Economic Implications of Electric Vehicles in Europe: A Scenario-Based Analysis of Gross Value Added and Strategic Responses

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Research field: ☒ Economics, ☐ Technology, ☐ Politics, ☐ Social Aspects
Preferred Presentation Type: ☒ Oral ☐ Poster

Abstract

The automotive sector is experiencing a fundamental shift toward electric vehicles, a key component of global sustainability efforts. Europe's automotive industry, historically a robust economic foundation, now faces significant uncertainties regarding how this shift will reshape its economic contributions. However, the precise economic implications of transitioning from internal combustion engine vehicles to electric vehicles, specifically concerning the industry's gross value added, remain unclear. In this paper, I combine a comprehensive, scenario-based economic model of global automotive trade flows and granular vehicle-level value decompositions to quantify the effects on Europe's automotive economic output. The analysis demonstrates that a disruptive scenario – characterized by declining European OEM and supplier market shares and increased import dependency – could substantially reduce Europe's gross value added by 7 percentage points. Conversely, by optimizing the electric vehicle ecosystem through local production and targeted policy measures, Europe could replicate its traditional automotive leadership, increasing economic output by 45% by 2035. This study extends the existing body of research by precisely quantifying trade-offs between market scenarios, offering actionable insights for policymakers and industry stakeholders, and introducing a framework for analyzing value chain shifts in the transport sector. It underscores the strategic necessity for Europe to actively build local battery production and establish resilient domestic supply chains, positioning the auto industry for sustainable competitiveness in a globally electrified market.

Introduction and Motivation

Europe's automotive industry is a cornerstone of the economy, contributing 7% of the EU's GDP, 13.8 million jobs, and driving value across adjacent industries. Historically built upon internal combustion engine vehicles (ICEVs), the industry now faces a transformation to electric vehicles (EVs) – posing economic challenges due to Europe's dependency on imported EV components such as batteries, predominantly from China. Growing penetration by non-European automakers further intensifies concerns regarding Europe's industrial competitiveness and economic sustainability in automotive manufacturing. This necessitates a clear understanding of how transitioning to EVs could reshape the industry's gross value

added (GVA) – the total economic contribution from production activities – particularly considering global trade flows and domestic value capture capabilities.

Applied Method

To quantify Europe's automotive economic contributions, I develop a scenario-based economic model that systematically integrates global automotive sales data with detailed vehicle-level pricing and value added breakdowns along the value chain. Initially, global vehicle sales are segmented into eight distinct trade flows, categorized by original equipment manufacturer (OEM) origin, production, and sales locations, leveraging Eurostat production and export data, Marklines global sales data, and International Energy Agency forecasts. Subsequently, vehicle prices are decomposed into major components (storage, drivetrain, electronics, glider, overhead, net income), based on cost analyses in the academic literature. European value added is systematically allocated using sourcing assumptions derived from recent industry analyses and teardown studies, capturing OEM-specific sourcing behavior by differentiating across production locations and manufacturer archetypes.

Results

The findings reveal substantial variability in value creation depending on the vehicle type. The GVA for EVs developed, produced, and sold in Europe is 10 percentage points lower than that for ICEVs, underscoring the economic vulnerability tied to the supply chain's international composition. The difference is even more pronounced between domestically developed ICEVs, contributing over 74% to GVA, and imported EVs, which contribute only 19%. Under a 'disruptive scenario' – marked by intensified competition from non-European manufacturers and increased reliance on imports – European automakers could face a substantial economic reduction of 7 percentage points in GVA by 2035. In contrast, an 'EV leadership scenario' enables Europe to capture nearly all stages of gross value added domestically through optimized local manufacturing and targeted policy measures, resulting in total GVA that is 45% higher than 2023 baseline levels.

Conclusions

While EV deployment is widely recognized as a climate imperative, the associated economic benefits are not guaranteed and depend significantly on strategic policy decisions and proactive industry positioning. Rather than posing a trade-off, the transition offers opportunities to accelerate decarbonization while reinforcing Europe's industrial strength. To realize this potential, Europe must work together to remain globally competitive, e.g., by fostering local battery production and creating competitive regulatory environments that encourage manufacturing localization. This study's findings provide policymakers and sector stakeholders with clear, scenario-driven evidence on how different market and policy trajectories conclusively determine the economic resilience of Europe's automotive sector.

References

BloombergNEF (2021): Hitting the EV Inflection Point. Electric vehicle price parity and phasing out combustion vehicle sales in Europe.

Cheng, Anthony L.; Fuchs, Erica R. H.; Karplus, Valerie J.; Michalek, Jeremy J. (2024): Electric vehicle battery chemistry affects supply chain disruption vulnerabilities. In *Nature communications* 15 (1), p. 2143. DOI: 10.1038/s41467-024-46418-1.

