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Bibliometric Analysis of Research Trends on Economic Decoupling: Insights from 2010 to 2025

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ABSTRACT

This study presents a comprehensive bibliometric analysis of global research trends on economic decoupling between 2010 and 2025. Drawing on 647 documents indexed in the Scopus database, the analysis maps the intellectual structure, thematic evolution, and collaborative networks shaping the field. Using VOSviewer, the study visualizes co-authorship patterns, keyword co-occurrences, temporal trends, and density of thematic concentration. Results indicate that research on decoupling has transitioned from abstract debates around economic growth and environmental limits toward empirical, policy-relevant studies focused on carbon emissions, decomposition analysis, and sustainable development strategies. China, the United States, and Germany emerge as dominant contributors, with rising global collaboration. The keyword overlay reveals an increasing shift toward themes like circular economy and renewable energy in recent years. The study contributes to the theoretical consolidation of the field while offering practical insights for policymakers and researchers to align future efforts with global sustainability goals. Limitations include reliance on a single database and the interpretive boundaries of bibliometric tools.

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1. INTRODUCTION

In recent decades, the concept of *economic decoupling* has emerged as a critical discourse in sustainability and development economics. It refers to the ability of an economy to grow without corresponding increases in environmental pressure—particularly resource consumption and carbon emissions. This idea gained traction in the context of global efforts to meet climate goals and implement sustainable development strategies. The United Nations' 2030 Agenda, particularly Sustainable Development Goal (SDG) 8 and SDG 12, underscores the importance of achieving economic growth while reducing ecological degradation [1], [2]. As nations grapple with climate change and resource limitations, the decoupling narrative has increasingly permeated academic, political, and business discussions.

The trajectory of decoupling research has closely paralleled global environmental policy milestones, such as the Paris Agreement and IPCC reports. Initially, much

of the literature focused on theoretical underpinnings and definitions—distinguishing between *relative decoupling* (where economic growth outpaces environmental impacts) and *absolute decoupling* (where economic growth occurs alongside a reduction in environmental harm) [3], [4]. As global data became more accessible and environmental accounting improved, empirical studies began to examine decoupling dynamics across sectors and geographies. This has led to a proliferation of cross-disciplinary research combining economics, environmental science, and industrial policy.

From 2010 onwards, academic interest in decoupling has intensified. Several bibliometric analyses and literature reviews have highlighted a surge in publications concerning environmental sustainability, green growth, and low-carbon development, within which decoupling is often a central theme [5]. This is partly due to the shifting landscape of global trade and production. As manufacturing and resource extraction continue to globalize, the environmental burdens of economic activity are increasingly displaced across borders, challenging the notion of decoupling as a purely national phenomenon [6]. Consequently, researchers have expanded their scope from national economies to global value chains and regional integration frameworks [7], [8].

The COVID-19 pandemic introduced a new dimension to the discourse on economic decoupling. Lockdowns and supply chain disruptions led to temporary reductions in emissions and consumption, offering an unintentional experiment in forced decoupling. Scholars began to ask whether these shifts were structural or merely episodic [9]. Furthermore, the pandemic reignited debates on economic resilience and the feasibility of self-sufficiency strategies—often linked with *strategic decoupling* from global economic dependencies. As a result, the post-2020 literature has seen a shift towards exploring decoupling not just in environmental terms, but also in geopolitical and trade contexts.

Despite growing attention, the research landscape on economic decoupling remains fragmented. Different disciplines apply varying definitions, methodologies, and data sources. For example, industrial ecologists often use material flow analysis (MFA), while economists may rely on GDP-to-emissions intensity metrics or input-output models [10]. Moreover, the policy relevance of decoupling studies depends heavily on the granularity of their findings—whether they focus on national aggregates or sectoral/subnational trends. This diversity of approaches, while enriching, also poses challenges for knowledge integration and policy translation.

Given the rapid expansion and diversification of research on economic decoupling, there is a pressing need to systematically map its intellectual structure, thematic evolution, and emerging trends. To date, no comprehensive bibliometric study has synthesized the academic output on economic decoupling from 2010 to 2025, despite its increasing salience in sustainability discourse. Without such mapping, it is difficult to identify research gaps, dominant knowledge clusters, or the influence of key contributors. Furthermore, scholars and policymakers alike may struggle to navigate the growing volume of publications, especially when cross-disciplinary perspectives are involved. This study aims to conduct a bibliometric analysis of global research trends on economic decoupling from 2010 to 2025.

