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Electrifying the Future: Assessing the Economic and Environmental Impacts of a Shift Towards EV Production in Morocco

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Abstract

This paper assesses the economic and environmental implications of Morocco's strategic transition from Internal Combustion Engine Vehicle (ICEV) manufacturing to Electric Vehicle (EV) production, with a particular focus on the regional impacts of localizing high-value battery manufacturing. Using an Interregional Input–Output (IR-IO) model extended with environmental satellite accounts, the study simulates a structural shock related to the wholesale substitution of ICEV-specific inputs with EV-specific components. The results highlight substantial macroeconomic gains, including a 1.9% increase in national GDP and positive employment growth, particularly in Tanger–Tétouan–Al Hoceima, Rabat–Salé–Kénitra, and Casablanca–Settat. However, these benefits are regionally concentrated, exposing the risk of deepening spatial inequalities. Additionally, while the transition enhances Morocco's position in global green value chains, it also induces a measurable rise in CO_2 emissions, especially in industrial and phosphate-rich regions. This paradox—economic advancement accompanied by environmental degradation—raises critical concerns about policy alignment between industrial growth and energy decarbonization.

Keywords: ICE, EV, Input-Output, Growth, Emissions.

1. Introduction

The global automotive sector is undergoing its most profound structural transformation since the advent of mass production, driven by mandatory decarbonization targets, accelerating technological maturity in Electric Vehicle (EV) platforms, and a geopolitical push for resilient supply chains. This transition fundamentally redefines the automotive Global Value Chain (GVC), altering input requirements, production locations, and the structure of industrial employment. For developing and middle-income countries that have successfully anchored their industrial bases around Internal Combustion Engine vehicle (ICEV) production, this pivot represents both an existential threat to established capacity and a significant opportunity for adaptive integration into emerging green GVCs.

Morocco stands as a paramount case study in this global dynamic. Over the past two decades, the nation has evolved from having an infant manufacturing sector to becoming a leading industrial platform and the country's primary export sector. Leveraging strategic geographical proximity to Europe, industrial policies, and competitive labor costs, Morocco achieved an assembly and production capacity exceeding 700,000 vehicles, solidifying its position as an attractive and competitive hub in the ICEV value chain. However, this established success is inherently vulnerable. As Europe, Morocco's principal market, accelerates its phase-out of ICEV vehicles, the significant capital stock, specialized workforce, and established supplier networks focused on ICEV-specific components risk rapid devaluation, necessitating a rapid and costly structural adjustment.

In response, Morocco has strategically committed to vertical integration within the high-value segment of the EV supply chain, aiming to decouple its manufacturing future from ICEV components. This strategy is anchored by decisive Foreign Direct Investments (FDIs) targeting EV battery and precursor material manufacturing. Crucially, China's Gotion High-Tech committed \$6.5 billion to establish Africa's first battery Gigafactory in Kenitra, located within the Rabat-Salé-Kénitra region. This facility is designed for an initial annual capacity of 20 gigawatt-hours (GWh), scaling rapidly to 100 GWh, and specializing in the production of high-value components such as cathodes and anodes. This pivot is further reinforced by leveraging domestic resources, specifically integrating OCP[1]'s expertise in phosphate chemistry to secure crucial upstream materials for lithium-iron-phosphate (LFP) cathode production, thereby securing supply chain sovereignty and reducing reliance on traditional Asian suppliers.

The localization of this specialized, capital-intensive manufacturing marks a radical structural transformation far exceeding mere industrial expansion. It creates entirely new, complex, and geographically concentrated inter-sectoral linkages that challenge the automotive sector's activity in Morocco, which is currently concentrated mainly across three main regions: Tanger-Tetouan-Al Hoceima, centered around the Renault Tangier plant; Grand Casablanca-Settat, the traditional industrial hub hosting SOMACA (a Renault subsidiary); and the emergent Rabat-Salé-Kénitra, anchored by the Stellantis plant in Kenitra. Among the fundamental questions confronting policymakers, there is a need of quantifying the scale and spatial distribution of the resulting economic, employment, and environmental impacts—particularly where the new growth drivers' conflict with established regional specialization and national sustainability goals.

To address this complex assessment and answer the following research question: Can the EV transition deliver meaningful economic gains for Morocco while maintaining environmental sustainability, and how are these effects distributed across regions? this paper employs a rigorous Interregional Input-Output (IR-IO) model. The IR-IO framework is uniquely suited to capture the spatially asymmetric consequences of policy-driven structural change, providing a granular view of output, value-added, and employment multiplier effects across distinct geographical areas. The methodology simulates a radical technology change shock to the national automotive sector, reflecting the wholesale substitution of intermediate demand away from ICEV-specific inputs (e.g., engines, mechanical parts) towards EV-specific components (e.g., batteries, specialized electronics).

Crucially, the localization of the Giga Factory is modeled as a massive exogenous stimulus within the Rabat-Salé-Kénitra region. Based on the scale of investment and planned vertical

[1] Office Cherifien des Phosphates, Morocco's leading company in phosphate mining industry.

integration, the scenario assumes a substantial increase in the total intermediate activity of the chemical industry sector specifically in this region. This shock captures the immediate backward linkages stimulation from high-value battery component manufacturing, which must supply the assembly hubs in the three Moroccan automotive regions. The study extends the traditional IR-IO structure by incorporating a satellite account for environmental analysis, quantifying the change in induced CO2 emissions resulting from the output expansion.

The simulation yields important, yet paradoxical, results for the sustainability of this transition. The economic analysis indicates substantial, positive increases in regional GDP and aggregate national employment, validating the strategic necessity of the GVC pivot and confirming the emergence of Rabat-Salé-Kénitra as a high-value manufacturing pole. However, the environmental extension reveals a measurable and concerning rise in aggregate CO2 emissions. This rise is directly attributable to the energy intensity inherent in battery component manufacturing (chemical processing) and the current reliance on non-decarbonized electricity generation sources utilized by these new manufacturing clusters. This juxtaposition of economic success with environmental compromise elevates the study from a mere calculation of economic impact to a critical analysis of policy synchronization, where accelerated industrial policy (battery manufacturing) must be rapidly aligned with national energy decarbonization goals to ensure the credibility of Morocco's 'green' transition.

