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วิวัฒนาการของผู้ประกอบการสีเขียว: การวิเคราะห์บรรณานุกรมและการทบทวนวรรณกรรม

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บทคัดย่อ

แนวความคิดของการเป็นผู้ประกอบการสีเขียว มีบทบาทสำคัญในการจัดการกับความท้าทายด้านสิ่งแวดล้อมทั่วโลก ผ่านกลยุทธ์ทางธุรกิจที่ปฏิรูปใหม่ การวิเคราะห์บรรณมิตินี้ ได้ทำการตรวจสอบวิวัฒนาการ ผลกระทบ และโครงสร้างทางปัญญาของการวิจัยในการเป็นผู้ประกอบการสีเขียวตั้งแต่ปี พ.ศ. 2549 ถึง พ.ศ. 2567 โดยใช้ข้อมูลจากบทความที่ผ่านกระบวนการตรวจสอบโดยผู้เชี่ยวชาญทั้งสิ้น 223 บทความ การศึกษาของเราเผยให้เห็นความสนใจทางวิชาการที่เพิ่มขึ้นอย่างมีนัยสำคัญ โดยเน้นประเด็นสำคัญ ได้แก่ ความยั่งยืน นวัตกรรม และเศรษฐกิจหมุนเวียน การกระจายทางภูมิศาสตร์ของงานวิจัย ได้ชี้ให้เห็นถึงการมีส่วนร่วมอย่างจริงจังจากประเทศต่าง ๆ เช่น เยอรมนี สหรัฐอเมริกา และอิตาลี โดยสะท้อนถึงการเป็นผู้นำในการบูรณาการความยั่งยืนเข้ากับการดำเนินธุรกิจ โครงสร้างทางปัญญา ที่ผ่านการวิเคราะห์การอ้างอิงร่วมโดยใช้โปรแกรม VOSviewer ได้ระบุถึงผู้เขียนและบทความที่มีอิทธิพล ซึ่งมีการจัดกลุ่มแนวคิดก้าวหน้าที่ผสานการจัดการสิ่งแวดล้อมเข้ากับนวัตกรรมของผู้ประกอบการ แนวโน้มใหม่ในการวิจัยในหัวข้อการเป็นผู้ประกอบการสีเขียว ชี้ให้เห็นถึงความเกี่ยวข้องที่เพิ่มขึ้นของการใช้เทคโนโลยีดิจิทัล และความสำคัญของกรอบนโยบายในการส่งเสริมโมเดลธุรกิจที่ยั่งยืน การประติดประต่อนี้ ไม่เพียงแต่กำหนดโดยเส้นทางการวิจัยในอดีตเท่านั้น แต่ยังชี้ให้เห็นถึงวิธีการพัฒนาที่ไม่หยุดนิ่งสำหรับอนาคต เพื่อพัฒนาแนวทางสหวิทยาการในการแก้ปัญหาที่ยั่งยืนภายในระบบนิเวศของผู้ประกอบการ

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The Evolution of Green Entrepreneurship: A Bibliometric Analysis and Literature Review

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Abstract

The paradigm of green entrepreneurship is pivotal in addressing global environmental challenges through innovative business strategies. This bibliometric analysis investigates the evolution, impact, and intellectual structure of research in green entrepreneurship from 2006 to 2024, utilizing data from 223 peer-reviewed articles. Our study reveals a significant growth in scholarly attention, highlighting key themes such as sustainability, innovation, and the circular economy. The geographic distribution of research underscores a robust engagement from countries like Germany, the United States, and Italy, reflecting their leadership in integrating sustainability into business practices. The intellectual structure, revealed through VOSviewer co-citation analysis, identifies influential authors and articles, mapping out predominant schools of thought that merge environmental management with entrepreneurial innovation. Emerging trends in green entrepreneurship research point to the increasing relevance of digital technologies and the importance of policy frameworks in fostering sustainable business models. This synthesis not only charts the trajectory of past research but also indicates vibrant avenues for future inquiry, emphasizing the necessity of interdisciplinary approaches to develop sustainable solutions within the entrepreneurial ecosystem.

Keywords: Bibliometric Analysis, Circular Economy, Green Entrepreneurship, Innovation, Sustainability

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Introduction

The concept of entrepreneurship, while well-established, has historically focused on driving change in business systems (Schaper, 2016; Schumpeter, 2013). Entrepreneurs identify undervalued opportunities and transform them into commercial realities, often bringing personal benefits and change to their communities. Growing awareness of social and environmental issues has led to the paradigm of sustainable development, a transformative approach defined by the World Commission on Environment and Development (WCED) as the ability to "meet the needs of the present without compromising the ability of future generations to meet their own needs". This shift led to sustainable entrepreneurship, which Hart and Milstein (1999, 2003) pioneered by integrating sustainability principles with traditional entrepreneurial drive. Hence, sustainable entrepreneurs mitigate environmental harm and embed social and environmental values within their business models.

Sustainable entrepreneurship, a concept that has transcended borders, has garnered global attention as a viable solution to pressing environmental issues such as climate change, resource depletion, and pollution. Diverse approaches and initiatives from across the globe highlight the international significance of this field. For instance, in Europe, green startups like Northvolt in Sweden are revolutionizing the battery industry with sustainable production practices, while in Africa, M-KOPA Solar provides affordable solar energy solutions to off-grid communities. These examples illustrate the tangible impact and potential of green entrepreneurship, making us all part of a larger movement towards a sustainable future.

The relevance of green entrepreneurship to contemporary environmental challenges cannot be overstated. The increasing frequency and severity of climate-related disasters underscore the urgent need for innovative solutions. Sustainable entrepreneurs, recognizing this urgency, are at the forefront, developing goods and services that not only protect nature and life support systems but also enhance community well-being. The transition to renewable energy sources and the promotion of circular economy principles are just two examples of how green entrepreneurship can drive significant positive change. This urgency should motivate us all to commit to these solutions.

However, green entrepreneurs face unique challenges, such as access to funding, regulatory hurdles, and consumer skepticism. Despite these obstacles, the opportunities in untapped markets and technological advancements present vast potential for growth and innovation. The fluid and evolving narratives of green entrepreneurs, as highlighted by Mondal (2023), emphasize their role in negotiating the tensions between environmental philosophies and mainstream economic activities. This dynamic field reflects a broader shift towards entrepreneurial solutions for social and environmental challenges, making sustainability a core element of modern entrepreneurship.

Research objectives

Within the broader field of sustainable entrepreneurship, green entrepreneurship has emerged as a distinct area of research, uniquely focused on prioritizing environmental values and the well-being of future generations (Schaper, 2016). Green entrepreneurs share the core traits of traditional entrepreneurs - identifying opportunities, taking calculated risks, and building a vision-but prioritize a positive environmental

impact throughout their business operations. This focus stems from a strong belief in environmental protection and sustainability. While profit remains essential, it may be secondary to environmental goals for some green entrepreneurs. This diverse field overlaps with sustainable entrepreneurship, prompting this study to provide a comprehensive synthesis. The following research questions guide this exploration:

RQ1: What is the volume, growth trajectory, and geographic distribution of research on green entrepreneurship?

RQ2: What authors and documents on green entrepreneurship have had the most significant impact?

RQ3: What is the intellectual structure of research on green entrepreneurship?

RQ4: What are key topical trends in research on green entrepreneurship?

This paper applies a bibliometric review, one type of systematic review, to analyze, synthesize, and extend the current knowledge in green entrepreneurship. This analysis will focus on understanding how the field has evolved through time. This review will present an intellectual structure and potential schools of thought using graphical network analysis. This review used a detailed keyword-based search to source green entrepreneur publications from the Scopus database. This systematic examination aims to reveal 1) the evolution of green entrepreneur research within the broader scope of management literature, 2) areas ripe for further exploration, and 3) synthesize renewed scholarly interest in the ever-evolving dynamics of green entrepreneur.

Methodology

Bibliometric Review

This review utilized a scientific mapping methodology involving bibliometric analyses to document and synthesize knowledge in green entrepreneurship. This review provides an intellectual analysis of knowledge advancements using this method (Zupic & Čater, 2015). Graphical drawings or tables are used to demonstrate the evolution of this topic and its other important features. The results of this methodology offer a more comprehensive insight into the subject, revealing the primary authors, influential publications, and top academic journals in the field (Van Eck & Waltman, 2010). The assessment utilized VOSviewer, a software selected for its robust co-citation analysis and network visualization features, to display the conceptual framework of green entrepreneur research (Szomszor et al., 2021; Van Eck & Waltman, 2010; Wörfel, 2021). The research uncovers several components, such as documents, authors, journals, and terms, while demonstrating conceptual subdomains and thematic progression. A thesaurus file was created to substitute synonymous terms with a standardized term because of the inconsistent and inaccurate metadata obtained from Scopus (Van Eck & Waltman, 2010). Hence, the results determine future research schemes.

Identification of Sources for Bibliometric Review

The study made use of the Scopus database due to its comprehensive coverage. It is common practice in social science studies to use materials from 2006 to 2024 (February), including 18 years of

research in green entrepreneurship. The range offered an extensive historical view of the study on green entrepreneurship. The search procedure adhered to PRISMA rules to provide an efficient review process. A robust keyword search strategy was created utilizing TITLE-ABS-KEY, incorporating the following terms: [TITLE-ABS-KEY ((“green startup*” OR “eco startup*” OR “sustainable entrepreneur*” OR “circular economy startup*” OR “low-carbon startup*”) AND (“success factor*” OR “performance” OR “sustainable business model*”OR “ecosystem” OR “green entrepreneurship ecosystem”))]

This initial search produced a dataset of 286 articles. Pre-established inclusion and exclusion criteria were applied to ensure focus. For inclusion, peer-reviewed research articles, publication dates within the specified range, English language publications, explicit focus on intersections of green entrepreneur with themes from sustainability management, sustainable development were included. For exclusion, non-research publications (editorials, commentaries, etc.), works outside the core disciplines of this study were excluded. This bibliometric analysis adhered to the established protocol the PRISMA guidelines (preferred reporting items for systematic reviews and meta-analyses) (Moher et al., 2009; Page et al., 2021). As a final data preparation step, articles were screened for eligibility, with particular attention to identifying and removing duplicates or non-conforming article types. This process resulted in a final dataset of 223 articles for bibliometric analysis. This thorough approach ensures that the search is inclusive of diverse aspects of green entrepreneurship. Complementing bibliometric analysis with qualitative assessments could also provide a richer understanding of the research landscape, related to green startups and sustainability.