2. METHOD

This study employed a bibliometric approach to systematically map and analyze global academic literature on economic decoupling between 2010 and 2025. Bibliometric analysis is a quantitative method that examines patterns in scientific publications, citations, and co-authorship networks to uncover the intellectual and thematic structure of a research field [11]. For this purpose, the Scopus database was selected as the primary data source due to its wide coverage of peer-reviewed journals,

consistency in indexing, and suitability for bibliometric applications. The search query was constructed using the keywords "economic decoupling", "decoupling growth and emissions", "resource decoupling", and related terms within titles, abstracts, and keywords. Only articles published in English were included, and document types were limited to peer-reviewed journal articles, conference papers, and reviews to ensure academic relevance.

After retrieving the dataset, a multi-step cleaning process was conducted to remove duplicates, irrelevant documents, and entries outside the scope of the study. The final dataset comprised 647 documents published between January 2010 and June 2025. The data was exported in RIS and CSV formats for analysis using VOSviewer and Microsoft Excel. VOSviewer was used to construct and visualize bibliometric networks, including co-authorship (to identify collaborative structures among authors and countries), co-citation (to detect influential literature), and keyword co-occurrence (to reveal dominant research themes and their evolution over time) (van Eck & Waltman, 2010). The bibliometric indicators were interpreted using both quantitative output metrics—such as the number of publications, citation counts, and h-index—as well as relational metrics derived from the network maps.

3. RESULT AND DISCUSSION

3.1. Co-Authorship Analysis

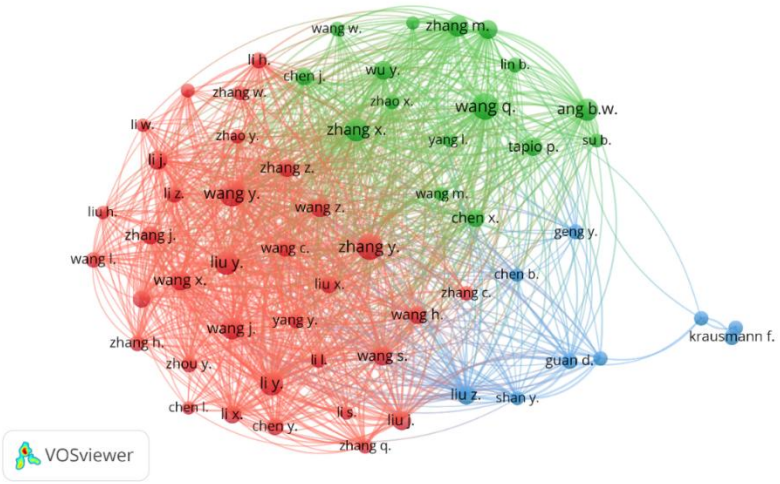

Figure 1. Author Visualization
Source: Data Analysis

Figure 1 is a **co-authorship network map** generated using VOSviewer, illustrating the collaborative relationships among authors contributing to the field of economic decoupling research between 2010 and 2025. Each node represents an individual author, and the size of the node reflects their total number of publications or citation impact within the dataset. The lines (edges) connecting nodes indicate co-authorship links, with thicker lines representing stronger collaboration frequency. The network is organized into three main clusters, shown in red, green, and blue. The **red cluster**, dominated by authors such as *wang y.*, *liu y.*, and *zhang j.*, appears to be the most densely connected, suggesting a high degree of intra-group collaboration, possibly centered in Chinese institutions. The **green cluster**, including *zhang m.* and *wu y.*, shows a distinct yet interconnected community, potentially representing another regional or thematic

subgroup. Meanwhile, the **blue cluster** is more sparsely connected and led by globally recognized scholars such as *krausmann f.*, *guan d.*, and *geng y.*, indicating a more international collaboration pattern.

