

Review

On the Theoretical Conceptualisations, Knowledge Structures and Trends of Green New Deals

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Abstract: The increasing impacts of climate change, coupled with the Greta Thunberg effect, the findings of the Intergovernmental Panel on Climate Change (IPCC) reports, and varied environmental policy documents, are pointing to the need for urgent and cohesive climate action and mitigation frameworks. One potent solution, gaining global acceptance, is that of the Green New Deal (GND), positioned as a radical rethinking of political and economic structures in view of pushing sustainability at the forefront of national, regional, and global issues. With the model rapidly gaining ground in various geographies, and in different forms in view of contextualization needs, there is a need to better understand its evolution, knowledge structures, and trends. This paper thus sets forth to provide an understanding of the evolution and implementation of GND through a bibliometric analysis and science mapping techniques using VOSviewer and CiteSpace to identify the thematic focus of 1174 articles indexed in the Web of Science since 1995. To understand the thematic evolution of the field over time, we divided the study period into three sub-periods, namely 1995–2014, 2015–2019, and 2020–2021. These sub-periods were determined considering important milestones related to GNDs. Term co-occurrence analyses were then conducted to understand thematic focus and associated trends. Also, co-citation analysis and bibliographic coupling were other methods applied to identify major sources, authors, publications, and countries that have made more contributions to the development of research on GNDs. The findings of this paper can help both researchers and policy makers understand the evolution and trends of GNDs to better formulate GNDs strategies and policies in accordance with varying needs and geographies.

Keywords: green new deal; green growth; bibliometric analysis; environmental policy; decarbonization; COVID-19; sustainability; climate change; negative externalities



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1. Introduction

The increasing impacts and challenges of climate change are more apparent and have been widely documented, with consequences ranging from increasing incidences of heatwaves and increased precipitation, leading to flashfloods, such as those lately witnessed in Western Europe where over 200 deaths were reported in July 2021 alone [1]. Climate change is also credited for the increasing incidences of drought, especially in sub-Saharan Africa, affecting regions are experiencing food insecurity, increased cases of water shortage and numerous challenges amongst pastoralists as vast lands experience desertification [2,3], and, amongst others, visible water sea-levels threatening some coastal regions with submersion and increases in vector diseases, to name a few [4].

According to the latest report by the IPCC [5], it is possible that the climate goals set in a number of global accords such as the Paris Agreement, aimed at ensuring that global temperatures are kept below 2 °C, preferably 1.5 °C, will not materialize, affirming similar findings documented by the same body in 2018 [6]. In the latest IPCC report, it is made clear that Earth is likely to exceed temperatures of 1.5 °C above pre-industrial levels and by 2100 [5], with the possibility that temperatures will have risen by between 3 °C and 3.5 °C. This is reinforced in the Nationally Determined Contributions (NDC) Synthesis report, published on the 17 September, outlining that even though the global rate of carbon emissions is decreasing, it is expected to peak by 2030 (with a 16% comparative rate of increase to 2010 levels, suggesting an increase in temperature rise of about 2.7 °C). Hence, further efforts have been demanded by countries to achieve the Paris Agreement targets [7].

The Paris Agreement, as noted in the UN Climate change report [8], required that member parties commit to meet at least 45% reduction on their emissions by 2030, but it was found that commitments could only be achieved if each party doubled their efforts. The scenario has further been complicated by emergence of COVID-19, which Shan, et al. [9] posited would prompt a 16.4% global increase in emissions as from 2020 depending on economic stimulus governments advance in their economies. On this, the UNEP [10] reports that only 18% of all the global recovery spending has some 'Green' elements. Temperatures above 1.5 °C will translate to devastating climate events such as heatwaves, flooding, desertification, acidification of water sources, and tropical cyclones among others. This may be disastrous for many regions of the world, and especially for small island developing states (SIDS), where cases of forced climate migration is expected to increase with sea water level rise, with others losing considerable amount of habitable spaces, fishing ground, tourism attraction sites, and essential infrastructures, leaving little options other than to migrate [4].