Ciftci, Kaan Y.; Michel, Alex; Siegfried, Patrick (2022): The Potential Impact of E-Mobility on the Automotive Value Chain. Cham: Springer International Publishing.

Di Felice, Louisa Jane; Renner, Ansel; Giampietro, Mario (2021): Why should the EU implement electric vehicles? Viewing the relationship between evidence and dominant policy solutions through the lens of complexity. In *Environmental Science & Policy* 123, pp. 1–10. DOI: 10.1016/j.envsci.2021.05.002.

Draghi, Mario (2024): The future of European competitiveness. Part A | A competitiveness strategy for Europe. European Commission. Available online at https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en?filename=The%20future%20of%20European%20competitiveness%20_%20A%20competitiveness%20strategy%20for%20Europe.pdf.

EAFO (2024): European Alternative Fuels Observatory - Road. European Commission. Available online at https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/european-union-eu27/vehicles-and-fleet.

European Commission (2024): Automotive industry. Internal Market, Industry, Entrepreneurship and SMEs. Available online at https://single-market-economy.ec.europa.eu/sectors/automotive-industry_en.

Eurostat (2024a): Employment and value added using FIGARO data - view into the automotive industry. Available online at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Employment_and_value_added_using_FIGARO_data_-_view_into_the_automotive_industry#Data_sources.

Eurostat (2024b): Sold production, exports and imports. Available online at https://ec.europa.eu/eurostat/databrowser/view/ds-056120/legacyMultiFreq/table?lang=en&category=prom.

Frieske, Benjamin; Möring-Martinez, Gabriel; Hasselwander, Samuel; Spielmann, Hagen (2024): Transformations-Factsheet „Entwicklungstrends bei Lieferketten und neue Wertschöpfungsstrukturen“. Deutsches Zentrum für Luft- und Raumfahrt e. V. – Institut für Fahrzeugkonzepte.

Grube, Thomas; Kraus, Stefan; Reul, Julian; Stolten, Detlef (2021): Passenger car cost development through 2050. In *Transportation Research Part D: Transport and Environment* 101, p. 103110. DOI: 10.1016/j.trd.2021.103110.

Krause, Jette; Thiel, Christian; Tsokolis, Dimitrios; Samaras, Zissis; Rota, Christian; Ward, Andy et al. (2020): EU road vehicle energy consumption and CO2 emissions by 2050 – Expert-based scenarios. In *Energy Policy* 138, p. 111224. DOI: 10.1016/j.enpol.2019.111224.

Marklines Information Platform (2024): Vehicle Sales. Available online at https://www.marklines.com/en/.

Nieto, Jaime; Brockway, Paul E.; Sakai, Marco; Barrett, John (2024): Assessing the energy and socio-macroeconomic impacts of the EV transition: A UK case study 2020–2050. In *Applied Energy* 370, p. 123367. DOI: 10.1016/j.apenergy.2024.123367.

Ola Källenius (2025): Boosting Europe’s automotive competitiveness for renewed economic growth. Letter to EU leaders. Automobile Manufacturers’ Association (ACEA). Available online at https://www.acea.auto/news/letter-to-eu-leaders-boosting-europes-automotive-competitiveness-for-renewed-economic-growth/.

Rottoli, Marianna; Dirnaichner, Alois; Pietzcker, Robert; Schreyer, Felix; Luderer, Gunnar (2021): Alternative electrification pathways for light-duty vehicles in the European transport sector. In *Transportation Research Part D: Transport and Environment* 99, p. 103005. DOI: 10.1016/j.trd.2021.103005.

Tamba, Marie; Krause, Jette; Weitzel, Matthias; Ioan, Raileanu; Duboz, Louison; Grosso, Monica; Vandyck, Toon (2022): Economy-wide impacts of road transport electrification in the EU. In *Technological forecasting and social change* 182, p. 121803. DOI: 10.1016/j.techfore.2022.121803.

Tschiesner, Andreas; Hertzke, Patrick; Schaufuss, Patrick; Heuss, Ruth; Labourier, David; Dampierre, Guillaume de et al. (2024): Europe’s economic potential in the shift to electric vehicles. McKinsey & Company. Available online at https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/europes-economic-potential-in-the-shift-to-electric-vehicles.

Ulrich, Philip; Lehr, Ulrike (2020): Economic effects of an E-mobility scenario – input structure and energy consumption. In *Economic Systems Research* 32 (1), pp. 84–97. DOI: 10.1080/09535314.2019.1619522.

Weng, Andrew; Ahmed, Omar Y.; Ehrlich, Gabriel; Stefanopoulou, Anna (2024): Higher labor intensity in US automotive assembly plants after transitioning to electric vehicles. In *Nature communications* 15 (1), p. 8088. DOI: 10.1038/s41467-024-52435-x.