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Outward Foreign Direct Investment, Carbon Emissions, and the Green Transition: Lessons from Turkey's Climate Policy for Vietnam

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Abstract: *The relationship between outward foreign direct investment (OFDI) and environmental quality has attracted growing scholarly attention, yet qualitative and case-based investigations — particularly in emerging economies — remain scarce. This paper adopts a qualitative multiple case study methodology to examine how Turkey's OFDI dynamics, corporate green transitions, and the implementation of Climate Law No. 7552 (2025) interact to shape carbon dioxide (CO_2) emissions at firm and policy levels. Drawing on three embedded cases — Arçelik's global green expansion, Turkey's industrial zones under the pilot Emissions Trading System (ETS), and the role of trade in services in environmental decoupling — this paper synthesises key institutional mechanisms that either amplify or mitigate the carbon impact of OFDI. Turkey's experience is particularly instructive because it mirrors the developmental trajectory of Vietnam: both are rapidly industrialising, middle-income economies with rising OFDI, heavy reliance on fossil-fuel-intensive manufacturing, and recent commitments to Net Zero by mid-century. The findings identify three transferable policy lessons for Vietnam: (1) conditional green OFDI incentives linked to reverse technology transfer; (2) a phased ETS architecture aligned with EU Carbon Border Adjustment Mechanism (CBAM) obligations; and (3) a services-led growth strategy to structurally decouple economic expansion from emissions. These lessons offer actionable guidance for Vietnam's carbon market pilot (2025–2028) and its National Climate Strategy.*

Keywords: outward foreign direct investment; carbon emissions; Emissions Trading System; green transition; Turkey; Vietnam; pollution haven hypothesis; reverse technology spillover

1. Introduction

The global imperative to achieve net-zero emissions by the second half of the twenty-first century has placed enormous pressure on emerging market economies to reconcile their developmental aspirations with environmental sustainability. Within this context, outward foreign direct investment (OFDI) has emerged as a double-edged phenomenon: it can either export pollution to host countries, retain high-emission industries at home, or — through reverse technology spillover — catalyse a domestic green transition (Abozriba & Khalifa, 2026; Wang et al., 2025). Understanding which of these pathways dominates in a given institutional context is not merely an academic exercise; it has direct implications for how governments design OFDI regulations, carbon pricing systems, and trade policies.

Turkey provides an extraordinarily rich context for this inquiry. As a trillion-dollar economy positioned at the intersection of Europe, Asia, and Africa, Turkey has experienced rapid OFDI growth — reaching USD 834 million in new outward investment in December 2024 alone. Crucially, a recent quantitative study by Abozriba and Khalifa (2026) using the Autoregressive Distributed Lag (ARDL) model and Frequency Domain Causality Analysis (FDCA) confirmed that OFDI increases CO_2 emissions in Turkey in both the short and long run, while trade in services (TROP) significantly reduces CO_2 across all time horizons. These findings suggest that the scale effect and pollution haven hypothesis — whereby high-emission industries are retained domestically rather than relocated — currently prevail over the technique effect in Turkey's OFDI landscape.

What the quantitative study could not fully address, however, is why this relationship holds and through what institutional mechanisms it might be altered. This paper addresses that gap through a qualitative case study approach, examining three emblematic cases within Turkey's economy that together illuminate the micro-level processes driving macro-level CO_2 dynamics. Moreover, Turkey's 2025 landmark Climate Law — establishing a national ETS, a Carbon Market Board, and a Net Zero 2053 target — creates a natural policy inflection point that offers a rare "before-and-after" lens for qualitative investigation.

The relevance of Turkey's experience for Vietnam is substantial. Both economies share critical structural parallels: rapid industrialisation, large inflows of FDI concentrated in carbon-intensive manufacturing, nascent carbon market development, and significant export exposure to EU CBAM obligations. Vietnam launched its own pilot ETS in June 2025, targeting power, steel, and cement sectors that account for roughly 50% of national CO_2 emissions. Vietnamese enterprises including Viettel, FPT, and Vinamilk are accelerating OFDI into Africa and Southeast Asia, yet environmental governance of these outward flows remains underdeveloped.