Failing to meet the agreed targets in the Paris Agreement will consequently impact the achievement of other agreements, such as the sustainable development goals [11] and that of other COPs that were reached earlier. This, however, will be a result of human inducement, especially after the COVID-19 pandemic where economies have been found to revert to fossil-fuel intensive industries in their effort to revive the economies [12]. On this, Shan, Ou, Wang, Zeng, Zhang, Guan, and Hubacek [9] note that if fossil-fuel intensive activities continue to prevail, the aftermath will be a chaotic global environment that will not only be unsustainable for the current generation, but make sustainable development more difficult for future generations. As expressed by The European Commission [13], there will be need for deep re-thinking and reversal in policies to ensure global extraction of resources, production of products, and their consumption and their ultimate disposal align with sustainability agendas. Additionally, there are needs to re-assess the cost or benefits of production or consumption of goods and services in sustainability narratives, introducing the notion of 'Negative Externalities' where damages from pollution are not factored in. This however calls for a cohesive ecosystem re-think with respect to both consumers and producers.

One solution that emerged in 2019, and has been gaining traction in the past two years, is the 'Green New Deal' that was first introduced in America after years of negotiations [14], and was subsequently adopted in varying forms by numerous countries, including country blocks such as the European Union [15]. This is further explored in the next section.

2. Surveying Green New Deals

The concept of Green New Deals can be argued to be an emerging, broad, and transformative approach toward addressing a series of issues impacting modern societies. It thus aims to address climate concerns in different geographies, while attempting to solve social and economic inequalities. According to Conte [16], the idea of the Green New Deal was conceived in 2006 in the United States, under the care of a taskforce that had been formed to deliberate and propose solutions on how different sectors engage in a sustainable transition as per the concept of the 'Global Greens'. This is interesting

noting that the emergence of associated terms such as ‘Green Economy’ and ‘Green Growth’ in 1989 and 2005, respectively [17], leading to foundational precepts to the Green New Deal. However, the proposed GND, as noted above and highlighted by Mastini, et al. [18], goes beyond economic growth in relative terms and aims to address other aspects such as social, economic, and environmental justice. In fact, the concept of ‘growth’ should not be a precursor for the GND, as expressed by Mastini, Kallis and Hickel [18], as degrowth policies also need to be part of the ‘GND’ narrative. This is true, noting that some green growth pursuits also have the potential to violate absolute planetary boundaries rather than solely improving environmental capital, or at least in the preservation of existing environmental resources [19]. The main inspiration for the Green New Deal is historical; its name was borrowed to mirror President Franklin D. Roosevelt’s approach of helping the U.S. recover from the Great Depression by instating a total makeover of his government, or the ‘New Deal’ as it was called [20]. Activism on climate action began in the 1970s after the oil crisis, but progressive actions were only arguably taken in 2006 [16]. The agitation for climate change, gained more support from the political class, where some politicians with Jill Stein, a presidential candidate in 2012 and 2016 under her Green Party, banked on the climate change debate as a campaign tool for the presidential position [21]. However, the main breakthrough of the political class came in 2018 after a youthful group that was protesting on the government inaction against climate change was joined by Rep. Alexandria Ocasio-Cortez and Senator ED Markey [14], who formulated the groundwork for what became a joint resolution passed by congress in 2019. The resolution mandated the Federal Government to create a Green New Deal that would address a raft of issues, including touching on the foundational challenges of climate, economic, and social justice.

On climate, the Green New Deal (GND) as passed by the Congress targeted to have the country (U.S.) achieve net-zero greenhouse gas emissions by 2050 by adopting transition mechanisms that would not be injurious to communities or workers. The achievement of reduced emissions would be championed by ensuring the country transitions 100% to the use of alternative renewable energies in all sectors, through deep transformation of the transport sector, such as ensuring electric vehicles and mass transit systems were the main mode of transport. Since the objectives of the GND matches the calls for climate action [22], there seems to have been an increase in popularity, not just in the United States but globally, towards the model. Indeed, an analysis, represented through a line diagram in Figure 1, of the popularity of the term ‘Green New Deal’ for the period from 2008 to 2021 showcases a peak in 2019, aligning with the time of the GND passing in congress in the USA. Additionally, it is observed (Figure 2) that the first five geographies where interest by regions is peaking are: Guatemala, South Korea, Singapore, the United States, and New Zealand, respectively.