The paper is structured as follows: Section 2 gives a review of the existing literature. Section 3 provides the theoretical and technical framework of the IR-IO model, defining the technology shock calibration and the CO_2 extension. Section 4 presents the simulation results regarding output and employment and carbon emissions. Section 5 concludes and discusses policy implications.

2. Literature Review

The transition from ICEV to EV is not merely a technological evolution—it represents a major economic restructuring, with complex implications for employment, industrial competitiveness, and environmental sustainability. Increasingly stringent carbon targets, coupled with technological advances and consumer preferences, have accelerated this transformation, prompting a growing body of research to quantify its impacts. Among these, Computable General Equilibrium (CGE) and Input-Output (IO) modeling frameworks have emerged as the principal tools for understanding the macroeconomic and intersectoral effects of EV transitions.

The existing economic literature highlights both disruptive and growth-inducing effects. Storm and Schröder (2025), analyzing the German auto sector, argue that while EVs will initially displace value-added in traditional ICEV supply chains, the long-term effect can be GDP-enhancing if nations successfully localize battery production and upgrade electric infrastructure. Similarly, in the EU context, Tamba et al. (2022) apply a CGE model incorporating techno-economic assumptions for road transport electrification. They find that EV deployment stimulates GDP and shifts value creation toward the energy and high-tech manufacturing sectors. However, their findings caution against neglecting the transitional frictions, including capital immobility and regional imbalances.

Employment effects have drawn special attention, given the differing labor profiles of EV and ICEV manufacturing. Studies consistently show that EVs, with fewer mechanical components, require less assembly labor but more specialized technical inputs. Guo et al. (2022), using an integrated CGE-IO model for China, find a net reduction in automotive employment but substantial job creation in upstream sectors such as battery manufacturing and grid infrastructure. In contrast, Fragkiadakis et al. (2020) emphasize that supportive industrial policy, particularly domestic battery manufacturing, can counterbalance employment losses. Alabi et al. (2022), employing a UK-wide CGE model, show that investment in charging networks and domestic supply chains can result in net employment gains under most transition scenarios.

Environmental impacts, especially those relating to CO_2 emissions, remain one of the key drivers of the EV agenda. Direct tailpipe emissions are eliminated in EVs, but the net climate benefit depends on lifecycle emissions, including electricity generation and battery production. In a comprehensive Multi-Regional Input Output (MRIO) analysis, Bravo et al. (2024) show that Spain could cut CO_2 emissions from passenger transport by over 50% if the grid decarbonizes in parallel with the EV rollout. Similarly, Peng et al. (2021), studying China's EV policy using a CGE framework, find that EV adoption significantly reduces CO_2 emissions, but the effect is nonlinear and depends on accompanying policies like emission trading schemes and clean electricity investments.

From a systems perspective, CGE and IO models provide the most holistic assessment. Alabi et al. (2022) use a dynamic CGE model for the UK to explore how network infrastructure spending for EVs interacts with macroeconomic outcomes. Their results highlight the importance of sequencing: network bottlenecks can create inflationary effects and suppress net economic gains. Pirmana et al. (2023), using a CGE framework calibrated to Indonesia, find that EV deployment leads to CO_2 reductions but also shifts emissions upstream if grid decarbonization lags. In France, Leurent and Windisch (2015) employ an IO-based fiscal modeling framework to evaluate how EVs affect public finances. They conclude that while EVs reduce energy tax revenues, they increase employment and VAT collections in infrastructure and R&D sectors, offering a complex but balanced fiscal picture.

In Morocco, the implications of electrifying the automotive sector are context-specific. Najib and Haddad (2024) provide a pioneering structural decomposition analysis combined with IO modeling, focusing on regional economic dynamics. Their simulations indicate that Morocco's coastal hubs, particularly Tangier, could benefit significantly from forward and backward linkages to Europe's EV market. However, they warn that without a national strategy for skills development and renewable energy deployment, the country may remain a low-value-added assembly zone. The study also finds that EV transition could increase GDP by up to 1.4% in a high-ambition scenario, while the employment impact depends heavily on the ability to localize battery and software components. The Moroccan case reemerges as particularly salient when viewed through an industrial policy lens. The IMF's analysis (Raissi et al., 2025) similarly emphasizes the need for integrated education, infrastructure, and environmental policies to manage the social and economic transition effectively.

Finally, several global studies echo the view that transition success hinges on coordinated, multi-sectoral approaches. Nieto et al. (2024), studying the UK's EV roadmap, suggest that while energy efficiency and CO_2 reduction targets are achievable, rebound effects from increased electricity demand and changes in labor income can dilute gains. Fragkos and Fragkiadakis (2022), using the GEM-E3-FIT model, find that ambitious EV and carbon pricing policies can simultaneously achieve employment and environmental goals, but only if equity concerns are addressed through fiscal redistribution.

3. Methodology

3.1. Interregional Input–Output Framework

This paper employs an interregional input–output (IR-IO) model tailored to Morocco's 12 region economy. Input–output analysis links the output of one industry to the inputs of another, and an interregional IO model adds a spatial dimension by linking industries across different regions. As a result, our IR-IO framework captures both intra-regional production linkages and interregional spillovers: for example, how a demand shock in the Rabat-Salé-Kénitra region chemical sector feeds into increased output of suppliers in other regions. This "full information" interregional model explicitly includes interregional feedback effects that single-region models would miss. We treat the model as a static Leontief model, assuming fixed technical coefficients and constant returns to scale. That is, industries have fixed input proportions and unlimited capacity to scale output proportionally to demand changes, an assumption consistent with standard IO analysis. Under these assumptions, the economy's response to shocks can be computed using the Leontief inverse.