This paper is structured as follows: Section 2 reviews the theoretical and empirical literature; Section 3 outlines the methodology; Section 4 presents the findings across three cases; Section 5 discusses cross-case implications; and Section 6 concludes with policy recommendations for Vietnam.

2. Literature Review

2.1 Theoretical Framework: Scale, Composition, and Technique Effects

The theoretical foundation for analysing OFDI and environmental quality rests on three canonical effects first formalised by Grossman and Krueger (1991) and subsequently extended to the FDI context. The scale effect posits that as economic activity expands through OFDI — whether by reinvesting foreign profits or retaining capital-intensive production at home — domestic emissions increase proportionally (Abozriba & Khalifa, 2026). The composition effect captures how a country's industrial structure, if dominated by pollution-intensive sectors, will sustain high emissions regardless of output scale. Critically, the technique effect — whereby firms access superior environmental technologies in host countries and transfer them back to the home country — represents the most promising channel through which OFDI can improve domestic environmental quality (Jiao et al., 2018; Wang et al., 2025).

Two competing hypotheses organise the empirical debate. The pollution haven hypothesis (PHH) holds that developed countries relocate carbon-intensive industries to nations with weaker environmental regulations (Abozriba & Khalifa, 2026). Conversely, the pollution halo hypothesis argues that FDI — whether inward or outward — diffuses superior management practices and cleaner technologies that improve environmental outcomes in both home and host countries. The empirical evidence is contested: while several studies support the PHH for Turkey and MENA economies (Seker et al., 2015; Abozriba & Khalifa, 2026), others find that OFDI reduces domestic pollution through reverse spillovers in China and BRICS countries (Gao et al., 2025; Wang et al., 2025).

2.2 Empirical Evidence on OFDI and CO_2: Turkey and Emerging Economies

Quantitative literature on Turkey's OFDI-CO_2 nexus is sparse but growing. Seker et al. (2015) found that economic growth significantly drives CO_2 in Turkey, while FDI has a positive but modest influence. More recently, Abozriba and Khalifa (2026) provided the most comprehensive treatment to date, confirming through ARDL and FDCA that OFDI Granger-causes CO_2 in Turkey's short and medium term, and that TROP reduces CO_2 across all time horizons. The study attributed the positive OFDI-CO_2 linkage to structural economic reallocation, whereby Turkish firms retain high-energy-intensive processes domestically while offshoring standardised, lower-emission activities.

In China and BRICS economies, the evidence is more nuanced. Chen et al. (using FMOLS and DOLS methods) confirmed the Environmental Kuznets Curve (EKC) hypothesis, suggesting OFDI in the long run can foster greener technologies in host nations. For developing economies, institutional quality has been identified as a key moderating variable: higher human capital and stronger domestic institutions amplify the reverse technology spillover of OFDI, thereby reducing CO_2 (Abozriba & Khalifa, 2026). Notably, for Vietnam specifically, prior research found no significant association between OFDI and CO_2, consistent with its National Climate Strategy prioritising low-carbon GDP growth in the 2021–2030 period.

2.3 Trade in Services, Digital Economy, and Environmental Decoupling

A notable contribution of Abozriba and Khalifa (2026) is its finding that trade in services (TROP) reduces CO_2 in Turkey across all time horizons, contradicting the assumption that a service-heavy economy still generates high emissions through aviation and hospitality. The mechanism operates through two channels. First, services are inherently less resource-intensive than manufacturing, reducing the carbon elasticity of GDP growth (Fiorini & Hoekman, as cited in Abozriba & Khalifa, 2026). Second, trade in services facilitates flows of clean technologies, management best practices, and digital infrastructure that improve carbon efficiency across sectors.

Turkey's Digital Transformation Strategy 2024–2028 explicitly treats digital investment as complementary to the green transition, recognising that digitalisation can substantially reduce carbon emissions in logistics, financial services, and public administration. This finding aligns with the broader emerging-market literature documenting that countries expanding their service export base — particularly in ICT, finance, and education — achieve faster decoupling of GDP from CO_2 than those relying primarily on manufacturing-led growth (Fiorini & Hoekman, cited in Abozriba & Khalifa, 2026).

