produces four groups:

- **I. Cleaner growth**: Income above the median, intensity below the median.
- **II. Growth first, carbon-heavy**: Income and intensity both above the median.
- **III. High-carbon, lagging**: Income below the median, intensity above the median.
- **IV. Low-carbon by default**: Income and intensity both below the median.

The median split is simple and transparent, and it is robust in the sense that group membership changes only for provinces close to the cut-off lines. It does not imply that the groups are internally homogeneous or that the boundaries have any structural meaning.

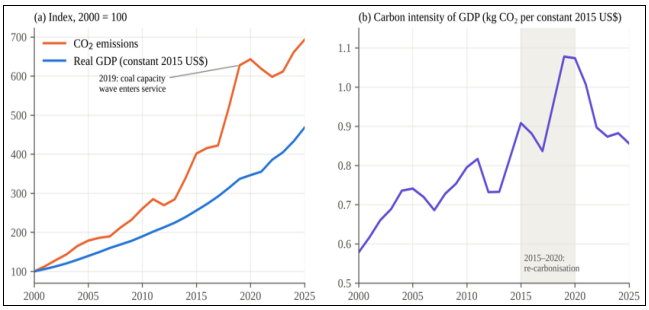
3.4 Caveats

Three caveats apply to all results. First, Climate TRACE estimates are modelled rather than reported. Coverage is strongest for large point sources such as power plants and steel mills and weaker for diffuse sources. Values for agriculture and buildings rely on activity proxies and emission factors. Climate TRACE totals are not identical to Vietnam's official inventory, so absolute levels should be read with caution, though relative patterns across provinces are more reliable. Second, the emission data follow a production-based, territorial principle. A coal plant's emissions are assigned to the province where it stands, regardless of where the electricity is used. Third, the provincial statistics refer to the 63 provinces that existed before Resolution 202/2025/QH15. Section 5.6 aggregates them to the 34 current units.

4. The national trajectory: From re-carbonisation to weak decoupling

4.1 Emissions grew faster than output for two decades

Fig 2 compares the growth of fossil CO_2 emissions and real GDP since 2000. Emissions rose from 54.1 Mt in 2000 to 374.7 Mt in 2025, almost a sevenfold increase. Real GDP grew 4.7 times over the same period. The carbon intensity of GDP therefore rose, from 0.58 kg CO_2 per constant 2015 US$ in 2000 to a peak of 1.08 kg in 2019.



Source: Author's calculations from Global Carbon Project (via Our World in Data) and World Bank WDI

Fig 2: Fossil CO_2 emissions and real GDP in Vietnam, 2000–2025. Panel (a) shows indices (2000 = 100); panel (b) shows the carbon intensity of GDP

The rise in intensity was not steady. It accelerated sharply between 2014 and 2019, when a wave of large coal-fired units came into operation in Quảng Ninh, Hà Tĩnh, Trà Vinh, Bình Thuận and other provinces. In 2018 and 2019 alone, emissions grew by 23% and 21%, roughly three times the rate of GDP growth. We refer to this period as one of re-carbonisation: Rather than becoming cleaner as it grew richer, the economy became more carbon-intensive.

Table 2 confirms this pattern with Tapio elasticities. In each five-year period from 2000 to 2020, the elasticity of emissions with respect to GDP exceeded 1.2, the threshold for expansive negative decoupling. The elasticity was highest in the first period (1.99), when Vietnam was industrialising from a low base, and again reached 1.70 in 2015–2020. Only in 2020–2025 did it fall to 0.22, a state of weak decoupling.

Table 2: Decoupling of CO_2 emissions from real GDP, five-year periods

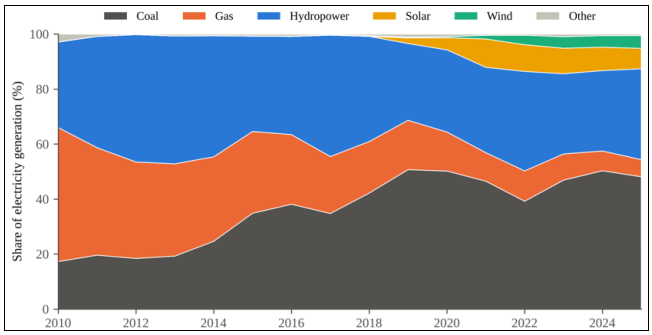
Period	GDP growth (% p.a.)	CO_2 growth (% p.a.)	Change in intensity (% p.a.)	Tapio elasticity	Decoupling state
2000–2005	6.90	12.33	5.08	1.99	Expansive negative decoupling
2005–2010	6.32	7.83	1.42	1.28	Expansive negative decoupling
2010–2015	6.17	9.03	2.69	1.55	Expansive negative decoupling
2015–2020	6.25	9.87	3.40	1.70	Expansive negative decoupling
2020–2025	6.20	1.50	−4.42	0.22	Weak decoupling

Source: Author's calculations from Global Carbon Project and World Bank WDI. Elasticity computed on cumulative changes over each period

The improvement after 2020 should be interpreted carefully. Part of it reflects the solar boom of 2019–2021, which raised the share of solar and wind in electricity generation from almost zero to more than 11% within three years. Part of it reflects strong hydropower years and the slowdown of energy-intensive output during and after the pandemic. Emissions resumed rapid growth in 2024 (+8.1%), as electricity demand rose and coal generation filled the gap. Weak decoupling, in other words, has started but is not yet secure.