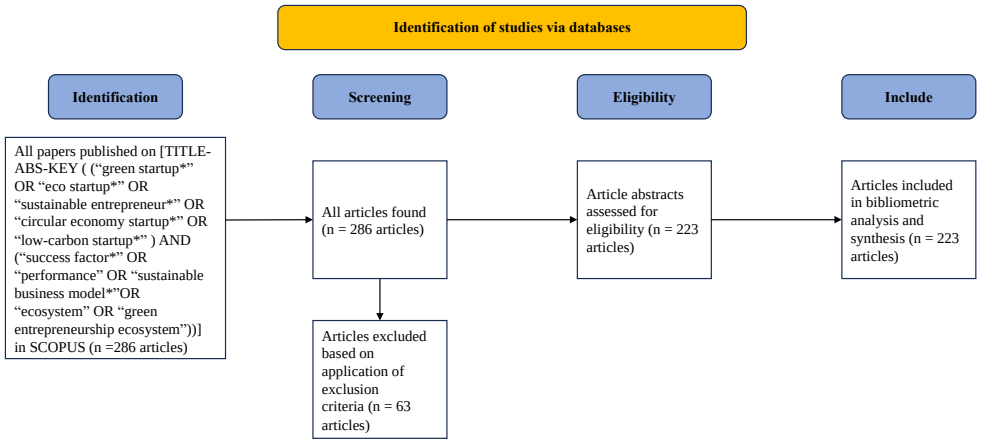

Figure 1 The preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram detailing the steps in identifying and screening sources

Bibliometric Analysis

The researchers utilized the VOSviewer software to discern significant “schools of thought” in green startup research (Van Eck & Waltman, 2010, 2017). or the bibliometric study, VOSviewer was employed to detect influential “schools of thought” in green entrepreneurship by analyzing co-citation patterns (Isfandyari-Moghaddam et al., 2023; Small, 1973). This was instrumental in mapping the domain and underscoring the linkages among researchers and burgeoning trends in green startups. The software’s

visualization capabilities allow for an understanding of the relative impact of authors, the connections between thematic areas, and the evolution of concepts within the sector.

This review also utilized co-word analysis to delve deeper into the conceptual terrain of green startup research (Bhattacharya & Basu, 1998; Callon et al., 1991). The analysis illuminated prevalent terms, indicating the frequency and prominence of themes within the field. The size of keyword nodes generally reflects their occurrence, while color may denote their development over time. Darker shades may represent more established themes in green entrepreneurship, whereas lighter shades highlight emergent areas of study. Investigating this database suggested that “sustainability” and “innovation” have come to the fore as prominent future topics in the current scholarship on green startups. This analysis is valuable for depicting the relative impact of researchers and the interconnections between themes. This provides a clear view of how different areas of green startup research are interrelated and how they have developed over time.

Research results

Data Extraction and Analysis

The authors applied descriptive statistics to examine the geographical spread, size, trajectory, and growth of the data contained in the articles focused on green startup (Hallinger & Kovačević, 2019). Moreover, they used citation and co-citation analysis to assess the prominence of article titles and author names in green entrepreneurship (Ji et al., 2022; Kleminski et al., 2022). Descriptive statistics helped to clarify the scope, scale, and geographical proliferation of articles in the dataset. Citation analysis measures the impact of an article by tracking how often it is referenced by subsequent publications, offering a measure of the article’s influence (Moed, 2006; Mohsen et al., 2023). Co-citation analysis measured how frequently two articles or authors were cited together, revealing intellectual connections and the importance of specific works in the green startup domain (Boyack & Klavans, 2010; Bu et al., 2020). Keyword co-occurrence analysis yielded insights into the research trends and the evolution of themes within the field of green startups, mirroring shifts observed in the broader entrepreneurial landscape (Figueiredo et al., 2011; Sedighi, 2016). This analysis maps out the network of knowledge and identify key thought leaders and foundational research towards the green startups.

Review Findings

Table 1 highlights the interdisciplinary scope of green entrepreneurship research, which spans environmental management, sustainable development, and business innovation. “Journal of Cleaner Production” leads with 1175 citations, asserting its preeminence in environmental aspects of green startups. Close behind, “Business Strategy and the Environment” garners 1136 citations, emphasizing its focus on sustainability in strategic business practices. Moreover, the table lists the number of articles published by each journal alongside their total link strength, indicating the extent of their influence in the green entrepreneurship discourse.

The citation counts and link strengths underscore the standing and scholarly impact of the journals, with “Sustainability” and “Small Business Economics” marked by their notable citation figures, reflecting

the intersection of green startups with broader business and economic concerns. “Organization and Environment,” as well as “Technological Forecasting and Social Change,” underscore the pivotal influence of innovation in sustainable business practices. This synthesis captures the diversity and connectivity within the field, as documented by the scholarly output in these leading journals.

Table 1 Ten major journals focusing on green startup

Rank	Source	Subjects	Documents	Citations	Total Link Strength
1	Journal of Cleaner Production	Environmental Management	24	1175	51
2	Business Strategy and the Environment	Corporate Sustainability	14	1136	63
3	Sustainability	Sustainability Studies	41	943	23
4	Small Business Economics	Entrepreneurial Economics	11	539	61
5	Organization and Environment	Environmental Strategy	2	441	12
6	Technological Forecasting and Social Change	Innovation Studies	2	394	5
7	Journal of Business Research	Business Management	3	110	22
8	Sustainable Development	Development Studies	2	84	4
9	International Journal of Entrepreneurial Behaviour and Research	Entrepreneurship	4	76	2
10	International Entrepreneurship and Management Journal	International Business	4	64	11

Table 2 reveals the most influential journals in the realm of green startup research through co-citation analysis, illuminating the field’s collaborative and interdisciplinary nature. “Journal of Cleaner Production” stands out with 733 co-citations, affirming its central role in environmental management

discussions within the green startup domain. “Journal of Business Venturing” is also pivotal with 624 co-citations, indicating its significance in the entrepreneurial process of sustainable business initiatives. Other prominent journals include “Sustainability” with 441 co-citations and “Business Strategy and the Environment” with 404 co-citations, both of which are instrumental in shaping strategic and sustainable business practices.

The presence of “Small Business Economics” and “Entrepreneurship Theory and Practice” with 367 and 359 co-citations, respectively, highlights their contribution to the economic and theoretical dimensions of green entrepreneurship. “Journal of Business Research” and “Journal of Business Ethics” are also key, with 227 and 226 co-citations, suggesting an ethical and managerial focus in the field. Moreover, “Academy of Management Review” and “Research Policy,” with their substantial link strengths, indicate that management theory and policy development are also integral to the discourse on green startups. This co-citation mapping is reflective of the robust intellectual ecosystem supporting green entrepreneurship scholarship.

Table 2 Top ten co-citations of sources in articles on green startup, 1987–2024

Rank	Source	Co-Citations	Total Link Strength
1	Journal of Cleaner Production	733	24,544
2	Journal of Business Venturing	624	21,292
3	Sustainability	441	14,454
4	Business Strategy and the Environment	404	16,862
5	Small Business Economics	367	14,686
6	Entrepreneurship Theory and Practice	359	13,731
7	Journal of Business Research	227	10,071
8	Journal of Business Ethics	226	8,397
9	Academy of Management Review	185	6,875
10	Research Policy	184	7,024

Table 3 presents the ten most highly cited articles in green entrepreneurship. The top-cited article by Cohen (2006) on “Sustainable Valley Entrepreneurial Ecosystems” received 1161 Google Scholar citations, indicating its significant impact in the field of sustainable business strategies. This is followed by Schaltegger et al. (2016), which explores business models for sustainability and has garnered 1556 citations, showing its foundational role in conceptualizing sustainability in business practices. Other notable works include Elia et al. (2020) with a review paper on the digital entrepreneurship ecosystem that received 795 citations, and Bocken (2015) discussing the role of sustainable venture capital in startup success, which has 528 citations. These leading articles, along with their Scopus citations, and paper types, showcase the pivotal works in the field of green entrepreneurship.

Table 3 Ten most highly cited articles on green startup based on Scopus and Google scholar citations, 1987–2024 (n = 223), in order

Rank	Document	Type of paper	Scopus citations	GS* link
1	Cohen, B. (2006). Sustainable valley entrepreneurial ecosystems. *Business strategy and the Environment*, *15*(1), 1-14.	Empirical	452	1161
2	Schaltegger, S., Hansen, E. G., & Lüdeke-Freund, F. (2016). Business models for sustainability: Origins, present research, and future avenues. *Organization & environment*, *29*(1), 3-10.	Conceptual	427	1556
3	Elia, G., Margherita, A., & Passiante, G. (2020). Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process. *Technological forecasting and social change*, *150*, 11979	Review	379	795
4	Bocken, N. M. P. (2015). Sustainable venture capital–catalyst for sustainable start-up success?. *Journal of cleaner production*, *108*, 647-658.	Empirical	198	528
5	Cohen, B., Smith, B., & Mitchell, R. (2008). Toward a sustainable conceptualization of dependent variables in entrepreneurship research. *Business Strategy and the Environment*, *17*(2), 107-119.	Theoretical	181	440
6	Theodoraki, C., Messeghem, K., & Rice, M. P. (2018). A social capital approach to the development of sustainable entrepreneurial ecosystems: an explorative study. *Small business economics*, *51*, 153-170.	Empirical	177	383
7	Neumeyer, X., & Santos, S. C. (2018). Sustainable business models, venture typologies, and entrepreneurial ecosystems: A	Empirical	165	307

Rank	Document	Type of paper	Scopus citations	GS* link
	social network perspective. *Journal of cleaner production*, *172*, 4565-4579.			
8	Terán-Yépez, E., Marín-Carrillo, G. M., Casado-Belmonte, M. D. P., & Capobianco-Uriarte, M. D. L. M. (2020). Sustainable entrepreneurship: Review of its evolution and new trends. *Journal of Cleaner Production*, *252*, 119742.	Review	161	307
9	Lüdeke-Freund, F. (2020). Sustainable entrepreneurship, innovation, and business models: Integrative framework and propositions for future research. *Business Strategy and the Environment*, *29*(2), 665-681.	Conceptual	150	312
10	Stubbs, W. (2017). Sustainable entrepreneurship and B corps. *Business Strategy and the Environment*, *26*(3), 331-344.	Empirical	148	292

GS* = Google Scholar

Research on green entrepreneurship and startups has been greatly advanced by key articles that expand our understanding of sustainable business practices, ecosystems, and integrating sustainability into business models. Table 4 reveals the top ten most cited articles in this field, highlighting foundational theories and models that have shaped green startup research. Cohen (2006) emphasized the importance of local ecosystems in fostering sustainable entrepreneurship. His analysis highlights how regional clusters can support green startups by providing a nurturing environment that includes access to resources, networks, and supportive policies. This foundational article has influenced the development of localized approaches to green entrepreneurship, where the interplay between environmental sustainability and economic development is seen as a synergistic process. Practitioners can apply these insights to develop strategies for establishing and growing green startups within their local ecosystems.