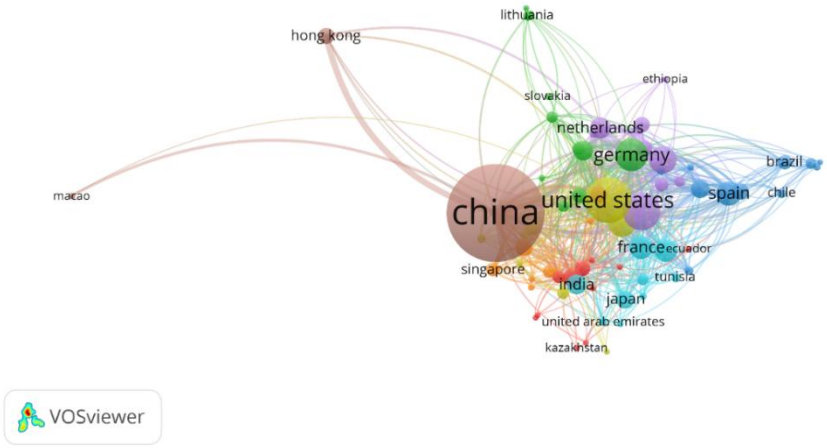

Figure 2. Country Visualization
Source: Data Analysis

Figure 2 above illustrates the **country-level co-authorship network** in the field of economic decoupling research from 2010 to 2025. Each node represents a country, with the size of the node corresponding to its volume of publications or citations. The thickness of the connecting lines reflects the strength of collaboration between countries. Notably, **China** occupies the central and most dominant position in the network, indicating its significant contribution and high collaboration intensity within the global research community. The **United States** also shows a prominent position and is highly interconnected with other countries, including **Germany**, **India**, and **France**, suggesting strong transnational partnerships. Peripheral nodes such as **Macao**, **Lithuania**, and **Ethiopia** appear less connected, indicating either emerging or regionally limited participation. The map reveals a vibrant and growing international collaboration landscape in economic decoupling research, with distinct clusters suggesting regional academic alliances—particularly among Asian countries (China, India, Singapore, Japan), European countries (Germany, Netherlands, Spain), and emerging bridges to South America and Africa. This structure reflects the global relevance of the topic and the increasing need for shared solutions across national boundaries.

3.2. Citation Analysis

Table 1. Most Cited Article

Citations	Author and Year	Title
21312	[12]	MobileNetV2: Inverted Residuals and Linear Bottlenecks
4347	[13]	A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems
2027	[14]	RepVgg: Making VGG-style ConvNets Great Again
1624	[15]	Network function virtualization: State-of-the-art and research challenges
1331	[16]	Classifying and valuing ecosystem services for urban planning
1191	[17]	Is Green Growth Possible?

Citations	Author and Year	Title
1141	[18]	The material footprint of nations
974	[19]	The irreversible momentum of clean energy: Private-sector efforts help drive decoupling of emissions and economic growth
789	[20]	Digitalization and energy consumption. Does ICT reduce energy demand?
728	[21]	Environmental and social footprints of international trade