4.2 A power system that became more dependent on coal

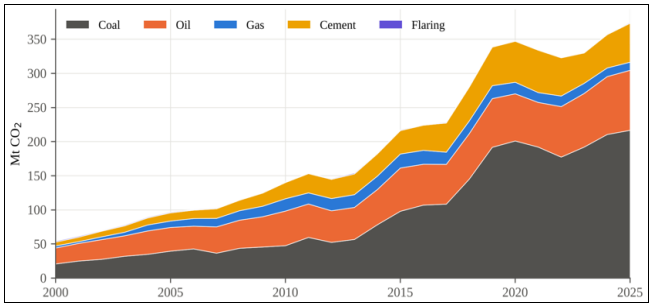
Fig 3 shows why the national trajectory looks the way it does. In 2010, gas and hydropower supplied about 80% of Vietnam's electricity and coal only 17%. By 2019, coal supplied just over half. Solar and wind expanded rapidly from 2019, but the share of coal fell only temporarily, reaching 39% in the wet year of 2022 before climbing back to 50% in 2024 and 48% in 2025. Gas, which emits roughly half as much CO_2 per kWh as coal, declined steadily from 49% of generation in 2010 to 6% in 2025 as domestic fields matured.



Source: Ember and Energy Institute, via Our World in Data

Fig 3: Electricity generation mix in Vietnam, 2010–2025 (% of total)

The fuel composition of emissions tells the same story (Fig 4). Coal accounted for 38% of fossil CO_2 in 2000 and 58% in 2025. Oil and cement contribute most of the rest. Cement emissions, which reflect the construction boom, rose from 5.6 Mt in 2000 to a peak of 62.1 Mt in 2021 before falling back as the property market cooled.

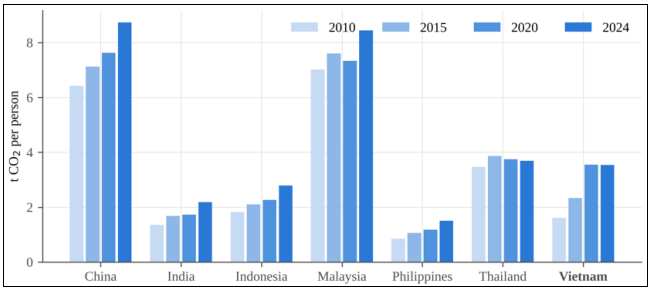


Source: Global Carbon Project, via Our World in Data

Fig 4: Fossil CO_2 emissions in Vietnam by source, 2000–2025 (Mt CO_2)

4.3 Vietnam in regional perspective

Fig 5 places Vietnam among its neighbours. In 2010, Vietnam's emissions per person (1.6 t CO_2) were below Indonesia's and less than half of Thailand's. By 2020 they had more than doubled to 3.5 t and were close to Thailand's level, even though Thailand's income per capita is substantially higher. In the 2025 estimates of the same dataset, which are not shown in Fig 5, Vietnamese emissions per person (3.7 t) exceeded Thailand's (3.6 t) for the first time. This is an unusual position: An economy that is still lower-middle-income in per capita terms is emitting at the level of an upper-middle-income neighbour.



Source: Global Carbon Project, via Our World in Data

Fig 5: CO_2 emissions per capita in Vietnam and selected Asian economies, 2010–2024 (t CO_2 per person)

These national results provide the context for the provincial analysis. Vietnam's growth has been carbon-intensive, and the intensity is closely tied to specific physical assets. The next section asks where these assets are and how their location relates to provincial development.

5. The provincial landscape

5.1 Large and spatially clustered differences

Table 3 summarises the provincial indicators. Gross emissions estimated by Climate TRACE for the 63 provinces total 442.1 Mt CO_2e in 2022 and 501.8 Mt in 2024. The national average carbon intensity is 46.0 t CO_2e per billion VND of GRDP and the average per capita level is 4.4 t CO_2e.

Table 3: Descriptive statistics, 63 provinces (2022 unless otherwise stated)

Indicator	Mean	Median	Std. dev.	Min	Max	Coef. of variation
GRDP per capita (million VND)	82.4	66.6	48.0	33.5	335.5	0.58
Gross GHG emissions (kt CO_2e)	7,017.6	3,768.0	8,837.2	742	54,418	1.26
GHG intensity (t CO_2e per billion VND)	63.5	45.1	62.1	8.0	368.0	0.98
GHG per capita (t CO_2e)	5.0	3.1	6.3	1.1	39.1	1.27
Energy–industrial share of emissions (%)	43.3	40.8	26.4	1.6	96.0	0.61
Agriculture share of emissions (%)	31.3	26.9	21.4	1.1	75.8	0.68
Change in emissions, 2021–2024 (%)	9.9	3.0	41.0	−37.8	293.4	4.15