Schaltegger et al. (2016) provided a comprehensive overview of how business models can be designed to incorporate sustainability from the ground up. They present a framework identifying the origins, current trends, and future directions in sustainable business model research. Their work has been instrumental in shifting the focus from traditional profit-driven models to those that integrate ecological and social value creation, thus providing a blueprint for green startups to follow. Elia et al. (2020) explored and illustrated how digital technologies and collective intelligence are revolutionizing entrepreneurial processes. This article underscores digitalization’s role in enhancing green startups’ efficiency and reach, opening new avenues for innovation and scalability. The transformative potential of digital tools in green entrepreneurship offers a promising future for sustainable business practices.

Bocken (2015) discusses venture capital's critical role in supporting green startups' success. She highlights how sustainable venture capital can act as a catalyst, providing financial resources and strategic guidance to help green startups achieve their environmental and social goals. This insight has encouraged more venture capitalists to consider sustainability as a key criterion in their investment decisions. Cohen et al. (2008) proposed a sustainable conceptualization of dependent variables in entrepreneurship research, advocating for the inclusion of sustainability metrics. Their work has influenced how green startups measure their performance and success by redefining success in entrepreneurial ventures to include environmental and social impacts. This encourages a holistic approach to entrepreneurship where profit is balanced with purpose.

Theodoraki et al. (2018) explored how social capital contributes significantly to the development of sustainable entrepreneurial ecosystems. They argue that social networks and community support are not just beneficial, but vital for the growth of green startups. This perspective underscores the importance of building strong, collaborative networks to support sustainable entrepreneurship, making the audience feel the significance of these networks. Neumeyer and Santos (2018) provided a social network perspective on green entrepreneurship. They highlight the diverse typologies of ventures and the ecosystems that support them, offering insights into how different types of green startups can thrive in various contexts. This work has helped to understand the nuanced needs of different green ventures and the importance of tailored support systems.

Terán-Yépez et al. (2020) identified emerging trends and shifts in the field. They offer a synthesis of the latest research, highlighting areas such as digital innovation and policy frameworks driving green entrepreneurship's future. Their work serves as a valuable resource for understanding the dynamic and ever-evolving nature of the field and the ongoing evolution of green startups, making the audience feel the dynamic nature of the field. Lüdeke-Freund (2020) presented an integrative framework offering propositions for future research. His work emphasizes the interconnectedness of sustainability, innovation, and business model development. This comprehensive framework has guided researchers and practitioners in exploring new ways to integrate these elements into green startups. Finally, Stubbs (2017) examined the role of certified B Corporations in promoting sustainable business practices. This article highlights how B Corps can be role models for green startups, demonstrating that businesses can be profitable and purpose driven. Stubbs' work has influenced the adoption of B Corp principles among green startups, fostering a culture of accountability and transparency in sustainability efforts.

These articles collectively shape the discourse on green entrepreneurship by providing diverse perspectives on sustainable business models, the role of digital technologies, the importance of social capital, and the integration of sustainability into venture capital and performance metrics. They offer valuable frameworks and insights that guide green startups in navigating the complexities of sustainability while striving for economic viability. However, it's important to note that these works are not exhaustive, and the field of green entrepreneurship continues to evolve. As the field progresses, it is crucial to acknowledge the limitations of current research and encourage further exploration to advance the understanding and practice of green entrepreneurship.

Table 4 Ranking of the top ten most co-cited articles on green startup, 1987–2024 (n = 2169), in order

Rank	Cited Reference	Citations	Total Link Strength
1	Cohen, B., & Winn, M. I. (2007). Market imperfections, opportunity and sustainable entrepreneurship. *Journal of business venturing*, *22*(1), 29-49.	51	105
2	Schaltegger, S., & Wagner, M. (2011). Sustainable entrepreneurship and sustainability innovation: categories and interactions. *Business strategy and the environment*, *20*(4), 222-237.	49	95
3	Dean, T. J., & McMullen, J. S. (2007). Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action. *Journal of business venturing*, *22*(1), 50-76.	48	103
4	Gast, J., Gundolf, K., & Cesinger, B. (2017). Doing business in a green way: A systematic review of the ecological sustainability entrepreneurship literature and future research directions. *Journal of cleaner production*, *147*, 44-56.	21	21
5	Hall, J. K., Daneke, G. A., & Lenox, M. J. (2010). Sustainable development and entrepreneurship: Past contributions and future directions. *Journal of business venturing*, *25*(5), 439-448.	19	49
6	Stam, E. (2015). Entrepreneurial ecosystems and regional policy: a sympathetic critique. *European planning studies*, *23*(9), 1759-1769.	18	55
7	Cohen, B. (2006). Sustainable valley entrepreneurial ecosystems. Business strategy and the Environment, *15*(1), 1-14.	16	47
8	Muñoz, P., & Cohen, B. (2018). Sustainable entrepreneurship research: Taking stock and	14	22

Rank	Cited Reference	Citations	Total Link Strength
	looking ahead. *Business Strategy and the Environment*, *27*(3), 300-322.		
9	Neumeyer, X., & Santos, S. C. (2018). Sustainable business models, venture typologies, and entrepreneurial ecosystems: A social network perspective. *Journal of cleaner production*, *172*, 4565-4579.	14	39
10	Parrish, B. D. (2010). Sustainability-driven entrepreneurship: Principles of organization design. *Journal of business Venturing*, *25*(5), 510-523.	13	40

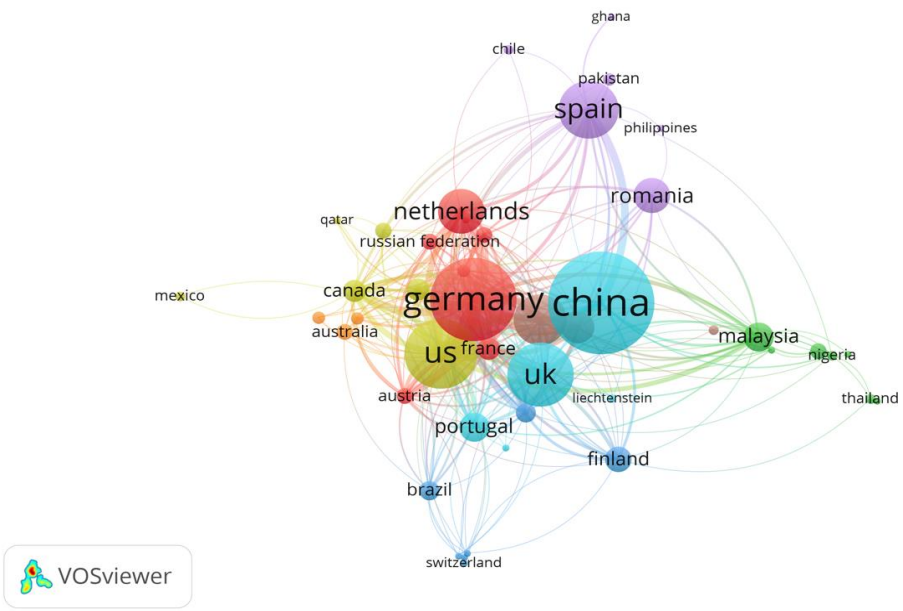

Figure 2 Map of the top countries focusing on green startup

Figure 2 and Table 5 illustrate the global scope of green startup research, demonstrating significant contributions from Germany, the United States, and Italy, which are leading in citation counts. Germany stands out with 1181 citations, emphasizing its leadership in sustainable industry practices and renewable energy technologies that form the backbone of its robust green startup ecosystem. Following closely, the United States, with 991 citations, highlights a diverse innovation landscape that nurtures a broad spectrum of sustainable and green technologies. Italy, with 836 citations, is noted for its efforts to incorporate sustainability into traditional manufacturing and agricultural sectors, using its historical industrial strengths to advance green business practices. These figures reflect the strong engagement and substantial

investments these countries have made in green technologies and environmentally focused entrepreneurial ventures.

Canada and the UK also make significant contributions to green startup research, with 735 and 724 citations respectively. Canada's research focuses predominantly on clean technology and natural resource management, leveraging its rich natural resources (Gyamfi et al., 2022; Jordaan et al., 2017). Canada can reduce the negative environmental impacts of non-renewable energy sources and maximize economic benefits by adopting advanced technologies like smart grids, energy storage systems, and carbon capture and storage (Subhan et al., 2024). In contrast, the UK's research emphasizes the financial aspects of sustainability, particularly green finance and investment (Akomea-Frimpong et al., 2022; Hafner et al., 2020). Further contributions come from Austria, Spain, the Netherlands, and China, each adding unique insights and applications to the green startup sector. (Bouchmel et al., 2024) indicates that SMEs in Eastern European countries depend largely on internal resources for green investments due to limited access to external funding, especially from banks, necessitating managers to allocate more internal funds for green practices and urging governments and policymakers to improve access to debt finance and provide financial incentives to encourage environmental engagement. Notably, China, despite being last on this list with 401 citations, produces a high volume of documents (32), showcasing a rapid increase in its dedication to green technology and sustainable entrepreneurship (Huang et al., 2022; Li et al., 2020). This diverse global research activity highlights a dynamic field where varied regional strengths and perspectives address the challenges and opportunities of sustainable entrepreneurship, driving theoretical and practical advancements in green startup ecosystems. These works have shown that advancement in green entrepreneurship on both regional and international scale.