Source: Scopus, 2025

3.3. Keyword Co-Occurrence Analysis

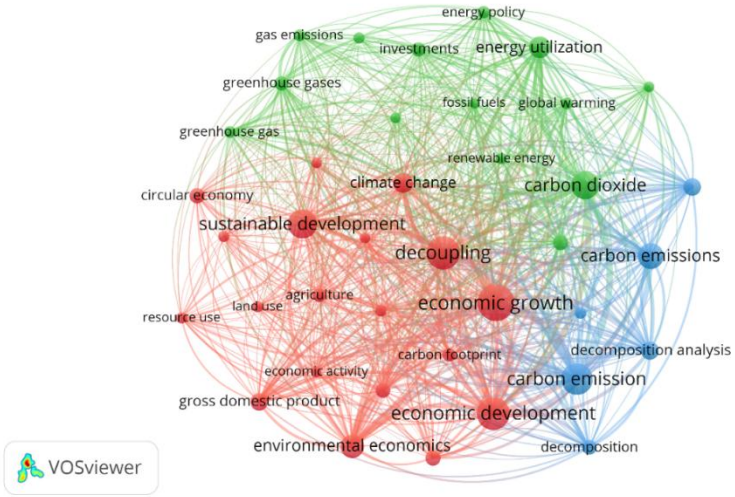

Figure 3. Network Visualization
Source: Data Analysis

Figure 3 represents a **keyword co-occurrence map** in the field of economic decoupling research, based on publications from 2010 to 2025. This VOSviewer map clusters frequently used keywords into distinct thematic groups, revealing how conceptual and disciplinary trends have evolved and interrelated over time. Each node is a keyword, and its size reflects its frequency of appearance. The lines connecting them represent the strength of co-occurrence, with color-coded clusters signifying dominant themes. The red cluster is centered around terms such as **"economic growth"**, **"sustainable development"**, **"environmental economics"**, **"resource use"**, and **"circular economy"**. This grouping reflects the core literature examining how economic expansion interacts with sustainability goals. These keywords are frequently found in discussions of the feasibility and measurement of decoupling, especially in relation to gross domestic product (GDP), land use, and agriculture. Researchers in this cluster typically explore macroeconomic models, development indicators, and ecological constraints, reflecting a policy-driven and systems-level perspective.

The green cluster revolves around terms like **"energy utilization"**, **"fossil fuels"**, **"greenhouse gases"**, **"climate change"**, and **"renewable energy"**. This indicates a strong linkage between decoupling research and energy transitions, as scholars investigate the role of cleaner technologies and energy policies in achieving decoupling. The presence of **"investments"** and **"energy**

policy" also suggests attention to institutional mechanisms and financing models necessary for shifting toward low-carbon economies. This cluster typically intersects with environmental science, energy economics, and climate policy domains. In the blue cluster, keywords such as **"carbon emissions"**, **"carbon dioxide"**, **"decomposition analysis"**, and **"carbon footprint"** dominate. This reflects the analytical backbone of many decoupling studies, particularly those using decomposition techniques to quantify the sources of emission changes across sectors and regions. The terms indicate a methodological orientation, with frequent use of index decomposition analysis (IDA) or structural decomposition analysis (SDA) to examine emission drivers. This cluster often feeds into national carbon accounting systems and policy assessments aimed at absolute decoupling.

At the center of the map lies the keyword **"decoupling"**, directly connected to all major clusters. It serves as a conceptual bridge linking economic, environmental, and technological dimensions of the literature. Its co-location with **"economic growth"**, **"carbon emissions"**, and **"sustainable development"** underscores the central debate: whether and how economies can continue growing while reducing environmental harm. The dense interconnections also highlight the interdisciplinary nature of decoupling research—drawing from environmental science, development studies, ecological economics, and energy policy.

The visualization clearly shows a maturing and expanding field, moving from abstract economic-environmental trade-offs toward more granular, technical, and policy-relevant studies. The presence of emerging terms such as **"circular economy"** and **"energy policy"** reflects a shift toward actionable strategies. Furthermore, the tightly woven network implies increasing integration across previously separate domains. Future research is likely to further bridge these areas—developing new models, policy tools, and frameworks to facilitate decoupling in both developed and emerging economies, especially in light of climate commitments and green growth agendas.