Source: Author's calculations from Climate TRACE and GSO provincial statistics. Gross emissions exclude forestry and land use

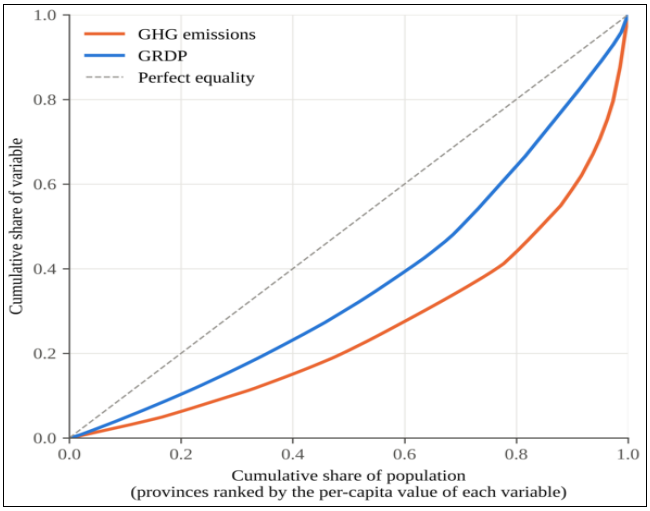
The dispersion is striking. The most carbon-intensive province, Bình Thuận, emits 46 times more per unit of output than the least intensive, Bắc Ninh. Emissions per person range from 1.1 t in Bến Tre to 39.1 t in Quảng Ninh.

The coefficients of variation for emissions and emissions per capita (1.26 and 1.27) are more than twice that for GRDP per capita (0.58). Emissions, in other words, are far more unequally distributed across provinces than income.

The spatial pattern is equally uneven. Income is concentrated in two poles, the Hà Nội–Hải Phòng–Quảng Ninh triangle in the north and the Hồ Chí Minh City–Bình Dương–Đồng Nai–Bà Rịa-Vũng Tàu cluster in the southeast. Carbon intensity follows a different geography. The darkest provinces lie along the coast where coal plants and heavy industry are located (Quảng Ninh, Hà Tĩnh, Quảng Ngãi, Bình Thuận, Trà Vinh), with secondary concentrations in the northern uplands and the western Mekong Delta. Emissions per capita highlight the same coastal hosts even more sharply.

5.2 Concentration: A few provinces carry most of the burden

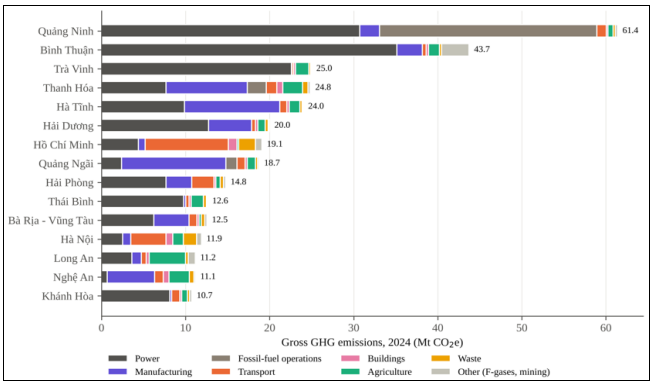
Fig 6 presents Lorenz curves for emissions and GRDP across the population, with provinces ranked by their per capita values. The emission curve lies well below the GRDP curve. The population-weighted Gini coefficient for emissions per capita is 0.47, compared with 0.27 for GRDP per capita. Concentration among provinces is high: The five largest emitters (Quảng Ninh, Bình Thuận, Thanh Hóa, Hà Tĩnh and Trà Vinh) account for 34.5% of gross emissions, and the top ten account for 51.5%. These ten provinces produce 34.5% of GRDP and are home to 24.7% of the population.



Source: Author's calculations

Fig 6: Lorenz curves of provincial GHG emissions and GRDP, 2022

Fig 7 shows the sectoral make-up of the fifteen largest emitters in 2024. Power dominates in Bình Thuận (Vĩnh Tân complex), Trà Vinh (Duyên Hải complex), Thái Bình and Khánh Hòa. In Quảng Ninh, power and fossil-fuel operations, mainly methane and CO_2 from coal mining, together make up 92% of the provincial total. Manufacturing dominates in Hà Tĩnh (Formosa steel), Quảng Ngãi (Hòa Phát Dung Quất steel and the refinery area) and Thanh Hóa (cement, steel and the Nghi Sơn refinery). Hồ Chí Minh City and Hà Nội are the only large emitters where transport is the main source.



Source: Author's calculations from Climate TRACE

Fig 7: The fifteen largest provincial emitters by sector, 2024 (Mt CO_2e)

The concentration of emissions in a small number of host provinces is a central feature of Vietnam's situation. The coal plants in Bình Thuận, Trà Vinh and Quảng Ninh supply the national grid. Their emissions are therefore embodied in electricity consumed in factories and homes across the country, including in the cleaner-growth provinces discussed below.