Table 5 Top countries publishing research on green start up from 1987 to 2024

Rank	Country	Documents	Citations	Total Link Strength
1	Germany	26	1181	216
2	United States	22	991	180
3	Italy	16	836	78
5	Canada	7	735	89
6	United Kingdom	20	724	92
7	Austria	5	615	61
8	Spain	18	537	60
9	Netherlands	14	519	72
10	China	32	401	79

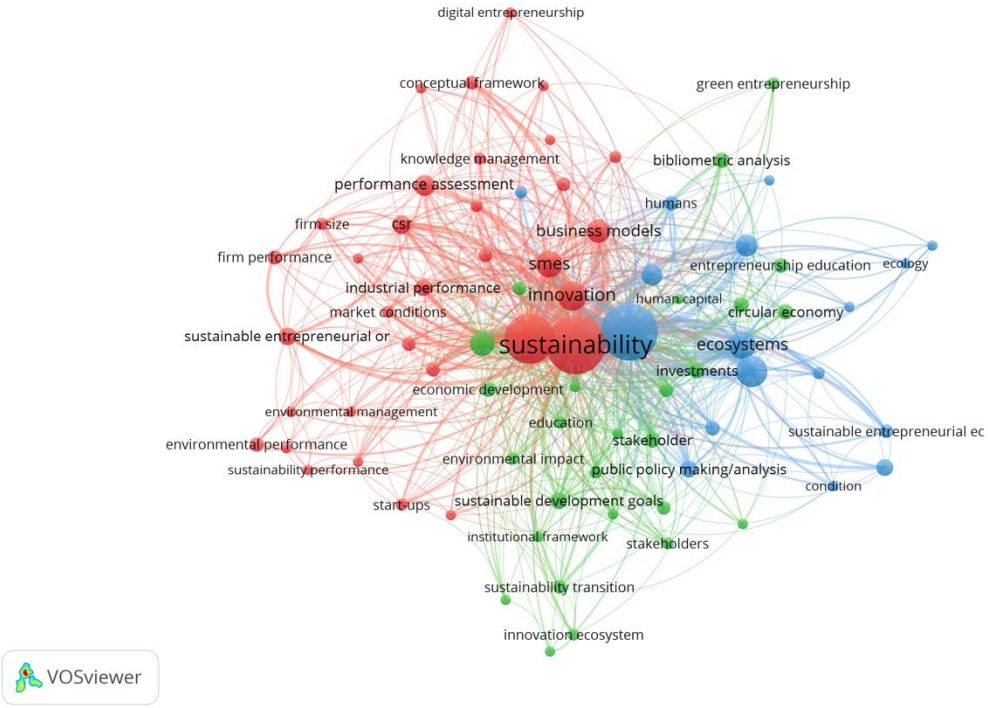

Figure 3 Co-word map for articles on green startup published from 1987 to 2024 (threshold, 5 co-occurrences; displayed, 87 keywords)

In Figure 3, the red cluster focuses on key aspects of green startups, including sustainability, innovation, and business models, underscoring the extensive research dedicated to understanding the intersection of entrepreneurial activities with sustainable development (Criado-Gomis et al., 2017). This cluster suggests robust academic engagement with how green startups can integrate sustainable practices within their business frameworks. Core themes such as corporate social responsibility (CSR) (Carroll, 2015; Carroll & Shabana, 2010), firm performance in relation to sustainability (Schrettle et al., 2014), and market conditions tailored to environmentally conscious businesses (Gelderman et al., 2021) are prevalent here. The strong interconnections signal a well-established research area, rich in studies that investigate how sustainability is driving business innovation and strategy (Saunila et al., 2018).

The green cluster emphasizes the transformative role of sustainability transitions, public policymaking and education in fostering green entrepreneurship (Hörisch, 2015; Lourenço et al., 2013; Makhloufi et al., 2022). The central nodes here-sustainability transition and innovation ecosystems-indicate key focal points for studies examining the shift toward a more sustainable economy and the cultivation of environments conducive to green innovation. These themes serve as a nexus connecting the importance of stakeholder engagement (Bergset & Fichter, 2015),policy analysis (Cojoianu et al., 2020), and the pursuit of sustainable development goals (Sreenivasan & Suresh, 2023). All of which are vital in understanding how green startups navigate and influence the broader economic and environmental landscape.

Meanwhile, the blue cluster reveals the interplay between green entrepreneurship and emerging concepts like the circular economy and ecosystems investments (Djukic & Ilic, 2021; Mondal et al., 2023). While these nodes are less interconnected, pointing to a relatively newer or more specialized field of

inquiry, their presence reflects a growing interest in circular economic models and the creation of entrepreneurial ecosystems that support sustainable ventures (Klofsten et al., 2024). The emergence of these areas highlights the ongoing evolution in how green startups are perceived and supported within the wider context of ecological and economic sustainability (Fath, 2015).

The visualization encapsulates the complexity and dynamism within green startup research, revealing a multifaceted discourse that spans from practical business considerations to broader environmental and policy implications. It captures the essence of a burgeoning field that is not only multidisciplinary but also crucial to the global agenda of promoting sustainable business practices for future generations.

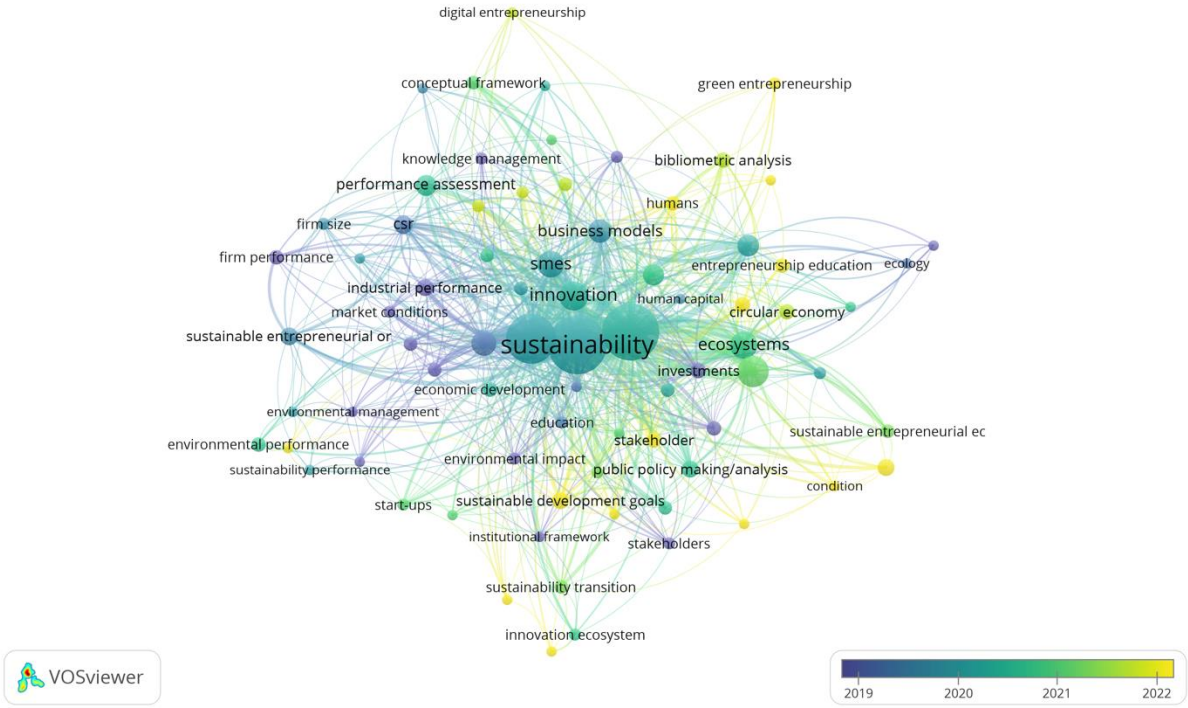

Figure 4 Co-word overlay map for articles on green startup published from 1987 to 2024 (threshold, 5 co-occurrences; displayed, 87 keywords)

In Figure 4, the visualization suggests a dynamic and evolving landscape of green startup research. Lighter nodes like digital entrepreneurship, circular economy and sustainable entrepreneurial ecosystems present emerging trends within the literature. These areas, possibly under-explored, offer fertile ground for new investigations as they signal shifts towards integrating digital advancements with sustainability (Mondejar et al., 2021) and the importance of circular economic principles in business models (Centobelli et al., 2020; Geissdoerfer et al., 2020). The network structure, with its dense hubs and links, paints a picture of a multifaceted research field. Central nodes such as sustainability, business models, and innovation denote well-established and extensively studied themes, indicating a solid academic foundation and a wealth of scholarly contributions. These core themes, intricately linked with smaller nodes like corporate social responsibility (CSR) and environmental performance underscore the

interconnected nature of sustainable business practices and their impact on corporate strategy (Kraus et al., 2020).

In contrast, the sparser connections in the network point to niche areas that are burgeoning within the green startup space. The potential for growth in these areas is substantial, as they touch upon cutting-edge topics like the integration of sustainability in education (Wamsler, 2020) and the role of public policy in promoting green businesses (Lüdeke-Freund, 2020). Tracking the temporal progression of these nodes, as indicated by the color gradient in the visualization, can reveal how the focus of green startup research is shifting over time. For example, it can highlight how recent global events, such as economic shifts or environmental policy changes (Fernandes et al., 2021; Söderholm, 2020), influence the direction and urgency of sustainability-focused entrepreneurship research (Yang et al., 2024). This visualization underscores the importance of staying attuned to the changes within the field to grasp new opportunities for innovation and impact within the field of green startup.