Considering X as the gross output, A the Leontief matrix of technical coefficients, and Y a final demand vector, we can describe the use of output between intermediate and final demand in matrix form as:

$$X = AX + Y$$

$$X - AX = Y$$

$$(I - A)X = Y$$

$$X = (I - A)^{-1}Y$$

$$\Delta X = (I - A)^{-1}\,\Delta Y$$

The entries of the Leontief inverse matrix represent output multipliers – they embody the direct and indirect production required in each sector (and region) per unit of final demand for a given sector's product. By summing a column of the Leontief inverse, we obtain the total output multiplier for that sector's demand, and by incorporating industry-specific employment or income coefficients, we derive employment and income multipliers. These features make IR-IO models well-suited to evaluate "what-if" policy scenarios and to trace the propagation of shocks through regional economies.

3.2. Shock Scenario Design and Assumptions

Using the IR-IO framework, we simulate a technology transition shock to Morocco's automotive sector reflecting the shift from ICEV-focused production to EV-focused production. The shock is introduced as follows:

We model the wholesale substitution of intermediate inputs in vehicle manufacturing: in the EV scenario, automobile assemblers drastically reduce or eliminate their purchases of ICEV-specific components (e.g. combustion engines, transmissions) and instead demand new EV-specific components (notably high-voltage battery packs and related electronics). In practice, Morocco's baseline (ICEV-centered) input structure involves significant expenditures on engines and drivetrain parts, many of which were imported or produced by local suppliers geared toward ICEV technology. Under the EV scenario, these inputs are assumed to drop to zero, while battery systems (categorized under the chemical/electrical components industry) become a major new input. We implement this by adjusting the technical coefficients of the automotive sector: Table 1 summarizes the key coefficient changes. The coefficient for "engine, transmission & drivetrain components" input into automotive assembly is set to zero in the EV case (down from an illustrative 0.2 in the baseline, i.e. 20% of input cost), whereas a new coefficient of 0.3 is introduced for "battery components" input (up from essentially zero in the baseline). This implies that for each dirham of vehicle output, 0.3 dirham of battery pack components is required in the EV scenario (replacing the 0.2 that was for engines in the ICEV case).

Table 1. Key Coefficients and Shock Parameters (Baseline vs. EV Transition Scenario)

Model Parameter	Baseline (ICEV-centric)	EV Transition Scenario
Automotive sector intermediate input from battery components (chemical industry)	~0 (negligible)	0.3 (30% of output)
Automotive sector intermediate input from engine, transmission & drivetrain components	0.2 (20% of output)	0 (eliminated)
Exogenous output shock to Chemical industry in Rabat–Salé–Kénitra	None (no local EV battery production)	+ $1.3 billion annual output (new EV battery Gigafactory)

Source: Miscellaneous web sources

Table 1 highlights the structural change imposed on the model. In the baseline, virtually no domestic battery production exists (and any battery inputs are imported), whereas in the EV scenario a sizable portion of the automotive value chain is now supplied by the local battery/chemical industry. Concurrently, domestic demand for combustion engines and related parts falls to zero – these ICEV-specific components either disappear or are imported at much lower volumes (Europe's phase-out of ICEV vehicles will render many ICEV component suppliers obsolete, per our assumption). The net effect is a substantial increase in demand for the chemical sector in the Rabat region, which is experiencing a positive output shock, while certain traditional automotive suppliers face contractions. It is important to note that our model keeps total vehicle output constant in this simulation – we assume Morocco's assembly plants produce a similar number of vehicles, but with a different mix of inputs. Thus, the scenario isolates the impact of changing the supply chain composition (rather than an overall increase in vehicle production). In reality, EV production could grow or reduce the total output, but that is beyond our conservative scope here. By holding final vehicle demand constant and reallocating intermediate demand, we can attribute changes in economic outcomes directly to the pivot in supply chain structure. This approach aligns with an intermediate demand-side simulation of technological change, a common application of IO models to explore "what-if" scenarios of industrial transformation.

We acknowledge that this is a stylized shock: it assumes instantaneous substitution and does not explicitly model dynamic adjustment costs or capacity constraints. However, it provides a first-order estimate of the direction and magnitude of regional impacts under the EV transition. The modeled shock is deliberately large – effectively a "maximum-impact" scenario – given that the Gigafactory represents a step-change in Morocco's industrial base. The government's stated aim is to use such investments to safeguard 220,000 automotive sector jobs during the shift from combustion to electric technologies, underscoring the scale of change being considered. Our scenario thus tests whether the new EV supply chain can indeed offset losses elsewhere by generating equivalent or greater economic activity.

After implementing the coefficient changes in the IR-IO system, we recompute the new equilibrium output for all industries and regions. The difference between the scenario output vector and the baseline output yields the impact of the EV transition shock on each region's economic output. From these output changes, we derive changes Gross Domestic Product (GDP) and employment by applying sector-specific value-added-to-output ratios and labor-output coefficients. These sectoral ratios are obtained from the IR-IO data (for value added) and from employment data aligned to IR-IO sectors. In essence, if sector i in region r has a baseline labor productivity of x jobs per million dirhams of output, then an increase of y million dirhams in that sector's output leads to xy additional jobs. This way, we translate the IR-IO model's output multipliers into socioeconomic metrics. Notably, the IR-IO model captures both direct effects (e.g. jobs at the battery factory itself) and indirect effects (jobs at suppliers of materials, electricity, services, etc., across all regions) stemming from the shock.

3.3. Environmental Impact Extension

To assess the sustainability implications, we integrate an environmental satellite account into the IR-IO model, focusing on CO_2 emissions. This involves attaching an emissions coefficient (intensity) to each sector in each region, representing Gigagrams of CO_2 emitted per unit of output. These sectoral coefficients are derived from MRIO EORA database and allocated to different regions according to relative output shares. (Table 2).