5.3 Regional patterns

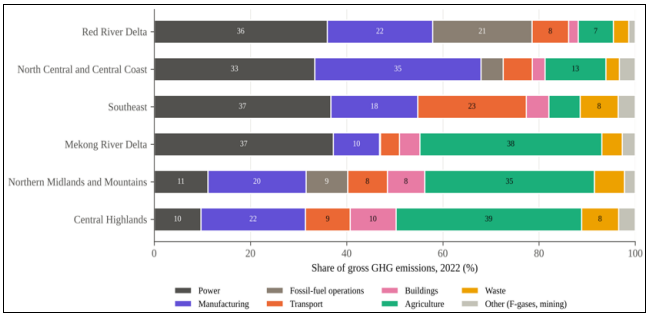
Table 4 aggregates the indicators to the six socio-economic regions. The Southeast is the clearest example of high income with low intensity: it produces 30.7% of national GRDP with 11.4% of gross emissions and has an intensity of 17.0 t per billion VND, about one-third of the national average. The Red River Delta has a similar share of output (30.1%) but a much larger share of emissions (28.8%), largely because Quảng Ninh, Hải Dương and the cement provinces of Ninh Bình and Hà Nam are included in it. The North Central and Central Coast region is the most carbon-intensive (92.8 t per billion VND), producing 14.9% of output but 30.1% of emissions.

Table 4: Regional indicators, 2022

Region	Prov.	Pop. share (%)	GRDP share (%)	Emission share (%)	GRDP per capita (m VND)	Intensity (t/bn VND)	Per capita (t)	Energy–industry share (%)	Agriculture share (%)	Change 2021–24 (%)
Red River Delta	11	23.6	30.1	28.8	123.4	44.0	5.4	78.6	7.3	7.4
Northern Midlands and Mountains	14	13.1	8.5	7.9	63.0	42.4	2.7	41.3	35.3	−6.0
North Central and Central Coast	14	20.8	14.9	30.1	69.5	92.8	6.4	72.7	12.7	19.1
Central Highlands	5	6.1	3.8	3.6	60.0	43.1	2.6	32.0	38.6	3.1
Southeast	6	18.9	30.7	11.4	157.0	17.0	2.7	54.9	6.5	13.9
Mekong River Delta	13	17.5	11.9	18.3	65.5	70.8	4.6	47.1	37.8	9.4
Total	63	100	100	100	96.6	46.0	4.4	63.8	17.7	10.6

Source: Author's calculations. Shares of emissions refer to gross emissions excluding forestry and land use

Fig 8 shows that regions differ not only in the level of emissions but in their sources. Power accounts for 33–37% of emissions in four regions, but in the Mekong River Delta its share is driven by just two coal complexes (Duyên Hải in Trà Vinh and Sông Hậu in Hậu Giang). Agriculture is the largest single source in the Mekong River Delta (38%), the Central Highlands (39%) and the Northern Midlands and Mountains (35%). In the Mekong Delta this is mainly methane from flooded rice cultivation; in the uplands it combines rice, livestock and crop residues. These agricultural emissions are diffuse and tied to livelihoods, and they require a different policy toolkit from that used for coal plants or steel mills.

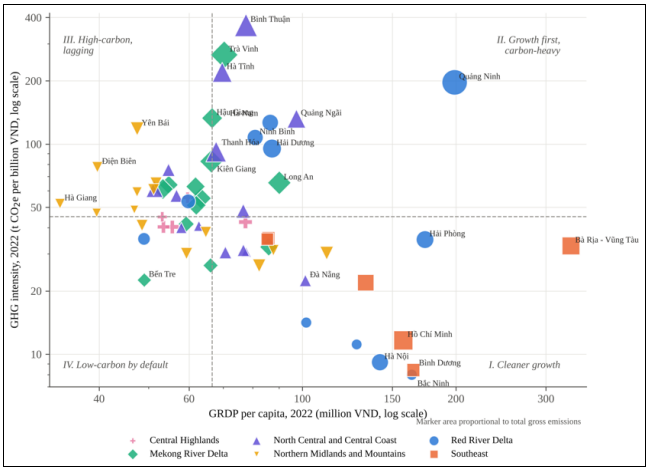


Source: Author's calculations from Climate TRACE

Fig 8: Sectoral composition of gross GHG emissions by region, 2022 (%)

5.4 Four provincial development paths

Fig 9 plots each province by GRDP per capita and carbon intensity. The dashed lines mark the medians and divide the space into the four development paths defined in Section 3.3. Marker size is proportional to total emissions.



Source: Author's calculations

Fig 9: Provincial development paths: GRDP per capita and GHG intensity of output, 2022 (log scales)

Across all 63 provinces, higher income is associated with lower carbon intensity (Spearman's $\rho = -0.34$, $p = 0.007$), but not with lower emissions per person ($\rho = 0.14$, $p = 0.26$). Richer provinces produce output more cleanly on average, but because they produce more of it, their residents' territorial emissions are no lower. The relationship is also far from tight. At similar income levels of 66–80 million VND per person, intensity ranges from about 30 t per billion VND (Bình Định, Ninh Thuận) to more than 200 t (Trà Vinh, Hà Tĩnh, Bình Thuận). Income alone tells us little about a province's carbon profile; what matters is which assets it hosts.