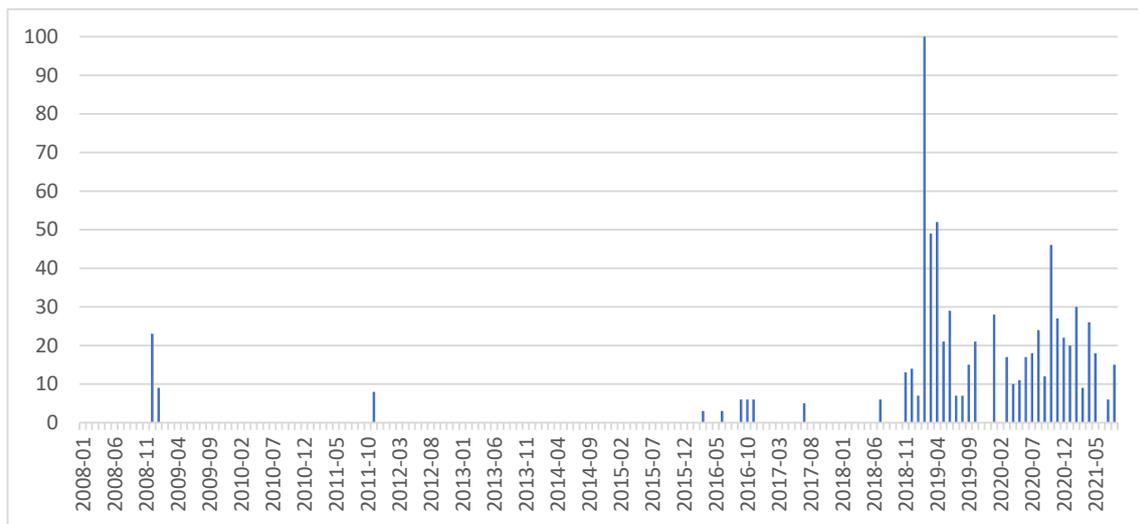


Figure 1. Web popularity of the term ‘Green New Deal’ from 2008 to 2021, with popularity ranging from 0 to 100. Sourced from Google Trends [23].

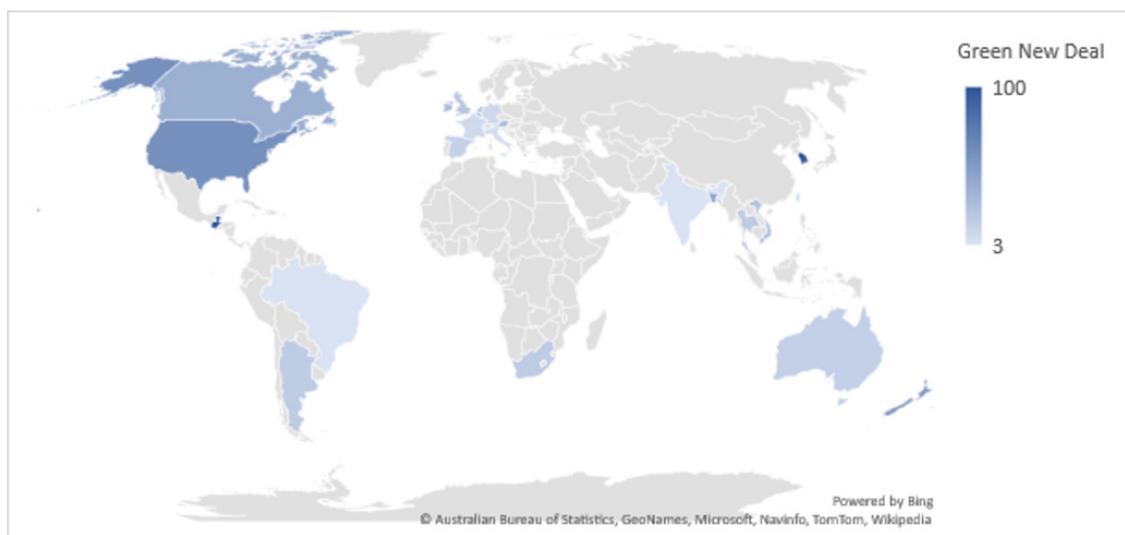


Figure 2. Web popularity of the term ‘Green New Deal’ (2008 to 2021), interest by region. The popularity ranges from 3 to 100, where 100 is the most popular. Sourced from Google Trends [24].