Table 6 Top cited author on green entrepreneurship (n = 223)

Rank	Author	Nation	Focus	Documents	Scopus Citation	CPDs
1	Cohen B.	SPA	Entrepreneurship, Ecosystems, and Sustainable Ecosystems	2	633	316.50
2	Lüdeke-Freund F.	FRA	Sustainable and Circular Business Models	2	577	288.50
3	Hansen E.G.	AT	Sustainability and Circular Economy Innovation	2	496	248.00
4	Schaltegger S.	GER	Sustainability and Management	2	496	248.00
5	Passiante G.	ITA	Technology Entrepreneurship	2	403	201.50
6	Theodoraki C.	FRA	Entrepreneurship, Ecosystem, Support, Incubators, Strategy	2	235	117.50
7	Fichter K.	GER	Sustainable Entrepreneurship and Innovation	3	191	63.67

8	Kratzer J.	GER	Entrepreneurship and Innovation Management	2	106	53.00
9	Jay J.	USA	Sustainability Innovation	2	101	50.50
10	Michelfelder I.	USA	New Ventures and Social Innovation	2	101	50.50

Table 6 illuminates the pivotal research and diverse geographic contributions shaping green startup discourse. Leading the citation index, Cohen B. emphasize the integration of entrepreneurial ventures within sustainable ecosystems, leading Europe toward environmentally conscious business practices. This regional inclination is further echoed by Lüdeke-Freund F. and his colleague, whose research underscores the necessity of sustainable and circular business models (Fichter et al., 2023; Lüdeke-Freund et al., 2024; Lüdeke-Freund, 2020). Hansen E.G. along with other scholar brings to the fore innovations in sustainability and circular economies (Fraccascia et al., 2021; Hansen et al., 2021; Wagner et al., 2021). These scholars, along with Schaltegger S., contribute to a strong European narrative that melds business strategy with sustainable development, demonstrating a commitment to redefining business practices for ecological viability (Burritt et al., 2023; Busch et al., 2024; Schaltegger et al., 2024).

Horne et al. (2020) and pivot towards integrating sustainability into technology and fostering social innovation. Their work represents a broader, global momentum towards addressing environmental challenges through entrepreneurial innovation. Collectively, these authors are not merely reporting on existing practices but actively driving a paradigm shift towards businesses that are as concerned with social and environmental impact as they are with profitability. Their research offers a blueprint for future green startups, positioning the triple bottom line as a cornerstone of contemporary and future business strategies.

Table 7 High-impact scholars in green startup based on co-citations

Rank	Author	Focus	Co-Citations	Total Link Strength
1	Cohen B.	Entrepreneurship, Ecosystems, and Sustainable Ecosystems	633	36
2	Audretsch D. B.	Entrepreneurship, economic and innovation	96	9
3	Bischoff K.	Entrepreneurial ecosystems	80	16
4	Cervera-Taulet A.	Strategic Marketing	80	7
5	Blok V.	Environmental philosophy and responsible innovation	75	1

Rank	Author	Focus	Co-Citations	Total Link Strength
6	Ahmad N. H.	Management and Entrepreneurship	72	1
7	Brouwer R.	Environmental Economics	51	7
8	Bărbulescu O.	Entrepreneurship and International Business	40	0
9	Ashraf S. F.	Entrepreneurship Business Strategies and Green Innovation	31	0
10	Aliabadi V.	Sustainable Agriculture	27	6

Table 7 presents a snapshot of influential researchers in the green startup domain, with a strong emphasis on sustainable practices within entrepreneurship. Cohen (2006) and Cohen et al. (2008) leads the field, merging the concepts of entrepreneurship with sustainable ecosystems, reflecting a significant interest and engagement in creating business practices that support environmental sustainability, as shown by his substantial co-citations and link strength. Audretsch and Fiedler (2023) and Aparicio et al. (2023)‘s research complements this by bridging entrepreneurship with economic growth and innovation, while Bischoff et al. (2018) and Criado-Gomis et al. (2017) contribute to understanding entrepreneurial ecosystems and strategic marketing within this context. Blok and Lemmens (2015) and Scholten and Blok (2015) introduces a philosophical angle, focusing on responsible innovation, and along with scholars like Ahmad N. H. and Brouwer R., who delve into management, entrepreneurship, and environmental economics, shapes a comprehensive dialogue on integrating sustainability into various business facets (Ahmad et al., 2020; Dijkstra et al., 2020). Bărbulescu O., Ashraf S. F., and Aliabadi V. round out the list, expanding the discussion to international business strategies, green innovation, and sustainable agriculture, illustrating a multidisciplinary approach to advancing green startups (Nicolau et al., 2022). Collectively, these scholars’ co-citations indicate a vibrant academic exchange and a converging interest in ensuring that entrepreneurial ventures advance sustainability goals, an essential component for addressing current environmental challenges.

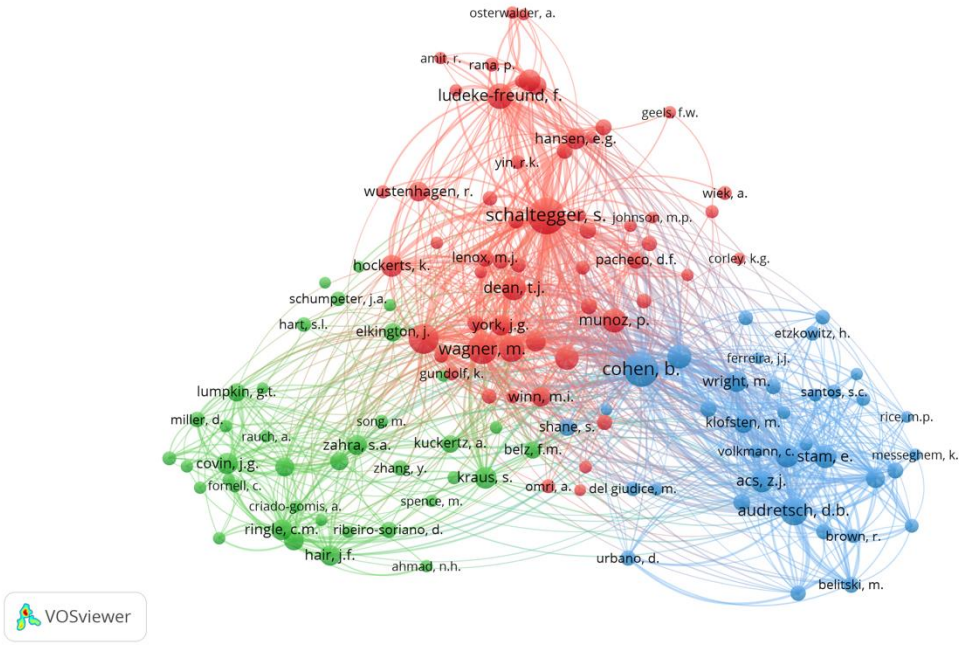

Figure 5 Co-citation analysis map on green startup, 1987–2024 (threshold, 20; displayed, 131 authors

Intellectual Structure of Research on Green Entrepreneurship

The visualization in the image appears to be a co-citation network map was created by VOSviewer with threshold, 20 and displayed, 131 authors. The map showcases the relationships between authors within the field of green entrepreneurship and sustainability**.** The network is likely divided into clusters that represent different schools of thought within the broader domain. In the red cluster, the key authors like Schaltegger et al. (2016) suggests a concentrated inquiry into crafting business models that inherently address the principles of sustainability. This school of thought explores how businesses can redesign their core strategies and operational processes to embed environmental and social considerations. For example, Lüdeke-Freund's work along with others (Boons & Lüdeke-Freund, 2013; Schaltegger et al., 2016; Schaltegger et al., 2012) are known for advancing the concept of circular business models, which focus on minimizing waste and making efficient use of resources throughout the product lifecycle. Similarly, Hansen's contributions bold on the innovation management processes that enable companies to transition to sustainable practices without compromising on competitiveness or profitability (Hansen & Schaltegger, 2018)

The red cluster may also investigate the systemic changes required for sustainable transformation, from both the micro-level of individual firm behaviors and the macro-level, where industries and entire markets shift toward sustainability (Skare & Porada-Rochon, 2022). This school of thought inherit interdisciplinary approaches, drawing from fields such as environmental science, economics, and management studies to construct comprehensive frameworks that can be adopted by businesses seeking a sustainable path forward. It reflects a narrative that business sustainability is not a peripheral concern but a central strategic priority that demands innovative thinking and long-term planning.

The green cluster discourse on entrepreneurial orientation in the context of green startups. This cluster suggests a focus on how entrepreneurial attitudes and actions can drive sustainable practices within

new ventures (Sargani et al., 2020; Thelken & Jong, 2020). The research on entrepreneurial orientation often revolves around how businesses approach innovation, risk-taking, and proactiveness, crucial traits for navigating the complexities of sustainability (Lumpkin & Pidduck, 2021). Arya et al. (2023) also address similar themes, exploring how a firm's strategic posture influences its environmental and social initiatives. This school of thought probes the interplay between the proactive pursuit of new opportunities that green entrepreneurship embodies and the strategic implementation of sustainability as a core business objective. It examines how sustainability can be integrated into the DNA of startup ventures, influencing everything from their mission and value proposition to their day-to-day operations and long-term strategy. By studying these aspects, the green cluster may provide insights into how sustainability-driven entrepreneurial ventures can not only exist but thrive within competitive markets by leveraging sustainability as a key differentiator and driver of value creation (Ponte, 2020; Pujari & Sadovnikova, 2020). This integration of sustainability principles into entrepreneurship theory could be providing a new lens through which we understand the role of startups in advancing economic, social, and environmental goals.

The blue cluster points to scholarly research centered on the interconnection between economic growth, policymaking, and sustainability goals. The research often associated with how the theory of entrepreneurship how knowledge translates into economic development, innovation, and entrepreneurial activity (Konno & Schillaci, 2021; Pujari & Sadovnikova, 2020). Within the sustainability context, the research could be examining the ways in which green startups not only contribute to but also benefit from economic development policies that incentivize innovation in environmental technologies. Moreover, some research also highlights the importance of entrepreneurship in economic systems, especially how entrepreneurial ventures can serve as catalysts for transformation within traditional economic structures to embrace sustainability (Filser et al., 2019). The presence of these authors in the blue cluster may also reflect an investigation into the policy frameworks that best support sustainable entrepreneurship, including regulations, financial incentives, and research and development initiatives.

All together, these intellectual school of thoughts explore the proposition that environmental sustainability and economic growth are complementary objectives. It proposes that with the right mix of innovation, policy support, and entrepreneurial dynamism, it is possible to pursue a growth strategy that is also environmentally sound. This could involve studies on how policy interventions can enhance the competitiveness of green startups, the role of technological innovation in driving economic sustainability, and the ways in which economic policies can be structured to support both ecological integrity and business growth. The synthesis from these clusters contribute to the broader understanding that economic policy and sustainability goals need to be aligned to ensure a affluent future that does not compromise the planet's ecological balance.

Thus, these clusters illustrate a rich, interconnected scholarly community that is dissecting various aspects of sustainability in the business context-from conceptual foundations and strategic implementation to economic policies and entrepreneurial practices. This synthesis suggests that the field is dynamic and multifaceted, with a growing emphasis on cross-disciplinary research that addresses complex issues at the intersection of environmental stewardship, economic viability, and social responsibility.