The methodology extends the input–output model with an environmental layer by attaching to each sector a coefficient that represents how much carbon dioxide it emits per unit of output. For example, if production rises due to the EV transition shock, these coefficients will allow the model to calculate the corresponding increase in emissions, including indirect effects such as higher electricity use triggered by battery manufacturing. This matters because, although EVs reduce emissions at the point of use, producing their batteries is very energy-intensive and more polluting than making conventional engines. As a result, the scenario may show that while Morocco gains economically from the shift, overall carbon emissions also increase, highlighting the trade-off between industrial development and environmental sustainability.

Table 2: Coefficients of CO_2 Emissions by Sector: Morocco, Gg/DHS* Millions, 2019

Sector	CO2/GO (Gg/DHS millions)
Agriculture	0,07337
Mining	0,05734
Food, Tobacco	0,00583
Textiles, Leather	0,01175
Chemicals	0,06511
Metals, Machinery	0,01871
Other Industry	0,01638
Utilities	0,47487
Construction	0,00813
Trade	0,00995
Hotels, Restaurants	0,01428
Transport	0,17821
Post, Telecom	0,01092
Finance	0,00682
Real Estate	0,00682
Public Admin	0,01055
Education, Health	0,07061
Other Services	0,00256

Source: MRIO EORA Database

4. Results

4.1. Macroeconomic and regional economic impacts

At the national level, Morocco records a 1.9 percent increase in GDP as a result of a hypothetical radical shift towards EV production. On one side, the country benefits from the surge of activity in the chemical industry driven by the Gigafactory investment and from the strong ripple effects into upstream and downstream suppliers. On the other, the transition reduces demand for ICEV-specific suppliers such as engines, transmissions and drivetrains, components that are largely imported rather than domestically produced, which limits the negative growth impact of the import leakage. The aggregate result is therefore decisively positive, confirming that the transition to EV production yields broad-based macroeconomic gains.

Regionally, the outcomes are highly asymmetric (Table 3). Tanger–Tétouan–Al Hoceima records a 2.1 percent increase, placing it above the national average. Considering location of Renault's Tangier plant and a dense supplier network, particularly in wiring harnesses and assembly components, the region is well positioned to gain from the EV shift. Harness demand expands with high-voltage systems, and assembly activity remains robust, while strong backward linkages connect Tangier to the new battery production capacity in Kenitra. Rabat–Salé–Kenitra region posts the highest increase, 2.3 percent, confirming its emergence as the new growth pole. This reflects the scenario's design, with the Gigafactory shock modeled as a major boost to the chemical industry sector as well as the region's growth. Anchored by the Stellantis plant, Rabat–Salé-Kenitra region now combines assembly capacity with localized battery manufacturing, transforming it into a vertically integrated hub with powerful multiplier effects. Casablanca–Settat grows by 2.8 percent, placing it alongside Rabat–Salé–Kénitra as a top beneficiary of the transition rather than a laggard. The region's strong result reflects how its dense supplier base, business services, logistics and finance functions, and the SOMACA-centered industrial ecosystem are able to pivot toward EV demand. Conventional suppliers retool into activities that remain or expand under electrification—metal stampings and structures, wiring and electronics integration, testing and certification, engineering and IT services—while Casablanca's role as a procurement, trade, insurance, and logistics hub amplifies multipliers. Spillovers from the Gigafactory raise orders that flow through Casablanca's chemicals distribution, machinery maintenance, packaging, and port-related services, so the uplift is broad-based and not merely residual. In short, Casablanca's diversification and service-intensive backbone allow it to capture a disproportionate share of the new EV value chain, matching Rabat–Kénitra's 2.8 percent surge driven by direct battery manufacturing.

Other regions experience more moderate gains. Beni Mellal–Khénifra records the highest gains among the non-automotive regions, expanding by 1.8 percent. This positive outcome is mainly driven by the backward linkages of the EV sector to the phosphate industry used in battery production, as the region hosts the country's largest phosphate rock mine. Marrakech–Safi and Fès–Meknès expand by 1.3 percent and 0.8 percent respectively, reflecting their industrial and service linkages to the automotive sector. The Oriental region and Souss–Massa both record increases at the order of 0.5-1 percent. The southern regions see also differentiated impacts: Laâyoune–Sakia El Hamra grows by just 1.3 percent due to the present of phosphates sites, while Guelmim–Oued Noun and Dakhla–Oued Ed-Dahab record very low gains, 0.2 and 0.1 percent respectively, mirroring their limited industrial base.

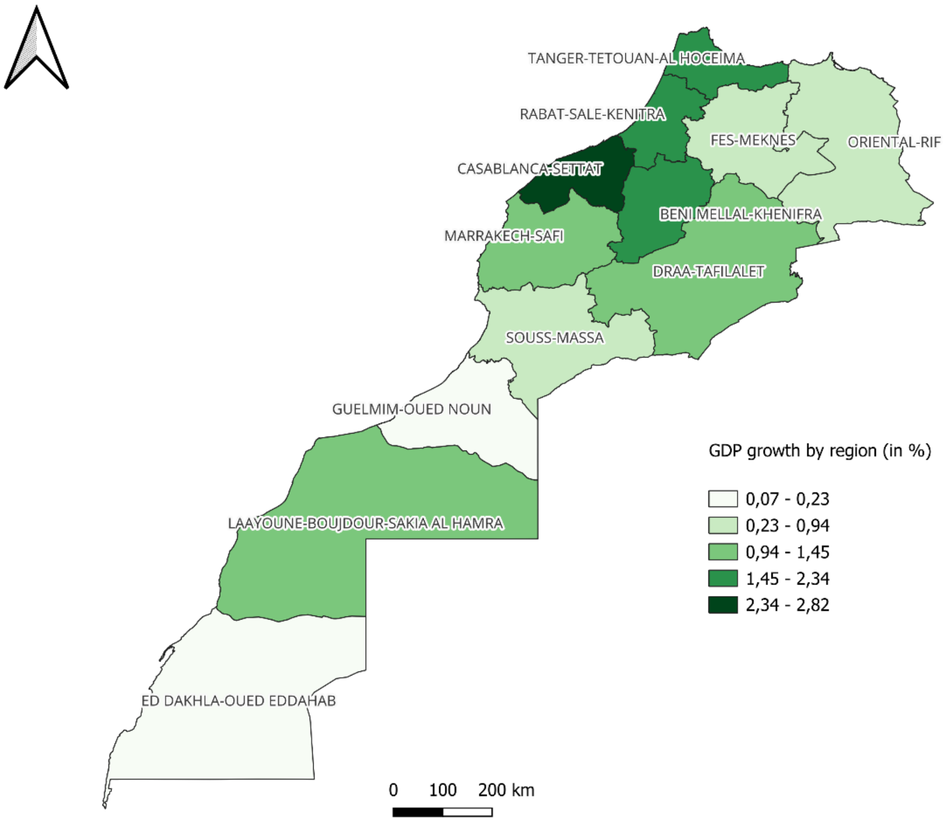
Table: Macroeconomic and regional impacts of a radical shift towards EV production (in %)