Since the adoption of the Green New Deal in the U.S Congress in 2019, there have been substantial number of other countries that have adopted similar approaches under different names, as shown in Table 1 below. Though they vary from each other, they all seem to have a convergence of intentions, especially regarding the need to reduce emissions and concentrate on attaining net-zero emissions in the future while achieving equity and inclusivity in the socio-economic fabric. In the table, China and India are included, but their commitment to reduction of emissions is not expressly defined in their Green New Deal agendas [25]. However, notable and practical actions have been taken. These include increased efforts and investments in renewable energy, adoption of technologies in their manufacturing industries, and introduction of fiscal mechanism such as the use of emission trading schemes (ETS) [26] are evident, especially in China.

Table 1. Mapping Green New Deal national policy proposals and name variations.

Country	Name of Policy	Year Proposed	Source
Canada	Pact for a Green New Deal	2019	[27]
United Kingdom	Green Recovery Act	2019	London Assembly [28]
South Korea	Green New Deal	2020	Chowdhury [29]
The European Union	European Green New Deal	2019	European Commission [15]
China	Ecological Civilization	2020	Paszak [30]
United States of America	Green New Deal	2019	Congress [14]
Mexico	Green New Deal	2020	Moreno-Brid and Gallagher [31]
Singapore	Green Plan	2021	Government of Singapore [32]

Besides individual countries and regions pursuing the GND, it is interesting that there are also notable organizations that support Green New Deal policies, pushing sectoral and thematic agendas on sustainability transitions. Those are outlined in Table 2 below. Most of those are domiciled in countries and regions such as the U.S. and Europe that have already pioneered in forming models of their GND. However, even in countries such as Australia where there is no formal announcement of the GND program, from the federal government, some states within the republic are seen to actively advocate for its acknowledgement and the embracement of deep sustainable transitions [33]. However, there appears to be clear disagreement on what constitutes a ‘green deal’, especially in view of criticisms on an AUD 2 billion renewable energy project between the New South Wales (NSW) government and the federal government [34].

Table 2. Mapping organizational adoption of Green New Deals.

Organizations	Year	Source
The Climate Mobilization	2017	The Climate Mobilization [35]
The European Green Party	2006	Green Party [36]
The Green-European Free Alliance	2011	The Greens/EFA [37]
The Democracy in Europe Movement 2025	2019	DiEM25 [38]
Green Party of the United States	2006	Green Party of the United States [39]
Heinrich Böll Foundation	2009	French, et al. [40]
League of Conservation Voters	2019	League of Conservation Voters (LCV) [41]
The New Economic Foundation	2008	New Economics Foundation [42]
Open Democracy	2018	Robinson [43]
The United Nations Environmental Program	2009	UNEP [44]
The Global Marshall Plan Initiative	2020	Saha, et al. [45]
The United Nations Economic and Social Commission for Asia and the Pacific	2012	Ministry of Environment [46]

Bradshaw, et al. [47] note that while the concept is gaining attention, leading to a rapid acceptability and adoption in diverse geographies and quarters (specifically with civil societies pressuring legislative makers) and underlining evidence of diversification in terms of the content advanced in the different countries or regional specific models. This has led to confusion on the specific underlying principles that the varied models aim to address thus, pointing to the need for countries to first address underlying market failures, such that the GND is not seen as a knee-jerk reaction to failures that could be sorted using other means. In fact, even in country specific models, such as the Green New Deal in the U.S., there is still confusion noted from leaders from different political divides (i.e., Democrats vs. Republicans), as to who are against the deal (notably mostly Republicans, who perceive some of the issues such as social justice as being unrealistic, and hence are dismissive of the proposal) [47]. While the variations may be deemed to represent interests that different countries have in their pursuit and conviction of the best way to address climate change, rising oil prices, and unsustainable energy consumption, there is need for some uniformity in order to address common goals and principles. This is affirmed when a critical