Discussion

The study underscores a paradigm shift in entrepreneurship towards sustainability, as traditional profit-driven business models are being reevaluated in light of social and environmental responsibilities. This shift is crystallized in the emergence of green startups, which balance economic objectives with the need for environmental stewardship and societal wellbeing. These businesses are characterized by their commitment to sustainability as a core value, often prioritizing it over immediate financial returns.

Central to this emerging field is the concept of sustainable entrepreneurship, which is defined as the process of creating products and services that protect the environment and support communities while also achieving economic gains. Green entrepreneurs are distinguished by their dual focus on opportunity recognition and environmental impact, indicating a nuanced evolution of Schumpeter's classical view of the entrepreneur as a driver of economic change.

The intellectual structure of green startup research, as revealed through bibliometric mapping, indicates diverse schools of thought. The analysis highlights prominent authors and articles that have shaped the discussion, pointing to influential works that explore the systemic changes necessary for sustainable transformation, both at the micro and macro levels. Central to these discussions are sustainable business models, circular economy innovations, and the role of policy and economic frameworks in supporting green entrepreneurship.

Emerging trends in green startup research, as indicated by keyword co-occurrence and co-citation analyses, suggest a growing interest in how digital technologies and innovation ecosystems can further the goals of sustainability. Moreover, the research points to the importance of cross-disciplinary approaches that draw from environmental science, economics, and management to construct comprehensive frameworks for businesses seeking a sustainable path forward.

Hence, the bibliometric analysis reveals a rich and dynamic field of green startup research, grounded in a global discourse that spans practical business considerations, environmental strategies, and policy implications. The study calls for ongoing exploration into the evolving dynamics of green startups, emphasizing the need for new research that can guide these ventures in contributing to a sustainable future. The analysis serves as a catalyst for renewed academic interest in how entrepreneurship can be a force for positive environmental and social change.

Conclusion

Interpretation of the Findings

This bibliometric analysis has captured the significant and growing body of literature surrounding green startups, reflecting the imperative of integrating sustainability into entrepreneurship. The reviewed corpus of 223 articles reveals an expanding research landscape, where sustainability is not merely a trend but a foundational element of new business paradigms. The emphasis has shifted towards innovative models that prioritize ecological balance and social equity, illustrating an entrepreneurial spirit aligned with the sustainability mandate. The global spread of research, including substantial contributions from China,

indicates a universal acknowledgment of the importance of green startups in achieving sustainable development goals.

Limitation of the Current Study

This study, while extensive, recognizes limitations inherent to its methodology. The reliance on the Scopus database may not encapsulate the entirety of global research, potentially missing out on significant contributions published elsewhere or in other languages. The rapid evolution of the field suggests that the most cutting-edge practices may not yet be documented in the academic literature, pointing to a possible lag between practice and scholarship. Publication bias and the focus on English-language literature may have restricted the scope, possibly omitting diverse perspectives on green entrepreneurship.

Recommendations

Recommendations for Future Research

Future research should broaden its analytical reach by incorporating a more diverse array of databases and languages to capture the full spectrum of global innovation in green entrepreneurship. This approach will ensure a more comprehensive understanding of the field's development worldwide. Empirical studies examining the real-world impact of green startups will be critical in validating theoretical frameworks. Such studies will provide concrete evidence on the effectiveness and practicality of these theories in various contexts. Longitudinal research can also reveal trends and outcomes over extended periods, offering valuable insights into how green startups can maintain their sustainability goals over time. Comparative studies across different cultural and economic contexts will also provide deeper insights into the unique challenges and opportunities faced by green entrepreneurs in various settings. These studies can highlight how local conditions influence the success and strategies of green businesses, offering guidance for entrepreneurs operating in diverse environments. In summary, future research should be comprehensive, empirical, longitudinal, and comparative, adapting to the evolving landscape of green entrepreneurship. By doing so, it can provide the necessary insights and guidance to foster sustainable practices and support the growth of green startups globally.

Academic Implication

The findings of this study have several important implications for academic research in the field of green entrepreneurship. First, the study underscores the necessity of incorporating a multidisciplinary approach to fully understand and address the complexities of green entrepreneurship. By integrating insights from environmental science, economics, management, and technology, researchers can develop more holistic frameworks that capture the diverse factors influencing green startups. This research highlights the critical role of social networks and policy frameworks in supporting green entrepreneurship, suggesting that future studies should delve deeper into these areas. Understanding how social capital and supportive policies interact to foster sustainable business practices can provide valuable insights into creating more effective ecosystems for green entrepreneurs.

Moreover, the study's bibliometric analysis reveals the evolution of green entrepreneurship research and identifies key themes such as sustainability, innovation, and the circular economy. These findings suggest that future research should continue to explore these themes, particularly how digital technologies and innovation ecosystems can further the goals of sustainability. By examining emerging trends and leveraging advanced analytical methods like co-citation and co-word analysis, researchers can uncover new directions and opportunities for advancing the field. Longitudinal studies are particularly important for assessing the long-term viability and sustainability of green startups. Such research can provide insights into the success factors and challenges faced by green entrepreneurs over time, offering valuable guidance for both practitioners and policymakers. Additionally, comparative studies across different cultural and economic contexts can deepen our understanding of the unique challenges and opportunities faced by green entrepreneurs in various settings.

The academic community can benefit from this study's comprehensive review of the intellectual structure of green entrepreneurship research. By identifying influential authors, articles, and journals, this study provides a roadmap for future research, highlighting the foundational works and emerging trends that are shaping the field. This can help scholars build on existing knowledge and contribute to a more nuanced and sophisticated understanding of green entrepreneurship. In summary, the academic implications of this study are multifaceted, emphasizing the need for a multidisciplinary approach, deeper exploration of social networks and policy frameworks, and continued investigation into emerging trends. By addressing these areas, future research can significantly advance the field of green entrepreneurship, providing valuable insights that drive both theoretical and practical advancements.

Practical Implication

The findings from this study have significant implications for the practice of green entrepreneurship and policymaking. For practitioners, understanding the critical role of social networks and supportive policies can inform strategies for building stronger, more resilient green businesses. Entrepreneurs can focus on building robust networks, both locally and globally, to access resources, share knowledge, and gain market insights. Green entrepreneurs can use the insights from this study to develop strategies that align their business goals with sustainability objectives. For instance, adopting business models that prioritize resource efficiency, renewable energy use, and waste reduction can not only improve environmental performance but also enhance brand reputation and customer loyalty. By engaging with local and global networks, entrepreneurs can access valuable resources and market insights that help them stay competitive and resilient in a rapidly changing market. Additionally, prioritizing business models that focus on sustainability can appeal to a growing consumer base that values eco-friendly practices, thereby enhancing brand reputation and fostering customer loyalty.

For policymakers, the study underscores the importance of creating a conducive environment for green entrepreneurship. Policies that reduce financial barriers, provide incentives for sustainable practices, and foster innovation in green technologies are crucial. Policymakers can support green entrepreneurs by implementing policies that make it easier to access financing, such as grants, low-interest loans, and tax incentives for sustainable practices. Furthermore, encouraging businesses to adopt green technologies

through various incentives can drive wider adoption of sustainable business practices. Supporting research and development in green technologies is also essential, as it creates new opportunities for green entrepreneurs and ensures they have access to the latest innovations. Moreover, policymakers should design policies that look beyond immediate economic gains and consider the long-term benefits of sustainable ventures. This approach can help create a more supportive environment for green businesses to thrive, ensuring that sustainability is integrated into the core business strategy and enhancing long-term value. By focusing on these areas, both entrepreneurs and policymakers can contribute to a more sustainable and resilient business landscape. Entrepreneurs can leverage supportive networks and sustainable business models to achieve their goals, while policymakers can foster an environment that encourages and supports green entrepreneurship.

Entrepreneurs should focus on integrating sustainability into their core business strategies, investing in green technologies, and building strong social networks. Policymakers, on the other hand, should create supportive frameworks that incentivize sustainable practices, reduce regulatory barriers, and provide financial support for green ventures. For instance, a green startup in the renewable energy sector could benefit from government grants or tax incentives to offset initial investment costs. Similarly, a company focusing on sustainable fashion could leverage social media and community partnerships to build a loyal customer base and promote eco-friendly products.

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References

Ahmad, N. H., Rahman, S. A., Rajendran, N. L. K. A., & Halim, H. A. (2020). Sustainable entrepreneurship practices in Malaysian manufacturing SMEs: the role of individual, organisational and institutional factors. *World Review of Entrepreneurship, Management and Sustainable Development, 16*(2), 153-171.

Akomea-Frimpong, I., Adeabah, D., Ofosu, D., & Tenakwah, E. J. (2022). A review of studies on green finance of banks, research gaps and future directions. *Journal of Sustainable Finance & Investment*, *12*(4), 1241-1264.

Aparicio, S., Hughes, M., Audretsch, D., & Urbano, D. (2023). Incentivizing knowledge institutions for entrepreneurship and society. *International Journal of Entrepreneurial Behavior & Research*. https://doi.org/10.1108/IJEBR-07-2022-0652

Arya, B., Horak, S., Bacouel-Jentjens, S., & Ismail, K. (2023). Leading entrepreneurial sustainability initiatives in emerging economies. *International Journal of Emerging Markets*, *18*(1), 64-85.

Audretsch, D. B., & Fiedler, A. (2023). Does the entrepreneurial state crowd out entrepreneurship?. *Small Business Economics*, *60*(2), 573-589.

Bergset, L., & Fichter, K. (2015). Green start-ups–a new typology for sustainable entrepre-neurship and innovation research. *Journal of innovation management*, *3*(3), 118-144.

Bhattacharya, S., & Basu, P. (1998). Mapping a research area at the micro level using co-word analysis. Scientometrics, *43*(3), 359-372.

Bischoff, K., Volkmann, C. K., & Audretsch, D. B. (2018). Stakeholder collaboration in entrepreneurship education: an analysis of the entrepreneurial ecosystems of European higher educational institutions. *The Journal of Technology Transfer*, *43*, 20-46.