Region	Output Gain
Tanger-Tetouan-Al Hoceima	2,1%
Oriental	0,9%
Fès-Meknès	0,8%
Rabat-Salé-Kénitra	2,3%
Béni Mellal-Khénifra	1,8%
Grand Casablanca-Settat	2,8%
Marrakech-Safi	1,3%
Drâa-Tafilalet	1,3%
Souss-Massa	0,5%
Guelmim-Oued Noun	0,2%
Laayoune-Sakia El Hamra	1,4%
Dakhla-Oued Eddahab	0,1%
Morocco	**1,9%**

Source: Author's elaboration

Taken together, these results highlight the fundamentally uneven geography of Morocco's EV transition. At the aggregate level the gains are cleart, but the distribution of those gains remains highly concentrated (Figure 1). Rabat–Salé–Kénitra and Casablanca–Settat emerge as the principal winners, the former propelled by the Gigafactory and the latter by its diversified industrial and service ecosystem. Tangier–Tétouan–Al Hoceima consolidates its role as the assembly powerhouse, while Beni Mellal–Khénifra and Laâyoune–Sakia El Hamra leverage their phosphate endowment to secure substantial increases outside the automotive heartlands. Other regions capture more modest benefits, mainly through indirect service, trade, and resource linkages. The picture that emerges is one of national-level dynamism anchored in a few industrial poles, with peripheral regions only partially integrated into the new value chain. This raises the prospect of significant regional imbalance, underscoring the need for complementary policies to diffuse the benefits of electrification beyond the core hubs of Kenitra, Casablanca, and Tangier.

Figure 1: Regional economic impacts of a radical shift towards EV production (in %)



Source: Author's elaboration

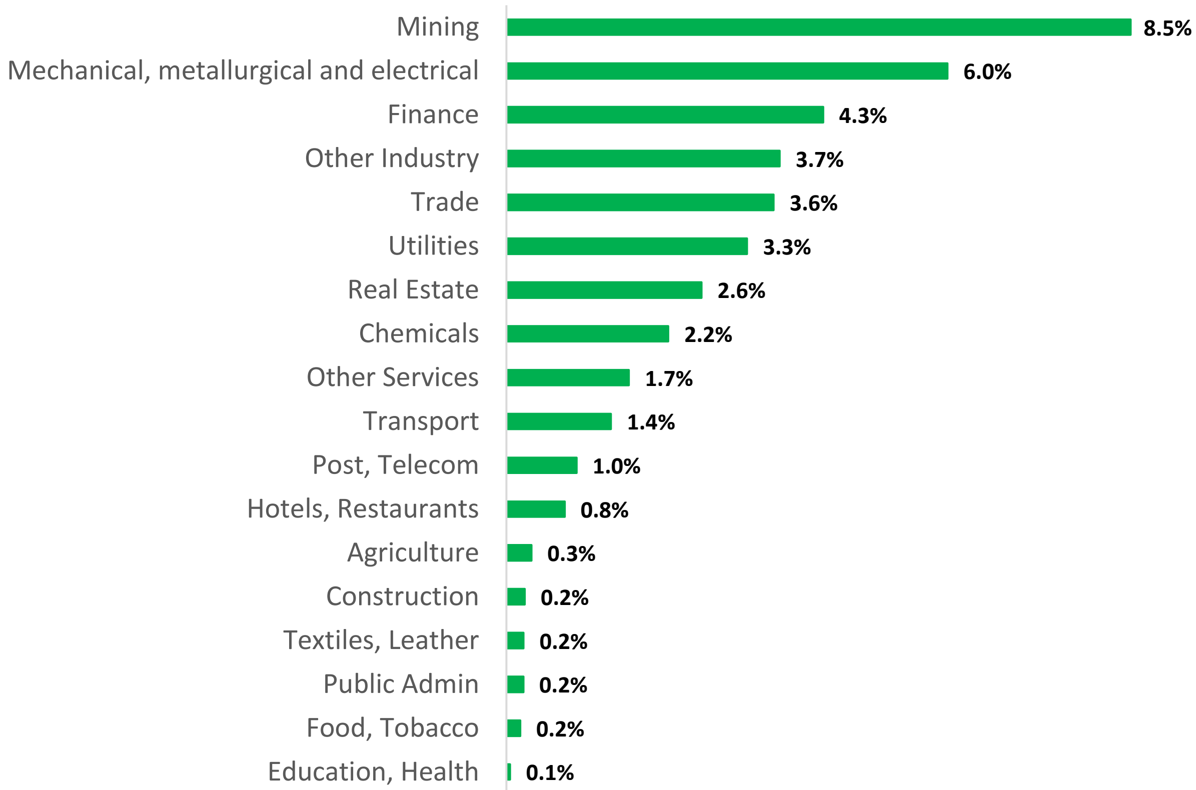
4.2. Sectoral impacts

The sectoral results show that the strongest gains are concentrated in industrial and extractive activities (Figure 2). Mining expands by 8.5 percent, the clearest beneficiary of the EV pivot given the upstream pull of battery production on phosphate and metal inputs. Mechanical, metallurgical and electrical activities follow with 6.0 percent, reflecting Morocco's specialization in wiring harnesses and the additional demand created by high-voltage systems and power electronics. Chemicals increase by 2.2 percent, but this relatively moderate gain, despite the sizable initial Gigafactory shock, is explained by two factors: the shock is geographically concentrated in Rabat–Salé–Kénitra, and the chemicals sector itself is only weakly integrated into the rest of the Moroccan economy, with a substantial share of demand leaking out through imports.