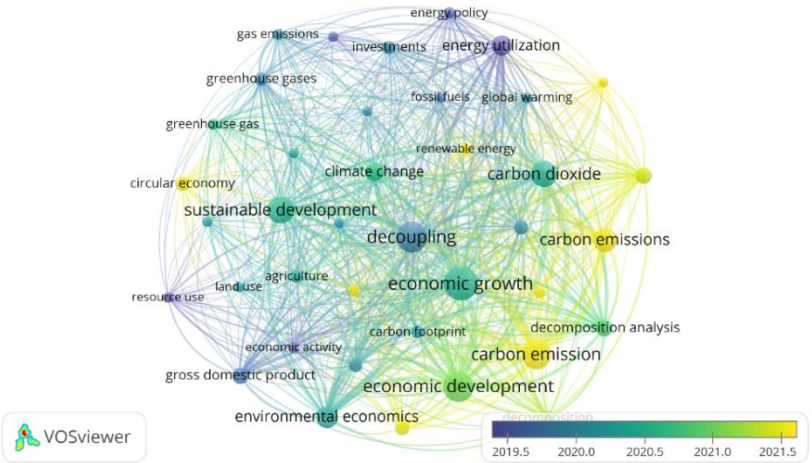

Figure 4. Overlay Visualization
Source: Data Analysis

Figure 4 displays the **temporal evolution of keyword usage** in the field of economic decoupling research between 2019.5 and 2021.5. The color gradient—from **purple (older keywords)** to **yellow (more recent keywords)**—indicates the average publication year in which the terms appeared. The central terms such as **"decoupling," "economic growth,"** and **"sustainable development"** are displayed in **green**, signifying consistent usage throughout the period. This suggests that these foundational concepts have remained central to scholarly discussions across multiple years, reflecting their role as anchor themes in the broader decoupling discourse. Meanwhile, terms such as **"carbon emissions," "carbon dioxide," "decomposition analysis,"** and **"circular economy"** are highlighted in **yellow**, pointing to their rising prominence in recent years. This indicates a clear trend toward emissions-focused and measurement-driven research, as well as the integration of circular economic models into the decoupling narrative. The emergence of decomposition methodologies as a recent hotspot shows that scholars are increasingly interested in quantifying the drivers behind emission reductions—moving from conceptual exploration to empirical validation and policy analysis.

On the other hand, older themes such as **"energy utilization," "fossil fuels,"** and **"gas emissions"** appear in **blue to purple**, reflecting earlier focus areas in the post-2010 literature. These keywords were likely more prominent in the earlier phase of decoupling studies, especially when discussions revolved around conventional energy systems and global warming. The shift toward newer concepts (e.g., carbon footprint, decomposition, circular economy) suggests a maturing of the field—moving away from diagnosing the problem to formulating precise tools and strategies to address it. This transition underscores the dynamic and responsive nature of economic decoupling research in the context of evolving sustainability challenges.