Table 5 summarises the four groups and Table 6 lists their members.

Table 5: Characteristics of the four provincial development paths, 2022

Path	Provinces	Pop. share (%)	GRDP share (%)	Emission share (%)	GRDP per capita (m VND)	Intensity (t/bn VND)	Per capita (t)	Energy–industry share (%)	Agriculture share (%)	Change 2021–24 (%)
I. Cleaner growth	20	44.7	62.4	24.6	134.9	18.1	2.4	49.6	13.2	19.1
II. Growth first, carbon-heavy	12	17.9	16.2	51.0	87.8	144.5	12.7	84.7	7.8	9.6
III. High-carbon, lagging	20	23.5	13.3	18.2	54.8	62.7	3.4	38.6	41.6	6.3
IV. Low-carbon by default	11	13.9	8.0	6.3	55.7	35.8	2.0	21.8	46.4	−0.1

Source: Author's calculations. Medians: GRDP per capita 66.6 million VND; intensity 45.1 t CO_2e per billion VND

Table 6: Province membership of the four development paths (ordered by GRDP per capita, 2022)

Path	Provinces
I. Cleaner growth (20)	Bà Rịa-Vũng Tàu, Hải Phòng, Bình Dương, Bắc Ninh, Hồ Chí Minh City, Hà Nội, Đồng Nai, Vĩnh Phúc, Thái Nguyên, Hưng Yên, Đà Nẵng, Lào Cai, Cần Thơ, Tây Ninh, Bình Phước, Bắc Giang, Ninh Thuận, Lâm Đồng, Khánh Hòa, Bình Định
II. Growth first, carbon-heavy (12)	Quảng Ninh, Quảng Ngãi, Long An, Hải Dương, Hà Nam, Ninh Bình, Bình Thuận, Quảng Nam, Trà Vinh, Hà Tĩnh, Thanh Hóa, Hậu Giang
III. High-carbon, lagging (20)	Kiên Giang, Tiền Giang, Đồng Tháp, Cà Mau, Thái Bình, Đắk Nông, Thừa Thiên Huế, Sóc Trăng, Quảng Bình, An Giang, Kon Tum, Lạng Sơn, Nghệ An, Tuyên Quang, Yên Bái, Lai Châu, Bắc Kạn, Điện Biên, Cao Bằng, Hà Giang
IV. Low-carbon by default (11)	Vĩnh Long, Hoà Bình, Quảng Trị, Phú Thọ, Bạc Liêu, Phú Yên, Đắk Lắk, Gia Lai, Bến Tre, Nam Định, Sơn La

Source: Author's classification

Path I, cleaner growth: Twenty provinces with 44.7% of the population produce 62.4% of GRDP but only 24.6% of gross emissions. Their average intensity (18.1 t per billion VND) is less than half the national average. The group includes the two metropolitan areas, the electronics and assembly hubs of Bắc Ninh, Bắc Giang, Vĩnh Phúc and Thái Nguyên (anchored by Samsung and its suppliers), and the industrial provinces around Hồ Chí Minh City. Their growth model relies on services and on high value-added assembly that uses grid electricity rather than on-site combustion. Transport is a large source in the metropolitan areas, and almost half of the group's emissions still come from the energy–industrial core. The low intensity is real, but it also reflects the fact that much of the coal power these provinces consume is generated elsewhere.

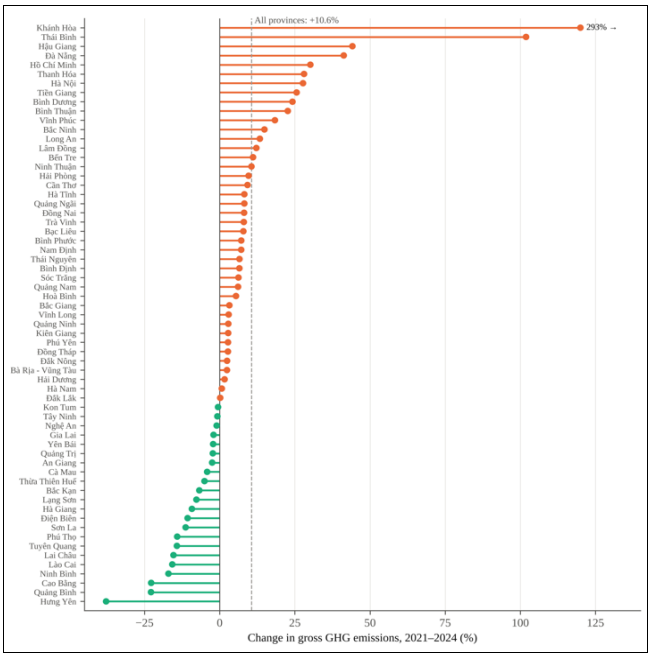
Path II, growth first, carbon-heavy: Twelve provinces with 17.9% of the population and 16.2% of GRDP emit 51.0% of gross greenhouse gases. Their intensity (144.5 t per billion VND) is eight times that of path I and their emissions per person (12.7 t) are five times higher. Nearly 85% of their emissions come from the energy–industrial core. These are the hosts of Vietnam's coal mines (Quảng Ninh), coal power complexes (Bình Thuận, Trà Vinh, Hải Dương, Hậu Giang), steel (Hà Tĩnh, Quảng Ngãi), cement (Ninh Bình, Hà Nam, Thanh Hóa) and refining (Thanh Hóa, Quảng Ngãi). Several of them, such as Trà Vinh, Hậu Giang and Bình Thuận, have only modest income per capita despite hosting gigawatt-scale plants. Hosting carbon-intensive assets has raised their GRDP but has not turned them into high-income provinces. This is the clearest illustration of a growth-first path whose benefits are shared with the rest of the country through the grid while the emissions stay local.