Blok, V., & Lemmens, P. (2015). The emerging concept of responsible innovation. Three reasons why it is questionable and calls for a radical transformation of the concept of innovation. In B.-J. Koops I. Oosterlaken H. Romijn T. Swierstra & J. V. D. Hovan (Eds.), *Responsible innovation 2: Concepts, approaches, and applications* (pp. 19-35). Springer.

Bocken, N. M. P. (2015). Sustainable venture capital–catalyst for sustainable start-up success?. *Journal of Cleaner Production*, *108*, 647-658.

Boons, F., & Lüdeke-Freund, F. (2013). Business models for sustainable innovation: state-of-the-art and steps towards a research agenda. *Journal of Cleaner Production*, *45*, 9-19. https://doi.org/10.1016/j.jclepro.2012.07.007

Bouchmel, I., Ftiti, Z., Louhich, W., & Omri, A. (2024). Financing sources, green investment, and environmental performance: Cross-country evidence. *Journal of Environmental Management*, *353*, 120230.

Boyack, K. W., & Klavans, R. (2010). Co-citation analysis, bibliographic coupling, and direct citation: Which citation approach represents the research front most accurately?. *Journal of the American society for Information Science and Technology*, *61*(12), 2389-2404.

Bu, Y., Wang, B., Chinchilla-Rodríguez, Z., Sugimoto, C. R., Huang, Y., & Huang, W.-b. (2020). Considering author sequence in all-author co-citation analysis. *Information Processing & Management, 57*(6), 102300.

Burritt, R. L., Schaltegger, S., & Christ, K. L. (2023). Environmental Management Accounting – Developments Over the Last 20 years from a Framework Perspective. *Australian Accounting Review*, *33*(4), 336-351. https://doi.org/10.1111/auar.12407

Busch, T., Barnett, M. L., Burritt, R. L., Cashore, B. W., Freeman, R. E., Henriques, I., Husted, B. W., Panwar, R., Pinkse, J., Schaltegger, S., & York, J. (2024). Moving beyond “the” business case: How to make

corporate sustainability work. *Business Strategy and the Environment*, *33*(2), 776-787. https://doi.org/10.1002/bse.3514

Callon, M., Courtial, J. P., & Laville, F. (1991). Co-word analysis as a tool for describing the network of interactions between basic and technological research: The case of polymer chemsitry. *Scientometrics*, *22,* 155-205.

Carroll, A. B. (2015). Corporate social responsibility: The centerpiece of competing and complementary frameworks. *Organizational dynamics*. *44*(2), 87-96.

Carroll, A. B., & Shabana, K. M. (2010). The business case for corporate social responsibility: A review of concepts, research and practice. *International Journal of Management Reviews*, *12*(1), 85-105.

Centobelli, P., Cerchione, R., Chiaroni, D., Del Vecchio, P., & Urbinati, A. (2020). Designing business models in circular economy: A systematic literature review and research agenda. *Business Strategy and the Environment*, *29*(4), 1734-1749.

Cohen, B. (2006). Sustainable valley entrepreneurial ecosystems. *Business Strategy and the Environment*, *15*(1), 1-14.

Cohen, B., Smith, B., & Mitchell, R. (2008). Toward a sustainable conceptualization of dependent variables in entrepreneurship research. *Business Strategy and the Environment*, *17*(2), 107-119.

Cohen, B., & Winn, M. I. (2007). Market imperfections, opportunity and sustainable entrepreneurship. *Journal of business venturing*, *22*(1), 29-49.

Cojoianu, T. F., Clark, G. L., Hoepner, A. G. F., Veneri, P., & Wójcik, D. (2020). Entrepreneurs for a low carbon world: How environmental knowledge and policy shape the creation and financing of green start-ups. *Research Policy*, *49*(6), 103988.

Criado-Gomis, A., Cervera-Taulet, A., & Iniesta-Bonillo, M.-A. (2017). Sustainable entrepreneurial orientation: A business strategic approach for sustainable development. *Sustainability*, *9*(9), 1667.

Dean, T. J., & McMullen, J. S. (2007). Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action. *Journal of business venturing*, *22*(1), 50-76.

Dijkstra, H., Beukering, P. V., & Brouwer, R. (2020). Business models and sustainable plastic management: A systematic review of the literature. *Journal of Cleaner Production*, *258*, 120967.

Djukic, G., & Ilic, B. (2021). Importance of green investment and entrepreneurship for economic development. In P. Jasovka D. Logue & H. G. Rammal (Eds.), *Contemporary Entrepreneurship Issues in International Business* (pp. 195-220). World Scientific.

Elia, G., Margherita, A., & Passiante, G. (2020). Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process. *Technological Forecasting and Social Change*, *150*, 119791.

Fath, B. D. (2015). Quantifying economic and ecological sustainability. *Ocean & Coastal Management*, *108*, 13-19.

Fernandes, C. I., Veiga, P. M., Ferreira, J. J. M., & Hughes, M. (2021). Green growth versus economic growth: do sustainable technology transfer and innovations lead to an imperfect choice?. *Business Strategy and the Environment*, *30*(4), 2021-2037.

Fichter, K., Lüdeke-Freund, F., Schaltegger, S., & Schillebeeckx, S. J. D. (2023). Sustainability impact assessment of new ventures: An emerging field of research. *Journal of Cleaner Production*, *384*, 135452.

Figueiredo, F., Rocha, L., Couto, T., Salles, T., Gonçalves, M. A., & Meira, W. (2011). Word co-occurrence features for text classification. *Information Systems*, *36*(5), 843-858.

Filser, M., Kraus, S., Roig-Tierno, N., Kailer, N., & Fischer, U. (2019). Entrepreneurship as catalyst for sustainable development: Opening the black box. *Sustainability*, *11*(16), 4503.

Fraccascia, L., Giannoccaro, I., Agarwal, A., & Hansen, E. G. (2021). Business models for the circular economy: Empirical advances and future directions. *Business Strategy and the Environment*, *30*(6), 2741-2744.

Gast, J., Gundolf, K., & Cesinger, B. (2017). Doing business in a green way: A systematic review of the ecological sustainability entrepreneurship literature and future research directions. *Journal of cleaner production*, *147*, 44-56.

Geissdoerfer, M., Pieroni, M. P. P., Pigosso, D. C. A., & Soufani, K. (2020). Circular business models: A review. *Journal of Cleaner Production*, *277*, 123741.

Gelderman, C. J., Schijns, J., Lambrechts, W., & Vijgen, S. (2021). Green marketing as an environmental practice: The impact on green satisfaction and green loyalty in a business-to-business context. *Business Strategy and the Environment*, *30*(4), 2061-2076.

Gyamfi, B. A., Onifade, S. T., Nwani, C., & Bekun, F. V. (2022). Accounting for the combined impacts of natural resources rent, income level, and energy consumption on environmental quality of G7 economies:

a panel quantile regression approach. *Environmental Science and Pollution Research*, *29*(2), 2806-2818.

Hafner, S., Jones, A., Anger-Kraavi, A., & Pohl, J. (2020). Closing the green finance gap–A systems perspective. *Environmental Innovation and Societal Transitions*, *34*, 26-60.

Hall, J. K., Daneke, G. A., & Lenox, M. J. (2010). Sustainable development and entrepreneurship: Past contributions and future directions. *Journal of business venturing*, *25*(5), 439-448.

Hallinger, P., & Kovačević, J. (2019). A bibliometric review of research on educational administration: science mapping the literature, 1960 to 2018. *Review of Educational Research*, *89*(3), 335-369.

Hansen, E. G., & Schaltegger, S. (2018). Sustainability balanced scorecards and their architectures: irrelevant or misunderstood?. *Journal of Business Ethics*, *150*(4), 937-952.

Hansen, E., Wiedemann, P., Fichter, K., Lüdeke-Freund, F., Jaeger-Erben, M., Schomerus, T., Alcayaga, A., Blomsma, F., Tischner, U., Ahle, U., Büchle, D., Denker, A.-K., Fiolka, K., Froehling, M., Haege, A., Hoffmann, V., Kohl, H., Nitz, T., Schiller, C., & Kadner, S. (2021). *Circular Business Models: Overcoming Barriers, Unleashing Potentials.* National Academy of Science and Engineering.

Hart, S. L., & Milstein, M. B. (1999). Global sustainability and the creative destruction of industries. *MIT Sloan Management Review, 41*(1), 23-33.

Hart, S. L., & Milstein, M. B. (2003). Creating sustainable value. *Academy of Management Perspectives*, *17*(2), 56-67.

Hörisch, J. (2015). Crowdfunding for environmental ventures: an empirical analysis of the influence of environmental orientation on the success of crowdfunding initiatives. *Journal of Cleaner Production*, *107*, 636-645.

Horne, J., Recker, M., Michelfelder, I., Jay, J., & Kratzer, J. (2020). Exploring entrepreneurship related to the sustainable development goals-mapping new venture activities with semi-automated content analysis. *Journal of Cleaner Production*, *242*, 118052.

Huang, W., Chau, K. Y., Kit, I. Y., Nureen, N., Irfan, M., & Dilanchiev, A. (2022). Relating sustainable business development practices and information management in promoting digital green innovation: evidence from China. *Frontiers in psychology*, *13*, 930138.

Isfandyari-Moghaddam, A., Saberi, M. K., Tahmasebi-Limoni, S., Mohammadian, S., & Naderbeigi, F. (2023). Global scientific collaboration: A social network analysis and data mining of the co-authorship networks. *Journal of Information Science*, *49*(4), 1126-1141.

Ji, P., Jin, J., Ke, Z. T., & Li, W. (2022). Co-citation and Co-authorship Networks of Statisticians. *Journal of Business & Economic Statistics*, *40*(2), 469-485.

Jordaan, S. M., Romo-Rabago, E., McLeary, R., Reidy, L., Nazari, J., & Herremans, I. M. (2017). The role of energy technology innovation in reducing greenhouse gas emissions: A case study of Canada. *Renewable and Sustainable Energy Reviews*, *78*, 1397-1409.

Kleminski, R., Kazienko, P., & Kajdanowicz, T. (2022). Analysis of direct citation, co-citation and bibliographic coupling in scientific topic identification. *Journal of Information Science*, *48*(3), 349-373.

Klofsten, M., Kanda, W., Bienkowska, D., Bocken, N., Mian, S., & Lamine, W. (2024). Start-ups within entrepreneurial ecosystems: Transition towards circular economy. *International Small Business Journal*, *42*(4), 383-395. https://doi.org/10.1177/02662426241227520

Konno, N., & Schillaci, C. E. (2021). Intellectual capital in Society 5.0 by the lens of the knowledge creation theory. *Journal of Intellectual Capital*, *22*(3), 478-505.