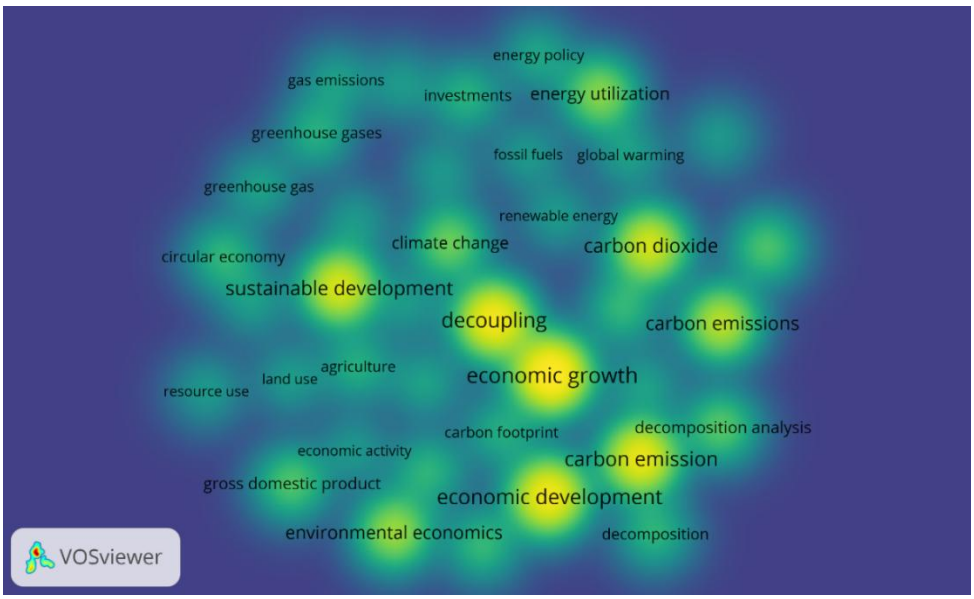

Figure 5. Density Visualization
Source: Data Analysis

Figure 5 highlights the **concentration and intensity of keyword occurrences** in the domain of economic decoupling research. The heatmap uses color gradients to show the frequency with which keywords co-occurred in the analyzed literature. Areas in **bright yellow** represent the highest keyword density—signifying central and frequently studied themes—while **green** and **blue** indicate progressively lower levels of concentration. At the core of the map, we observe keywords such as **"economic growth"**, **"decoupling"**, **"carbon emissions"**, and **"sustainable development"** glowing brightly, affirming their foundational role in the field's knowledge structure. These concepts have consistently formed the backbone of discussions surrounding the balance between growth and sustainability. Surrounding these high-density cores are secondary but still influential terms such as **"carbon dioxide"**, **"economic development"**, **"decomposition analysis"**, and **"environmental economics"**, which also appear in yellow-green hues. These terms suggest more specialized discussions branching out from the central debate. Meanwhile, peripheral terms like **"energy policy"**, **"fossil fuels"**, and **"land use"** appear in cooler colors, indicating they are less frequently mentioned or more narrowly scoped within the literature.

3.4. Practical Implications

The findings of this bibliometric analysis offer valuable insights for policymakers, sustainability strategists, and international development institutions. By identifying the most active regions (e.g., China, United States, Germany) and dominant themes (e.g., carbon emissions, sustainable development, decomposition analysis), this study provides a navigational map for aligning national research agendas with global sustainability goals. Policy stakeholders can leverage this information to foster cross-border academic partnerships, invest in underexplored thematic areas, and encourage evidence-based policymaking. For instance, the growing prominence of "circular economy" and "decomposition analysis" suggests a shift toward more actionable and quantitative tools, which can guide resource efficiency frameworks, emissions accounting, and green industrial policies. Furthermore, the keyword evolution map indicates emerging interest in topics like carbon footprint and renewable energy, signaling priority areas for future funding and capacity-building efforts in the green transition.

3.5. Theoretical Contribution

This study contributes to the theoretical consolidation of economic decoupling research by mapping its intellectual structure, thematic evolution, and disciplinary integration over a 15-year span. The co-authorship and keyword networks provide empirical evidence of how the field has matured from a predominantly conceptual debate—centered on economic growth versus environmental limits—into a multifaceted, interdisciplinary domain involving environmental economics, energy policy, and systems modeling. The visualization of co-citation and temporal trends enriches the understanding of how theories of sustainable development, ecological economics, and carbon intensity reduction have converged and diverged. Moreover, by documenting the temporal shift from broad terms like "global warming"

to more technical terms like "decomposition analysis," this study demonstrates the increasing methodological rigor and analytical depth within the literature. In doing so, it helps bridge gaps between conceptual frameworks and empirical applications.

3.6. Limitations

Despite its contributions, this study is not without limitations. First, it relies solely on the **Scopus database**, which, although comprehensive, may exclude relevant publications indexed in other repositories such as Web of Science, Dimensions, or Google Scholar. This creates the possibility of coverage bias, particularly for non-English or regionally indexed literature. Second, the bibliometric tools used—primarily VOSviewer—are powerful for visualizing trends but limited in qualitative interpretation. Co-occurrence of keywords or citations does not always imply thematic agreement or collaboration, and deeper content analysis would be necessary to validate conceptual relationships. Third, the study spans data up to 2025 (including early access and in-press articles), which may lead to inconsistencies in indexing and citation metrics for the most recent works. Lastly, bibliometric analysis, by nature, captures the quantity and structure of research, but not necessarily its **quality or impact** in practical terms—factors that would require case-based or policy evaluation studies to supplement.

4. CONCLUSION

This bibliometric analysis provides a comprehensive overview of the evolving landscape of economic decoupling research from 2010 to 2025. Through the use of co-authorship networks, keyword co-occurrence mapping, temporal overlay visualizations, and density mapping, the study reveals how scholarly attention has gradually shifted from broad environmental-economic themes to more focused and policy-relevant topics such as carbon emissions, decomposition analysis, and the circular economy. The field is increasingly characterized by interdisciplinary collaboration, particularly among leading countries like China, the United States, and Germany, as well as by the emergence of technical methodologies for measuring and modeling decoupling dynamics. These insights not only help clarify the intellectual structure of the field but also highlight the growing urgency and complexity of achieving sustainable economic growth in a carbon-constrained world. As the global community moves deeper into the climate crisis, this mapping of academic trajectories offers a critical foundation for future research, policy intervention, and international collaboration.

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