Path III, high-carbon, lagging: Twenty provinces combine below-median income with above-median intensity. They hold 23.5% of the population, 13.3% of GRDP and 18.2% of emissions. Two sub-paths can be distinguished. In ten provinces, mostly in the Mekong Delta (An Giang, Đồng Tháp, Sóc Trăng, Kiên Giang) and the northern mountains (Hà Giang, Cao Bằng, Bắc Kạn, Lai Châu, Điện Biên), agriculture accounts for 57–76% of emissions, and the high intensity reflects rice methane combined with low output per hectare. In the other ten, such as Yên Bái, Nghệ An, Thái Bình, Cà Mau and Thừa Thiên Huế, the energy–industrial core accounts for 46–71% of emissions (fuel-related and mining sources in Yên Bái, cement in Nghệ An, the gas–power–fertiliser complex in Cà Mau and a new coal plant in Thái Bình). The two sub-paths call for different responses, but both face the risk of becoming locked into carbon-intensive activities before they reach middle-income levels.

Path IV, low-carbon by default: Eleven provinces with 13.9% of the population emit only 6.3% of gross emissions. Their intensity is below the median, but not because of clean technology. Rather, they have little heavy industry; agriculture accounts for 46% of their emissions. Their low-carbon status is fragile. If they follow the path of their neighbours and attract cement, steel or thermal power to raise income, they could move rapidly into path II or III.

5.5 Recent dynamics, 2021–2024

Fig 10 ranks provinces by the change in gross emissions between 2021 and 2024. Total gross emissions grew by 10.6%. The median province, however, saw only a 3.0% increase, and 22 provinces recorded a decline. The aggregate growth was driven by a handful of large increases.



Source: Author's calculations from Climate TRACE

Fig 10: Change in gross GHG emissions by province, 2021–2024 (%). Bars truncated at 120%

The largest increases are linked to individual coal units entering service. Khánh Hòa's emissions almost quadrupled (+293%) after the Vân Phong 1 plant began operation; Thái Bình's doubled (+102%) with Thái Bình 2; Hậu Giang (+44%) reflects the ramp-up of Sông Hậu 1. Bình Thuận added a further 8.1 Mt CO_2e (+23%). Among the metropolitan areas, Hồ Chí Minh City (+30%), Hà Nội (+28%) and Đà Nẵng (+41%) grew mainly through transport as post-pandemic mobility recovered.

By group, the cleaner-growth provinces recorded the fastest growth (+19.1%), ahead of growth-first provinces (+9.6%), lagging high-carbon provinces (+6.3%) and low-carbon-by-default provinces (−0.1%). This finding needs careful interpretation. It is partly mechanical, because Khánh Hòa was classified on its 2022 intensity before Vân Phong 1 came online; with 2024 emissions, it would move into path II. It nevertheless shows that the cleaner-growth group is not insulated. New coal capacity can shift a province's path within a single year, and metropolitan transport emissions are rising quickly from a large base. The provinces whose emissions fell were mostly upland and agricultural provinces (Cao Bằng, Lai Châu, Tuyên Quang, Sơn La, Điện Biên), where livestock and crop emissions declined slightly, and a few provinces with lower cement or industrial output (Ninh Bình, Lào Cai).

5.6 The picture after the 2025 provincial merger

Resolution 202/2025/QH15 reduced the number of provincial units from 63 to 34 with effect from July 2025. Future provincial master plans, green-growth action plans and, potentially, emission-reduction responsibilities under the carbon market will be organised around the new units. Table 7 re-aggregates the 2022 data accordingly and re-applies the median classification to the 34 units (medians: 67.3 million VND per capita; 55.5 t CO_2e per billion VND).