2.4 Carbon Market Mechanisms and the CBAM Imperative

The European Union's Carbon Border Adjustment Mechanism (CBAM) has fundamentally altered the policy calculus for both Turkey and Vietnam. Turkey exports approximately €19 billion worth of CBAM-covered goods (steel, aluminium, cement, fertilisers) to the EU annually, representing approximately 8% of total exports. The financial exposure to CBAM levies — which take effect fully from 2026 — was the primary catalyst for Turkey's enactment of Climate Law No. 7552 in July 2025. The law establishes a national ETS with a pilot phase covering 800+ facilities emitting over 50,000 tonnes CO_2e annually, launching in 2026–2027 and transitioning to full implementation by 2028–2035.

Vietnam faces an analogous pressure. Its exports of steel, textiles, and electronics to the EU are substantial, and Vietnamese enterprises are already grappling with CBAM compliance obligations that intensify from 2026. Vietnam launched a pilot ETS in June 2025 (Decree 119/2025/ND-CP), covering power generation, steel, and cement sectors responsible for approximately 50% of national CO_2 emissions, with a full carbon trading platform anticipated by late 2026. The institutional design challenges facing Vietnam closely mirror those Turkey confronted in 2023–2024, making comparative case analysis particularly valuable.

2.5 Energy Efficiency Spillovers from FDI: Micro-Level Evidence

Beyond the macro-econometric literature, micro-level evidence from Turkish manufacturing firms provides important supplementary insights. Imbruno et al. (2023) demonstrated that domestic Turkish firms in sectors more likely to purchase inputs from foreign-owned suppliers tend to reduce their energy intensity significantly — confirming that vertical FDI linkages generate measurable environmental gains. This finding is consistent with the pollution halo hypothesis at the supply-chain level and suggests

that the aggregate OFDI-CO_2 result reported by Abozriba and Khalifa (2026) may mask significant heterogeneity across industries and firm types.

Similarly, technology spillover from FDI in Turkey does not occur automatically; it depends critically on domestic absorptive capacity, human capital, and ICT infrastructure (Econstor, 2018). This institutional conditionality has direct implications for Vietnam, where absorptive capacity in green technology sectors remains limited outside of large state-owned enterprises and foreign-invested firms.

3. Methodology

This paper employs a qualitative multiple case study design, following the methodological framework of Yin (2018). Three embedded cases within Turkey's economy were selected using purposive theoretical sampling to maximise conceptual variation across the OFDI-environment nexus: (1) a corporate-level case of green OFDI and reverse technology spillover (Arçelik); (2) a sector-level case of ETS implementation in industrial zones (steel sector); and (3) a macro-level case of trade-in-services-led environmental decoupling (digital services and tourism).

Data sources include publicly available corporate sustainability reports, official government policy documents (Climate Law No. 7552, ICAP ETS factsheets), peer-reviewed empirical studies, and institutional reports from the World Bank, UNCTAD, and ICAP. This triangulation of documentary sources follows established qualitative research practice in business and environmental studies (Bryman, 2016). For the Vietnam implications section, data were drawn from Vietnamese government decrees (Decision 232/QĐ-TTg, Decree 119/2025/ND-CP), enterprise sustainability disclosures, and comparative policy analyses.

Analysis proceeded through cross-case pattern matching and analytical generalisation (Yin, 2018), seeking to identify replicable causal mechanisms rather than statistical generalisability. Figure 1 illustrates the conceptual framework linking OFDI, institutional context, and CO_2 outcomes.

4. Findings

4.1 Case 1 — Arçelik and the Corporate Green OFDI Pathway

Arçelik is Turkey's largest home appliance manufacturer and one of its most prominent multinational firms, operating in over 50 countries across Europe, Africa, and Asia. As a case of OFDI with environmentally proactive management, Arçelik is distinctive because it has simultaneously expanded internationally while achieving significant domestic emission reductions — making it an outlier relative to the aggregate OFDI-CO_2 trend identified by Abozriba and Khalifa (2026).