Finance grows at 4.3 percent as capital- and trade-finance needs expand along with insurance and working capital services for batteries and new logistical platforms. Trade increases by 3.7 3.6 percent, capturing plastics, packaging, machining, and distribution effects that scale with EV assembly and battery inputs. Utilities rise 3.3 percent, in line with the energy and water intensity of cell and materials processing, while real estate advances 2.6 percent through industrial leasing and business services linked to the new EV-related production hubs.

The services and logistics cluster shows measured but broad-based increases. By contrast, agriculture growth at 0.3 percent, construction, textiles and leather, public administration, and food and tobacco growth at 0.2 percent exhibit only marginal links to the EV pivot, while education and health at 0.1 percent reflect limited training and occupational-health spillovers.

Figure 2: Sectoral impacts of a radical shift towards EV production (in %)



Source: Author's elaboration

4.3. Employment impacts

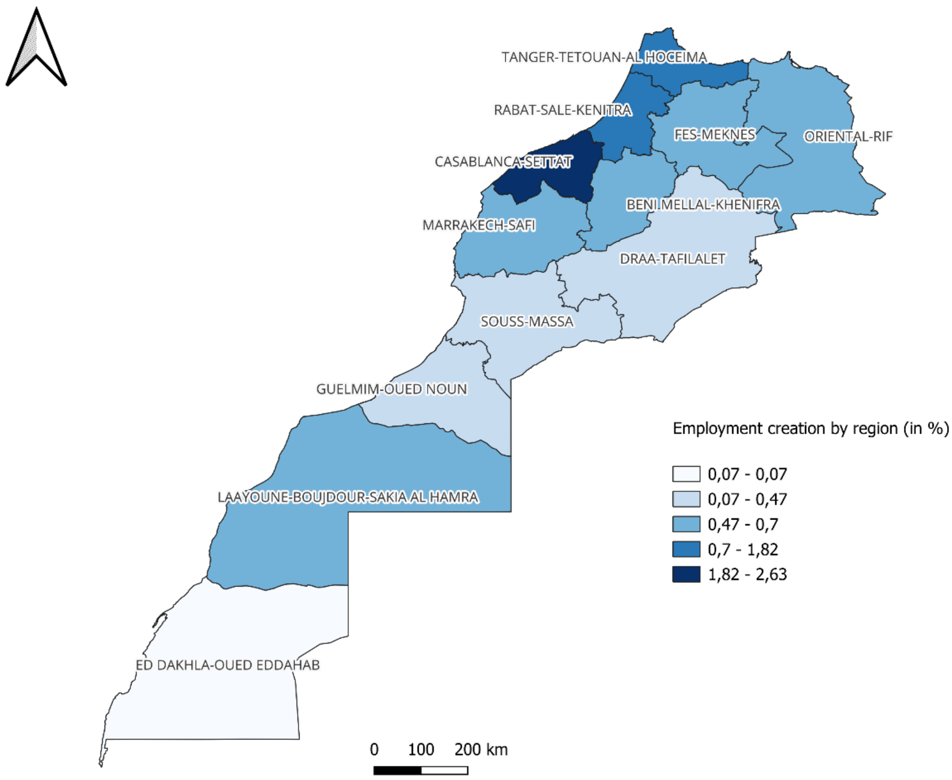
The radical shift towards EV production yields overall positive but mild employment creation (Figure 3). Gains are concentrated in Casablanca–Settat, which posts the largest increase at 2.6 percent. This reflects the region's dense supplier base, its service-intensive backbone in logistics, finance, and trade, and the ability of its SOMACA-centered industrial ecosystem to pivot toward EV-compatible activities. The scale of spillovers captured by Casablanca underscores its capacity to absorb and redistribute demand across a broad range of sectors, making it the primary source of job creation in the transition.

Rabat–Salé–Kénitra and Tanger–Tétouan–Al Hoceima also record strong employment gains at 1.8 percent and 1.7 percent respectively. In Rabat–Kénitra, the Gigafactory directly stimulates chemical-sector jobs and anchors a vertically integrated EV cluster around Stellantis. Tangier, as the hub of Renault's large assembly plant and a strong supplier network in wiring harnesses and assembly services, secures robust job creation through backward linkages and high-voltage system demand. Together, these two regions consolidate their role as the twin industrial engines of the EV transition.

A group of regions achieves more moderate but still significant employment growth. Oriental (0.70 percent), Marrakech–Safi, Béni Mellal–Khénifra, and Fès–Meknès (0.6 percent), and Laâyoune–Sakia El Hamra (0.5 percent) benefit from resource endowments and service linkages. Béni Mellal stands out as the phosphate hub feeding battery production, while Marrakech, Fès, and Oriental reflect diversified industrial and service ties that allow them to capture indirect gains. Laâyoune benefits from its mining base, even if broader industrial linkages remain limited.

Finally, the remaining regions display much smaller gains. Drâa–Tafilalet and Souss–Massa (0.4 percent), and Guelmim–Oued Noun (0.30 percent) remain only marginally connected to the automotive value chain, capturing mainly secondary service and trade effects. Dakhla–Oued Eddahab posts a near to zero increase, because of its limited industrial and service base and its weaker integration into national supply chains.