Kraus, S., Rehman, S. U., & García, F. J. S. (2020). Corporate social responsibility and environmental performance: The mediating role of environmental strategy and green innovation. *Technological Forecasting and Social Change*, *160*, 120262.

Li, L., Msaad, H., Sun, H., Tan, M. X., Lu, Y., & Lau, A. K. W. (2020). Green innovation and business sustainability: New evidence from energy intensive industry in China. *International Journal of Environmental Research and Public Health*, *17*(21), 7826.

Lourenço, F., Jones, O., & Jayawarna, D. (2013). Promoting sustainable development: The role of entrepreneurship education. *International Small Business Journal*, *31*(8), 841-865.

Lüdeke-Freund, F., Froese, T., Dembek, K., Rosati, F., & Massa, L. (2024). What Makes a Business Model Sustainable? Activities, Design Themes, and Value Functions. *Organization & Environment*, *37*(2). https://doi.org/10.1177/10860266241235212

Lüdeke- Freund, F. (2020). Sustainable entrepreneurship, innovation, and business models: Integrative framework and propositions for future research. *Business Strategy and the Environment*, *29*(2), 665-681.

Lumpkin, G. T., & Pidduck, R. J. (2021). Global entrepreneurial orientation (GEO): An updated, multidimensional view of EO. In A. C. Corbett P. M. Kreiser L. D. Marino & W. J. Wales (Eds.), *Entrepreneurial orientation: Epistemological, theoretical, and empirical perspectives* (pp. 17-68). Emerald Publishing Limited.

Makhloufi, L., Laghouag, A. A., Meirun, T., & Belaid, F. (2022). Impact of green entrepreneurship orientation on environmental performance: The natural resource- based view and environmental policy perspective. *Business Strategy and the Environment*, *31*(1), 425-444.

Moed, H. F. (2006). *Citation analysis in research evaluation* (Vol. 9). Springer Science & Business Media.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*, 339(b2535). https://doi.org/10.1136/bmj.b2535

Mohsen, M. A., Althebi, S., & Albahooth, M. (2023). A scientometric study of three decades of machine translation research: Trending issues, hotspot research, and co-citation analysis. *Cogent Arts & Humanities*, *10*(1). https://doi.org/10.1080/23311983.2023.2242620

Mondal, S. (2023). The nexus between green entrepreneurship and sustainable development: An econometric study. *Global Business Review*. https://doi.org/10.1177/09721509231157009

Mondal, S., Singh, S., & Gupta, H. (2023). Assessing enablers of green entrepreneurship in circular economy: An integrated approach. *Journal of Cleaner Production*, *388*, 135999.

Mondejar, M. E., Avtar, R., Diaz, H. L. B., Dubey, R. K., Esteban, J., Gómez-Morales, A., Hallam, B., Mbungu, N. T., Okolo, C. C., Prasad, K. A., She, Q., & Garcia-Segura, S. (2021). Digitalization to achieve sustainable development goals: Steps towards a Smart Green Planet. *Science of The Total Environment*, 794, 148539. https://doi.org/10.1016/j.scitotenv.2021.148539

Muñoz, P., & Cohen, B. (2018). Sustainable entrepreneurship research: Taking stock and looking ahead. *Business Strategy and the Environment*, *27*(3), 300-322.

Neumeyer, X., & Santos, S. C. (2018). Sustainable business models, venture typologies, and entrepreneurial ecosystems: A social network perspective. *Journal of Cleaner Production*, *172*, 4565-4579.

Nicolau, C., Nichifor, E., Munteanu, D., & Bărbulescu, O. (2022). Decoding Business Potential for Digital Sustainable Entrepreneurship: What Romanian Entrepreneurs Think and Do for the Future. *Sustainability*, *14*(20), 1-21. https://doi.org/10.3390/su142013636

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilsom, E., McDonald, S., McGuinness, L. A., Stewart, L. A., Thomas, J., Tricco, A. C., Welch, V. A., Whiting, P., & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, *372*(n71). https://doi.org/10.1136/bmj.n71

Parrish, B. D. (2010). Sustainability-driven entrepreneurship: Principles of organization design. *Journal of business Venturing*, *25*(5), 510-523.

Ponte, S. (2020). Green capital accumulation: business and sustainability management in a world of global value chains. *New Political Economy*, *25*(1), 72-84.

Pujari, D., & Sadovnikova, A. (2020). Sustainability Innovation: Drivers, Capabilities, Strategies, and Performance. *Oxford Research Encyclopedia of Business and Management.* https://oxfordre.com/business/view/10.1093/acrefore/9780190224851.001.0001/acrefore-9780190224851-e-11

Sargani, G. R., Zhou, D., Raza, M. H., & Wei, Y. (2020). Sustainable entrepreneurship in the agriculture sector: The nexus of the triple bottom line measurement approach. *Sustainability*, *12*(8), 1-24.

Saunila, M., Ukko, J., & Rantala, T. (2018). Sustainability as a driver of green innovation investment and exploitation. *Journal of Cleaner Production*, *179*, 631-641.

Schaltegger, S., Girschik, V., Trittin-Ulbrich, H., Weissbrod, I., & Daudigeos, T. (2024). Corporate change agents for sustainability: Transforming organizations from the inside out. *Business Ethics, the Environment & Responsibility*, *33*(2), 145-156. https://doi.org/10.1111/beer.12645

Schaltegger, S., Hansen, E. G., & Lüdeke-Freund, F. (2016). Business models for sustainability: Origins, present research, and future avenues. *Organization & Environment*, *29*(1), 3-10.

Schaltegger, S., Lüdeke-Freund, F., & Hansen, E. G. (2012). Business cases for sustainability: the role of business model innovation for corporate sustainability. *International Journal of Innovation and Sustainable Development*, *6*(2), 95-119.

Schaltegger, S., & Wagner, M. (2011). Sustainable entrepreneurship and sustainability innovation: categories and interactions. *Business strategy and the environment*, *20*(4), 222-237.

Schaper, M. (2016). *Making ecopreneurs: Developing sustainable entrepreneurship* (2nd ed.). Routledge. https://doi.org/10.4324/9781315593302

Scholten, V. E., & Blok, V. (2015). Foreword: Responsible innovation in the private sector. *Journal on Chain and Network Science*, *15*(2), 101-106.

Schrettle, S., Hinz, A., Scherrer-Rathje, M., & Friedli, T. (2014). Turning sustainability into action: Explaining firms' sustainability efforts and their impact on firm performance. *International Journal of Production Economics*, *147*, 73-84.

Schumpeter, J. A. (2013). *Capitalism, socialism and democracy*. routledge.

Sedighi, M. (2016). Application of word co-occurrence analysis method in mapping of the scientific fields (case study: the field of Informetrics). *Library review*, *65*(1/2), 52-64.

Skare, M., & Porada-Rochon, M. (2022). The role of innovation in sustainable growth: A dynamic panel study on micro and macro levels 1990-2019. *Technological Forecasting and Social Change*, *175*, 121337.

Small, H. (1973). Co-citation in the scientific literature: A new measure of the relationship between two documents. *Journal of the American Society for information Science*, *24*(4), 265-269.

Söderholm, P. (2020). The green economy transition: the challenges of technological change for sustainability. *Sustainable Earth*, *3*(1), 6.

Sreenivasan, A., & Suresh, M. (2023). Factors influencing sustainability in start-ups operations 4.0. *Sustainable Operations and Computers*, *4*, 105-118.

Stam, E. (2015). Entrepreneurial ecosystems and regional policy: a sympathetic critique. *European planning studies*, *23*(9), 1759-1769.

Stubbs, W. (2017). Characterising B Corps as a sustainable business model: An exploratory study of B Corps in Australia. *Journal of Cleaner Production*, *144*, 299-312.

Subhan, M., Irfan, M., Pan, X., Ahmad, G., Naeem, M. H., & Zamir, M. N. (2024). Unveiling the dynamic impact of energy generation on economic sustainability in Canada: A roadmap towards sustainable development. *Journal of Cleaner Production*, *434*, 139783.

Szomszor, M., Adams, J., Fry, R., Gebert, C., Pendlebury, D. A., Potter, R. W. K., & Rogers, G. (2021). Interpreting Bibliometric Data. *Frontiers in Research Metrics and Analytics*, *5*, 628703. https://doi.org/10.3389/frma.2020.628703

Terán-Yépez, E., Marín-Carrillo, G. M., Casado-Belmonte, M. D. P., & Capobianco-Uriarte, M. D. L. M. (2020). Sustainable entrepreneurship: Review of its evolution and new trends. *Journal of Cleaner Production*, *252*, 119742.

Thelken, H. N., & Jong, G. D. (2020). The impact of values and future orientation on intention formation within sustainable entrepreneurship. *Journal of Cleaner Production*, *266*, 122052.

Theodoraki, C., Messeghem, K., & Rice, M. P. (2018). A social capital approach to the development of sustainable entrepreneurial ecosystems: an explorative study. *Small Business Economics*, *51*, 153-170.

Van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523-538.

Van Eck, N. J., & Waltman, L. (2017). Citation-based clustering of publications using CitNetExplorer and VOSviewer. *Scientometrics*, *111*(2), 1053-1070.

Wagner, M., Schaltegger, S., Hansen, E. G., & Fichter, K. (2021). University-linked programmes for sustainable entrepreneurship and regional development: how and with what impact?. *Small Business Economics*, *56*(3), 1141-1158. https://doi.org/10.1007/s11187-019-00280-4

Wamsler, C. (2020). Education for sustainability: Fostering a more conscious society and transformation towards sustainability. *International Journal of Sustainability in Higher Education*, *21*(1), 112-130.

Wörfel, P. (2021). Unravelling the intellectual discourse of implicit consumer cognition: A bibliometric review. *Journal of Retailing and Consumer Services*, *61*, 101960. https://doi.org/10.1016/j.jretconser.2019.101960

Yang, N., Dousios, D., Korfiatis, N., & Chalvatzis, K. (2024). Mapping the signaling environment between sustainability-focused entrepreneurship and investment inputs: A topic modeling approach. *Business Strategy and the Environment, 33*(6), 5405-5422.

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, *18*(3), 429-472.