Between 2010 and 2019, Arçelik reduced its GHG emissions by 70% across Turkish operations and cut energy consumption per product by 46.3% in its Turkey, Romania, China, Russia, and South Africa facilities. The company achieved carbon neutrality in its global production operations in 2019 and 2020, obtaining carbon credits through an innovative Carbon Finance Project for Energy-Efficient Refrigerators that generated equivalent emission reductions of 305,407 tonnes of CO_2 between 2013 and 2018. In 2020, Arçelik announced a target to achieve carbon neutrality in all Turkish production plants by 2025 and to reduce water consumption per product by 45% by 2030.

Table 1. Arçelik's Key Sustainability Milestones

Year	Achievement	Metric
2010–2019	GHG reduction in Turkey	70% reduction
2019	Energy consumption per product	↓ 46.3% vs. 2010 baseline
2019–2020	Carbon neutrality in global production	Achieved via carbon credits
2019	Renewable electricity in Turkey & Romania	100%
2025 target	Carbon neutrality in all Turkish plants	Committed

Source: BSI Group (2020); Arçelik Sustainability Reports (2020, 2023)

The critical mechanism enabling Arçelik's green performance was its OFDI into EU markets with stringent environmental standards (Germany, UK, France). Operating in these high-regulation environments compelled the adoption of EU-grade energy efficiency standards, ISO 14064-1 compliant emissions monitoring, and participation in CDP (Carbon Disclosure Project) reporting at an A- level. These standards were then retroactively applied to Turkish operations, exemplifying the reverse technique effect theorised in the OFDI-environment literature. Arçelik's inclusion in the BIST Sustainability Index, MSCI Sustainability Index, and FTSE4Good Emerging Markets Index further institutionalised green norms within the corporate governance structure.

This case demonstrates that the aggregate finding of Abozriba and Khalifa (2026) — that OFDI increases CO_2 in Turkey — does not hold uniformly across firm types. Multinational firms with OFDI concentrated in high-regulatory-standard markets are significantly more likely to achieve reverse technology spillovers that reduce domestic CO_2. The key institutional variable is the regulatory stringency of the host country, not OFDI per se.

4.2 Case 2 — Turkey's Pilot ETS and Industrial Zone Decarbonisation

The enactment of Climate Law No. 7552 on July 9, 2025, represents Turkey's most consequential climate policy milestone in decades. The law established a national ETS with an intensity-based cap system, free allowance allocation methodology

benchmarked against EU ETS standards, and a pilot phase launching in 2026–2027 covering 800+ facilities emitting over 50,000 tonnes CO_2e annually, including 107 steel installations responsible for 33.3 million metric tonnes CO_2 — approximately 12% of national emissions.

The law's architecture reveals several findings relevant to the OFDI-CO_2 dynamic identified by Abozriba and Khalifa (2026). First, the primary driver of the Climate Law was Turkey's EU CBAM exposure: with approximately €19 billion in CBAM-covered exports annually, Turkey faced a stark choice — establish a domestic ETS to claim CBAM exemption or effectively transfer carbon revenue to Brussels. This finding confirms that external trade policy pressure, specifically CBAM, is a more powerful trigger for domestic carbon pricing reform than domestic environmental advocacy alone.

Second, the ETS design reflects a deliberate sequencing strategy. The pilot phase (2026–2027) operates with administrative penalties reduced by 80%, providing a learning phase for the 800+ covered facilities. Companies have three years from the law's entry into force to obtain emissions permits, and the Carbon Market Board (established under the law) is empowered to approve national allocation plans and regulate offset mechanisms.

Third, and most significantly for the OFDI-CO_2 nexus, the law explicitly redirects all ETS auction revenues exclusively toward green transformation and climate action, with up to 10% allocated to just transition measures for affected workers and communities. This revenue recycling mechanism is designed to finance the technique effect at scale — enabling firms to invest in cleaner technologies funded by the very revenues generated from their current emissions.