Figure 3: Employment creation resulting from a radical shift towards EV production, by region (in %)



Source: Author's elaboration

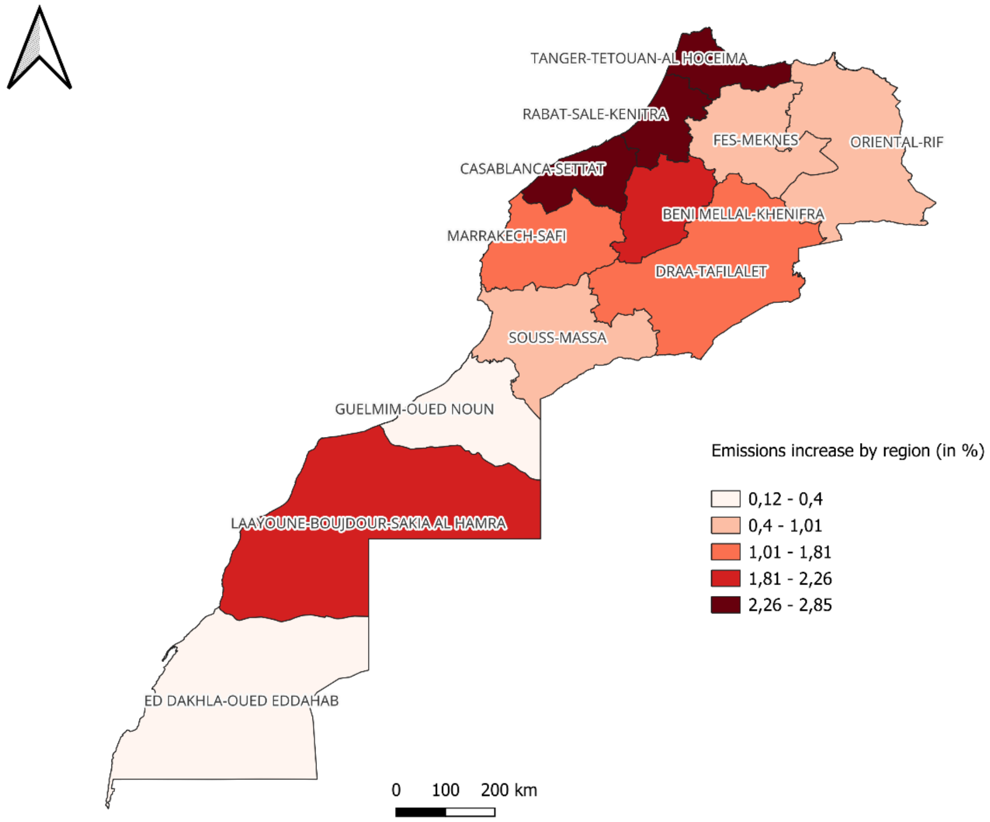
4.4. Environmental impacts

Environmental impacts of a radical shift towards EV production in Morocco, indicate that the sharpest increases in CO_2 emissions will be concentrated in Morocco's core industrial hubs. Rabat–Salé–Kénitra posts the highest rise at 2.8 percent, reflecting the immediate effect of the Gigafactory and its highly energy-intensive chemical activities. Tangier–Tétouan–Al Hoceima follows with 2.5 percent, driven by Renault's large assembly base and the expansion of high-voltage harness demand, while Casablanca–Settat records a similar CO_2 emissions increase, consistent with its diversified industrial ecosystem where manufacturing and logistics amplify the emissions impact. In these three regions, the growth of carbon-intensive sectors such as chemicals and electricity explains why economic dynamism translates directly into higher carbon emissions.

Resource-based regions also show significant increases. Laâyoune–Sakia El Hamra rises by 2.2 percent and Béni Mellal–Khénifra by 2 percent, both benefiting economically from their phosphate endowment but also bearing environmental costs given the carbon intensity of mining and processing. Marrakech–Safi (1.8 percent) and Drâa–Tafilalet (1.6 percent) register moderate rises, reflecting their limited industrial base and reliance on a mix of services and resource extraction, which spreads the impact across both low- and high-emission activities.

Elsewhere, the increases are more contained. Fès–Meknès (1 percent) and the Oriental (0.8 percent) gain mainly through indirect spillovers from national industrial expansion rather than direct participation in the EV supply chain. Automotive ecosystem distant regions such as Souss–Massa (0.7 percent) and Guelmim–Oued Noun (0.4 percent) capture only limited induced activity, while Dakhla–Oued Eddahab posts the smallest increase at 0.1 percent, underscoring its marginal connection to national manufacturing and chemical networks. Taken together, these results confirm that the environmental costs of Morocco's EV transition are unevenly distributed, with industrial and phosphate-rich regions absorbing the bulk of the emissions surge (Figure 4).

Figure 4: CO_2 emissions increase resulting from a radical shift towards EV production, by region (in %)



Source: Author's elaboration

5. Discussion and Conclusion

This paper has set out to analyze the economic and environmental consequences of Morocco's strategic pivot toward EV manufacturing, particularly through the localization of battery production. The research was driven by the central question: Can the EV transition deliver meaningful economic gains for Morocco while maintaining environmental sustainability, and how are these effects distributed across regions? To address this, an Interregional Input–Output (IR-IO) model was used and extended with environmental satellite accounts, simulating a structural technology shock related to substituting ICEV-specific inputs with EV components. This framework enabled a detailed regional, sectoral, and environmental analysis of Morocco's industrial reconfiguration.

The results demonstrate unequivocal macroeconomic benefits. National GDP increases by nearly 1.9%, and employment gains are positive across all regions, albeit unevenly distributed. The Rabat–Salé–Kénitra and Casablanca–Settat regions emerge as the primary winners, with the former benefiting from the direct localization of high-value battery manufacturing and the latter capitalizing on its diversified service-industrial base and its adaptability to the restructured automotive value chain. Importantly, these findings validate the core strategic thesis of

Morocco's policy direction: that deep vertical integration in the EV supply chain, especially in high-value components like batteries, can deliver substantive economic returns and elevate Morocco's positioning within the global automotive value chain.