Table 7: Carbon profile of the 34 provincial units formed in 2025 (based on 2022 data, ordered by intensity)

New unit	Former provinces	GRDP per capita (m VND)	Intensity (t/bn VND)	Per capita (t)	Energy–industry share (%)	Change 2022–24 (%)	Path
Hà Tĩnh	1	69.7	219.4	15.3	86.1	19.0	II
Quảng Ninh	1	198.8	196.5	39.1	96.0	12.8	II
Lâm Đồng	3	73.8	176.4	13.0	80.9	20.0	II
Quảng Ngãi	2	83.3	114.4	9.5	79.1	16.1	II
Vĩnh Long	3	60.8	109.6	6.7	79.4	27.3	III
Thanh Hóa	1	67.8	92.0	6.2	78.0	6.9	II
Ninh Bình	3	66.3	86.7	5.7	77.1	2.0	III
Điện Biên	1	39.7	77.7	3.1	23.0	1.9	III
An Giang	2	59.6	72.6	4.3	18.3	5.3	III
Lạng Sơn	1	51.7	65.2	3.4	45.9	3.1	III
Cần Thơ	3	69.8	63.7	4.4	43.1	7.9	II
Lào Cai	2	66.7	63.7	4.2	61.2	−2.0	III
Nghệ An	1	51.4	61.1	3.1	53.5	3.9	III
Quảng Trị	2	58.0	59.8	3.5	40.3	−16.7	III
Lai Châu	1	47.5	59.2	2.8	5.2	−0.7	III
Tuyên Quang	2	41.9	57.1	2.4	29.5	−2.7	III
Huế	1	56.7	56.8	3.2	55.0	−2.3	III
Hải Phòng	2	132.1	54.2	7.2	79.2	20.1	I
Cà Mau	2	60.7	53.8	3.3	46.8	−3.8	IV
Tây Ninh	2	88.4	53.7	4.7	41.2	7.6	I
Đồng Tháp	2	62.7	53.3	3.3	33.9	9.5	IV
Cao Bằng	1	39.6	47.0	1.9	4.8	2.6	IV
Sơn La	1	48.6	41.0	2.0	7.3	3.1	IV
Đắk Lắk	2	56.3	40.2	2.3	22.8	6.1	IV
Gia Lai	2	61.8	34.9	2.2	17.4	4.7	IV
Đà Nẵng	2	87.7	34.8	3.1	48.4	9.1	I
Hưng Yên	2	76.9	32.2	2.5	51.7	85.2	I
Thái Nguyên	2	99.0	32.0	3.2	56.7	9.9	I
Khánh Hòa	2	77.0	31.0	2.4	35.4	177.0	I
Đồng Nai	2	121.5	24.2	2.9	62.2	7.5	I
Phú Thọ	3	83.5	21.9	1.8	38.6	−4.1	I
Bắc Ninh	2	118.2	15.2	1.8	42.5	8.7	I
Hồ Chí Minh City	3	174.8	14.6	2.6	53.8	5.3	I
Hà Nội	1	141.9	9.2	1.3	28.4	8.5	I

Source: Author's aggregation using the merger list in Resolution 202/2025/QH15. Per capita and intensity computed from summed emissions, GRDP and population

The merger reshapes the map in two ways. Some mergers combine a carbon-heavy host with less intensive partners, so that the new unit's average intensity is lower but its absolute responsibility larger. The new Lâm Đồng, which absorbs Bình Thuận and Đắk Nông, becomes the third most carbon-intensive unit in the country (176 t per billion VND) and the second-largest emitter after Quảng Ninh. The new Vĩnh Long, which includes Trà Vinh, and the new Ninh Bình, which includes Hà Nam's cement belt, are similarly dominated by a few large plants. Other mergers dilute concentrated sources into large metropolitan economies. The Vũng Tàu industrial and power cluster is now part of Hồ Chí Minh City, whose combined intensity remains low (14.6 t). Hải Dương's coal plants are now inside Hải Phòng, which therefore sits close to the median intensity despite its high income.

The second effect is on the dynamics. Recent growth in the new Hưng Yên (+85% between 2022 and 2024, driven by Thái Bình 2) and Khánh Hòa (+177%, driven by Vân Phong 1) shows that two units classified as cleaner growth on 2022 data are already moving towards path II. Any provincial green-growth target set on the new boundaries will need to account for these large, recent additions.

6. Discussion

6.1 Green growth or growth first?

The evidence assembled here suggests that Vietnam's answer to the question in the title has so far been "growth first", with green growth emerging only recently and unevenly. Nationally, emissions grew faster than output in every five-year period from 2000 to 2020, which is the opposite of what the green growth narrative would predict for an economy moving up the value chain. The main reason is the expansion of coal power after 2014. Weak decoupling after 2020 is a welcome change, but it coincides with exceptional factors such as the solar feed-in tariff boom and good hydropower years, and the rebound in 2024 shows how quickly it can stall.

At the provincial level, the answer depends on where one looks. A large part of the country, accounting for most of its output, already follows a relatively clean growth path. Yet this path is supported by electricity from a small number of carbon-heavy host provinces. Seen as a system, the "cleaner growth" of Bắc Ninh or Hồ Chí Minh City and the "growth first" of Bình Thuận or Trà Vinh are two sides of the same model. This echoes Feng *et al.*'s (2013) [7] finding of within-country carbon outsourcing in China, and it means that

provincial intensity rankings, if used naively, would reward consumer provinces and penalise producer provinces for a division of labour that national planning has created.