The steel sector case illustrates the decarbonisation pressure most acutely. Turkey's 107 steel installations generate 33.3 million tonnes CO_2 annually — an industry deeply embedded in OFDI supply chains (Turkish steel producers invest in downstream operations across Europe and the Middle East). The ETS benchmark-based allocation methodology incentivises the most carbon-efficient producers to gain free allowances, while penalising laggards — creating a market signal that OFDI financing should be directed toward green technology acquisition rather than capacity expansion in high-emission domestic facilities. This directly addresses the structural reallocation problem identified by Abozriba and Khalifa (2026).

4.3 Case 3 — Trade in Services, Digital Transformation, and Environmental Decoupling

Abozriba and Khalifa (2026) found that TROP reduces CO_2 in Turkey across all short, medium, and long-term horizons — a finding attributed to the service economy's lower resource intensity and its role as a conduit for clean technology flows. Turkey's Digital Transformation Strategy 2024–2028 treats digital investment as structurally integral to green transition, providing a live institutional laboratory for this relationship.

Several qualitative patterns emerge from this case. First, Turkey's rapidly expanding digital services sector — including fintech, e-commerce logistics, software exports, and digital healthcare — represents a model of GDP growth with structurally lower carbon elasticity than manufacturing. Unlike industrial OFDI, which reinforces fossil-fuel-intensive domestic supply chains, digital service exports generate foreign exchange earnings with minimal domestic energy consumption.

Second, Turkey's tourism sector — historically a source of concern for its high carbon footprint through aviation and hospitality — is undergoing a structural shift toward premium, lower-volume, higher-value tourism. Istanbul and Cappadocia have implemented green accommodation standards that reduce per-tourist energy consumption, while MICE (Meetings, Incentives, Conferences, Exhibitions) tourism generates significantly lower per-revenue-unit emissions than mass beach tourism. This shift is consistent with the composition effect reducing aggregate emissions even as the tourism sector grows.

Third, Turkey's trade restrictions on service exports, where they persist, are identified in the literature as barriers to the deployment of specialised firms with clean commercial presences abroad (Fiorini & Hoekman, as cited in Abozriba & Khalifa, 2026). The progressive liberalisation of these restrictions — embedded in Turkey's 2024–2028 strategy — is anticipated to accelerate the TROP-CO_2 decoupling dynamic.

Table 2. Trade in Services vs. Manufacturing: Comparative Carbon Intensity (Turkey)

Sector	Share of GDP	Estimated CO_2 Intensity	ETS Coverage
Manufacturing (steel, cement)	~21%	High (>500 kg CO_2/USD 1,000 VA)	Yes (from 2026)
Tourism & hospitality	~12%	Medium (aviation-dependent)	Partial
Digital services & ICT	~8%	Low (<50 kg CO_2/USD 1,000 VA)	No
Financial services	~6%	Very low	No

Source: Authors' estimates based on World Bank data and Abozriba & Khalifa (2026)

5. Discussion

5.1 Cross-Case Synthesis: The Role of Institutional Quality

The three cases converge on a central finding: the OFDI-CO_2 relationship is not determined by OFDI itself, but by the institutional architecture within which OFDI occurs. Arçelik's green OFDI model succeeded precisely because EU regulatory stringency in host countries forced compliance that was then transferred back to Turkish operations. Turkey's ETS succeeded as a

policy instrument because CBAM created irresistible external fiscal pressure. The TROP-CO_2 decoupling dynamic operates most effectively when trade liberalisation is accompanied by digital infrastructure investment that shifts the composition of exports toward low-carbon services.

This synthesis resolves a key tension in the quantitative literature. Abozriba and Khalifa (2026) report that OFDI increases CO_2 in Turkey at the aggregate level — consistent with the scale effect and pollution haven hypothesis. Yet the Arçelik case demonstrates that firm-level heterogeneity is substantial: firms with OFDI in high-regulation markets exhibit the opposite dynamic. The aggregate result reflects the predominance of low-regulation-market OFDI in Turkey's OFDI portfolio, rather than an inherent property of outward investment.

5.2 Implications for Vietnam

Vietnam and Turkey share a strikingly similar structural profile: both are middle-income economies with manufacturing-led growth, large FDI inflows concentrated in carbon-intensive sectors, growing but still modest OFDI, and nascent carbon markets confronting EU CBAM obligations. Three targeted policy lessons emerge.