However, the transition is far from risk-free, and the simulations unearth critical challenges that warrant careful consideration by Moroccan policymakers. First, the transition creates industrial asymmetries. Established ICEV component suppliers—especially those concentrated in traditional mechanical manufacturing—face obsolescence unless adequately supported to retool for new demand. Although the IR-IO model does not capture micro-level adjustment costs such as capital depreciation or labor retraining frictions, the structural shift implies significant transitional risks that must be actively managed. Failure to provide bridging policies could erode Morocco's existing industrial capabilities even as new clusters emerge. In practical terms, policymakers should implement transition support programs for affected firms and workers. This could include subsidized credit lines for technological upgrading, fiscal incentives for diversification toward EV-compatible components, and specialized retraining programs in chemical and electrical sectors. Establishing a "Just Transition Fund" dedicated to automotive suppliers would help mitigate the social costs of industrial restructuring and sustain employment continuity in the most exposed segments of the value chain.

Second, and more urgently, the environmental findings reveal a CO_2 emissions paradox. While the EV transition eliminates tailpipe emissions and contributes to long-term decarbonization goals, the immediate effect of localizing battery manufacturing is a measurable rise in aggregate emissions—particularly in industrial hubs like Rabat–Salé–Kénitra and Casablanca–Settat. This counterintuitive result stems from the energy-intensive nature of battery component manufacturing and from Morocco's continued reliance on fossil-intensive electricity generation. Consequently, economic modernization is not automatically synonymous with environmental sustainability. If Morocco fails to accelerate the decarbonization of its electricity grid in tandem with industrial deepening, the environmental credibility of its "green" industrial policy will be undermined. Addressing this requires coordinated action between industrial and energy policies. Specifically, Morocco should fast-track investments in renewable energy and grid flexibility, impose energy-efficiency standards for new manufacturing sites, and design a national roadmap for low-carbon industrial zones powered primarily by solar and wind resources. Strengthening environmental regulation and monitoring, particularly for emissions from chemical and metallurgical industries, will be essential to ensure that industrial expansion aligns with the country's climate commitments.

This tension between economic ambition and environmental trade-offs is not unique to Morocco. In fact, the literature echoes similar concerns across other geographies. For instance, Bravo et al. (2024) show that Spain's CO_2 reduction from EV adoption is only achievable if grid decarbonization occurs in parallel. Likewise, Peng et al. (2021) demonstrate that in China, the EV transition's environmental benefits are nonlinear and heavily contingent upon complementary clean energy investments. Our findings align with these insights but extend the discussion in two novel directions.

The first is regional differentiation. While most of the global literature, such as Tamba et al. (2022) and Alabi et al. (2022), utilizes national-level CGE models or aggregate IO frameworks, this paper's IR-IO structure reveals Morocco's spatially asymmetric development path. Regions with high existing industrial density or strategic natural resources—such as phosphates in Beni Mellal–Khénifra—reap disproportionate benefits. Conversely, peripheral regions such as Guelmim–Oued Noun and Dakhla–Oued Eddahab remain largely disconnected from the new EV value chain, capturing minimal economic or employment spillovers. This geography of inequality presents a governance challenge: without targeted diffusion policies, Morocco's green industrialization may inadvertently deepen regional disparities. Decision-makers should thus design spatially tailored policies that expand EV-related infrastructure, logistics, and supplier networks beyond the industrial core. Establishing regional innovation clusters, co-financing vocational training centers in secondary cities, and incentivizing private investment through differential tax credits could help redistribute the benefits of electrification and enhance national cohesion.

The second contribution lies in the cross-analysis of economic efficiency versus environmental sustainability. Most studies either focus on GDP and employment effects or on environmental footprints in isolation. By integrating both dimensions into a unified simulation framework, this paper offers a holistic evaluation of the trade-offs inherent in Morocco's EV transition. The results make clear that economic gains and environmental costs are not perfectly aligned, and that a policy of accelerated EV industrialization must be accompanied by deliberate environmental planning—specifically, aggressive grid decarbonization, eco-efficiency mandates for new plants, and stronger regulatory frameworks for industrial emissions. To operationalize these measures, Morocco could introduce carbon pricing mechanisms for industrial producers, integrate sustainability benchmarks into FDI contracts, and promote technology partnerships focused on recycling and circular economy models for battery components.

In conclusion, the evidence presented here underscores the strategic potential but also the inherent complexity of Morocco's shift toward EV manufacturing. The transition promises considerable economic uplift and a repositioning of Morocco as a competitive node in the green global value chain. However, it also introduces new industrial and environmental risks that cannot be ignored. Industrial policy must be designed not as a one-dimensional growth engine but as a multi-dimensional transformation agenda, integrating spatial equity, social protection, and environmental stewardship. For policymakers, this entails deploying active labor market and capital support mechanisms to assist ICEV-linked firms in transitioning, investing in clean energy infrastructure to align industrial growth with emissions reduction, and crafting regional development strategies to prevent spatial polarization. Only through this comprehensive lens can Morocco ensure that the green transition does not reproduce the shortcomings of past industrial waves but rather catalyzes a more inclusive, sustainable, and resilient development path.

Finally, future research should seek to deepen understanding of the long-term dynamics and distributional effects of Morocco's EV transition. Building on the present IR-IO framework, future work could employ dynamic Computable General Equilibrium (CGE) or hybrid IR-IO–

CGE models to capture temporal adjustments, capital accumulation, and labor market shifts. Incorporating firm-level data and technological learning curves would refine the estimation of productivity and emission elasticities. Similarly, comparative analyses with peer economies pursuing similar transitions—such as South Africa, Türkiye, and Egypt—could reveal differentiated policy pathways and cooperative regional opportunities. Beyond modeling, qualitative research on institutional capacity, workforce adaptation, and the governance of industrial-environmental trade-offs would provide valuable insights for designing policy instruments that combine economic efficiency, social inclusion, and ecological responsibility.

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