6.2 Income is not destiny, assets are

The weak correlation between income and intensity, and the absence of any relationship between income and emissions per person, cast doubt on the idea that provinces will become greener simply by becoming richer. What distinguishes the most carbon-intensive provinces is not their income level but the presence of a few large, long-lived assets. Quảng Ninh's coal mines, the Vĩnh Tân and Duyên Hải power complexes, the Formosa and Hòa Phát steel works and the cement belt along the Red River Delta's southern edge account for a large share of national emissions. This is a textbook case of carbon lock-in (Unruh, 2000; Seto *et al*., 2016) [33, 28]. It also means that the transition is, in practice, manageable: The decisions that matter most concern a few dozen facilities in about a dozen provinces.

6.3 Two different kinds of high intensity

The typology also shows that high carbon intensity has two quite different sources. In growth-first provinces it reflects energy and heavy industry. In many lagging provinces, especially in the Mekong Delta, it reflects agricultural methane in economies with low output per worker. The mitigation options are entirely different. For the first group, they involve fuel switching, co-firing, efficiency standards, carbon pricing and planned retirement. For the second, they involve alternate wetting and drying of rice fields, straw management, livestock feed and manure practices and, above all, raising agricultural value added. The latter option reduces intensity by increasing the denominator rather than cutting emissions, and it aligns well with rural development objectives.

6.4 Limits of a territorial view

A production-based, territorial perspective is appropriate for questions of local planning and siting, but it is incomplete for questions of responsibility. Electricity consumed in an industrial park in Bắc Ninh may be generated in Quảng Ninh or Hải Dương; steel made in Hà Tĩnh is used in construction across the country. A consumption-based or "electricity-adjusted" provincial account would reallocate a large part of path II emissions to path I provinces. Constructing such accounts would require provincial electricity consumption and inter-provincial trade data, which are not yet publicly available.

7. Policy Implications

The findings point to several implications for provincial green-growth policy, especially as provinces prepare new master plans on the post-2025 boundaries.

Differentiate targets by development path: A uniform provincial target for reductions in carbon intensity would be easy for service-based provinces and very hard for host provinces. Targets could instead be set on the basis of each province's path. For path I, the priority is to curb transport and building emissions and to raise the share of directly procured renewable electricity in industrial parks. For path II, it is the planned conversion or retirement of coal units and decarbonisation of steel and cement. For path III, the agrarian sub-group needs low-emission rice programmes, while the industrial sub-group needs strict standards for new plants. For path IV, it is to avoid moving into carbon-intensive industrialisation in the first place.

Separate "host" emissions from "own" emissions in provincial accounting: For monitoring purposes, provinces could report emissions from grid-connected power plants separately from emissions related to their own economic activity. This would avoid penalising host provinces for national energy decisions while keeping them accountable for siting, environmental compliance and local air quality.

Share the benefits and costs of the transition with host provinces: The growth-first provinces have absorbed a disproportionate share of emissions, and they also stand to lose the most from coal phase-down in terms of jobs, budget revenue and land use. Resources mobilised through the Just Energy Transition Partnership and future carbon-market revenues could be directed towards just-transition plans in Quảng Ninh, Bình Thuận (now Lâm Đồng), Trà Vinh (now Vĩnh Long) and Hà Tĩnh.

Use the carbon market's facility-level design: Decision 232/QĐ-TTg establishes a pilot emissions trading system beginning with thermal power, steel and cement. These are exactly the sectors that define path II. The pilot can be designed to produce facility-level data that, aggregated by province, would greatly improve on the modelled estimates used here.

Build an official provincial inventory system: Decree 06/2022/NĐ-CP already requires large facilities to report greenhouse gas inventories. Publishing these data aggregated to the 34 new provinces, alongside provincial energy balances, would allow consumption-based adjustments and a proper monitoring framework for provincial green growth.

8. Conclusion

This paper provides a descriptive, province-level picture of the relationship between growth and greenhouse gas emissions in Vietnam. Nationally, growth has been carbon-intensive for most of the past quarter century, and weak decoupling has appeared only since 2020. Provincially, emissions are far more concentrated than income: A dozen host provinces with less than a fifth of the population and a sixth of output emit half of gross greenhouse gases. Twenty provinces that produce most of the country's output follow a cleaner growth path, but this path depends on electricity generated elsewhere and is not immune to new coal capacity. In poorer provinces, high intensity often reflects rice-paddy methane rather than heavy industry.

The answer to "green growth or growth first?" is therefore "both, in different places, and connected through the power grid". Vietnam's low-carbon transition will largely be decided in a small number of provinces that host its coal mines, power plants, steel mills and cement kilns. Provincial policies that recognise these different development paths, and that distinguish host emissions from emissions generated for local value added, are more likely to be both effective and fair.

The study has several limitations that suggest directions for future research. The emission estimates are modelled and cover only 2021–2024, which limits the analysis of long-run trends. GRDP data are available on a consistent basis only for 2022, so changes in intensity over time could not be computed at the provincial level. The territorial perspective ignores inter-provincial trade in electricity and goods.

Future work could combine Climate TRACE estimates with official facility reports as they become available, build electricity-adjusted provincial accounts, and, with longer series, test formally whether provincial development paths converge.

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