Lesson 1: Conditional Green OFDI Incentives. Vietnam's OFDI policy (currently oriented primarily toward telecommunications, agriculture, and mining) should incorporate environmental conditionality modelled on Turkey's approach. Enterprises seeking OFDI tax incentives or capital guarantees should be required to demonstrate that domestic operations will not exceed specified carbon thresholds, and that foreign profits or technology transfers will be reinvested in domestic green infrastructure within 3–5 years. Viettel's 2024 Sustainability Report — its first — signals nascent corporate awareness, but institutionalised green OFDI screening is absent.

Lesson 2: Phased ETS Aligned with CBAM. Vietnam's pilot ETS (June 2025, Decree 119/2025/ND-CP) is structurally well-positioned but faces implementation delays, with carbon trading platform launch now anticipated by late 2026. Turkey's ETS architecture — specifically its intensity-based cap system, 80%-reduced penalties during the pilot phase, and exclusive revenue recycling for green transformation — offers a directly applicable template. Vietnam should additionally accelerate CBAM readiness: EU-bound exports of steel, textiles, and electronics will face increasing CBAM scrutiny, and a domestic ETS provides the most efficient compliance pathway.

Lesson 3: Services-Led Decoupling Strategy. Vietnam's National Climate Strategy 2021–2030 explicitly prioritises low-carbon GDP growth but lacks a detailed services-sector pathway. Turkey's experience confirms that expanding trade in services — particularly digital services, fintech, logistics technology, and MICE tourism — can structurally reduce the CO_2 elasticity of GDP growth. Vietnam's FPT Software, VNG, and NashTech already export significant digital services to global markets; a dedicated services export strategy integrated with the carbon market would accelerate environmental decoupling.

6. Conclusions

This paper has employed a qualitative multiple case study methodology to investigate the institutional mechanisms through which OFDI shapes CO_2 emissions in Turkey, building on the quantitative foundations established by Abozriba and Khalifa (2026). Three central conclusions emerge.

First, the aggregate finding that OFDI increases CO_2 in Turkey reflects a composition problem rather than an inherent property of outward investment: Turkish firms predominantly invest in lower-regulation markets, retaining high-emission activities domestically. Where OFDI is directed toward high-regulation environments (as in Arçelik's EU operations), reverse technology spillovers demonstrably reduce domestic CO_2 — by 70% over nine years in the Arçelik case. This finding has critical implications for OFDI policy design: destination-sensitive OFDI incentives, favouring investment in economies with stringent environmental standards, can transform OFDI from a source of domestic pollution into a vehicle for green technology acquisition.

Second, Turkey's Climate Law No. 7552 (2025) and its pilot ETS represent a landmark institutional response to the CBAM-driven urgency of carbon pricing reform. The law's intensity-based architecture, phased implementation, and exclusive revenue recycling for green transformation provide a tested template that Vietnam can adapt to its own institutional context. Vietnam's pilot ETS (2025–2028) shares the same broad architecture but faces absorptive capacity constraints and implementation delays that Turkish experience can help navigate.

Third, trade in services represents an underutilised lever for environmental decoupling in both Turkey and Vietnam. The empirical finding of Abozriba and Khalifa (2026) — that TROP reduces CO_2 in Turkey across all time horizons — is supported qualitatively by Turkey's digital transformation strategy and the structural carbon efficiency advantage of service sectors. Vietnam, with a rapidly growing digital services export base, is well-positioned to pursue a services-led decoupling strategy if trade barriers are reduced and digital infrastructure investment is scaled.

For future research, scholars should examine the moderating role of institutional quality in the OFDI-CO_2 relationship using longitudinal qualitative methods across multiple emerging economies. Wavelet quantile regression and quantile-on-quantile causality approaches — suggested by Abozriba and Khalifa (2026) as future methodological directions — could complement the case-based insights presented here with more granular temporal analysis. Panel studies comparing Vietnam, Turkey, Indonesia, and other rapidly industrialising ASEAN economies would further enrich the policy-relevant evidence base.

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