consideration of models such as the EU's Green Deal, which will be expanded beyond EU as explained by Dartford [48]. While the intention is deemed as sincerely aiming at ensuring that Europe's pursuit of climate action is achieved, it may have deeper implications as the region's trading partners may not have any contextual plans for GND. The resulting implications from both the trading partners and the EU may be hostile with institution of stringent measures that may somehow disrupt the existing trading relationship. In the case of countries in the global south that in some ways rely on their counterparts on the global north, they may be inevitably forced to agree to some measures, which sometimes may be incoherent with their domestic policies. On this, Táiwò [49] argues that some of the policies engendered in the New Green Deal and other models, if they are eventually formalized to become guiding policies, have the potential to increase inequalities, akin to what scholars coin as being 'climate colonialism' [50]. While examples would vary in accordance to contextual needs and capacities, there are notable needs by countries for land and financial resources to develop renewable energy plants as alternatives for fossil fuel plants. This is further represented in the NDC Synthesis Report [7], stating the popularity of renewable energy projects, as a means to curb climate change, amounts to 84% in countries around the world. While this measure is welcomed globally, most economies in the global south may have sufficient land, without the associated financial capacities to support nationwide projects, and thus often rely on debt financing, grants, and other such sources [51–53]. This conventional approach could force nations to secure more debts, increasing an unsustainable dependency on developed economies, leading to the arguments of 'neo' and 'climate' colonialism [54]. In this case therefore, economies in the global south, just like is the case with their counterparts on the north should be allowed to pursue and craft their own sustainability plans, addressing their unique challenges, as well as allowing them to align with their commitments as per the Paris Agreement as well as SDGs (and hence calling towards contextualized models for Green New Deals).

While pursuing proposals for new models that would somehow apply conventionally (and hence acceptability in countries and by different organizations), it will be paramount to understand the underlying issues pertaining GND in terms of how it emerged, its evolution, and trends. This is particularly important in a time where GNDs are politically equated as an 'ecology-centered' economic stimulus program, which can help significant political attention [55]. This is key, especially when GNDs can be viewed as a strong narrative to help economic growth, hence posing as a self-funding mechanism to the crucial question as how to finance transitions. From this perspective, proponents of GNDs are largely unaligned with those of degrowth who argue growth makes it more difficult to accomplish emissions reductions [18]. This interestingly builds an alignment of agendas on GNDs between both the environmental and political class, with the agenda of economic growth as a mutual ground. Additionally, funding transitions across multiple sectors are required, and in this regard numerous innovations need to be fostered, which can also lead to white space opportunities for corporates. This is leading to emerging Green funds, aligning with the underlying GND theme, applicable at both national and regional levels, and which could provide some reprieve to global south economies without capacities to fully finance GNDs agendas.

In view of the above, countries looking at engaging in GND agendas will need to craft contextualized policies aiming at solving an array of socio-economic challenges, while introducing economic stimulus programs across numerous sectors. Of interest, would also be the careful drafting of policies to tap into emerging policies and green funds, a criteria which would be particularly key to developing and least economies and small island developing states, which often do not have the capacity to finance green transitions [53,56].

To align with this constant shift in global policies, including in view of the current COVID-19 pandemic (at the time of writing), there is a need for an updated review of literature on GNDs and associated strategies for Green Growth, as new economic challenges present itself, causing larger inequalities and posing a threat to long term sustainability agendas [57]. In view of this, a macroscopic perspective is required on the larger themes,

providing an overview of its evolution over time, including during the pandemic period, to better understand past, current, and future directions. This paper thus, through a bibliometric analysis, undertakes to advance our knowledge on GNDs to present findings that can help countries seeking to associate with GNDs would have substantial information, leading to the potentiality of crafting models with the potential to address local priorities and challenges.

3. Methods

Keeping pace with the rapid growth of scholarly publication has made literature review challenging in the recent years. One way to deal with this challenge is utilizing bibliometric analysis techniques that allow gaining an overview of specific fields. Such macroscopic overviews can be used to highlight major thematic focus areas and research trends. Various bibliometric analysis software tools such as SciMAT, CiteSpace, and VOSviewer have been developed in the past two decades. All of these tools can be used to explore thematic evolution and identify key authors, references, and sources. VOSviewer was used for the purpose of this study since it has a user-friendly interface, the outputs are more suitable for identifying and analyzing thematic clusters, and it can also provide detailed information on influential authors, references, sources, countries, and institutions [58]. Input data for bibliometric analysis using VOSviewer can be obtained from academic databases such as Scopus and the Web of Science (WoS). Here, we used WoS, given its broad coverage of quality peer-reviewed articles related to the topic. In addition, WoS bibliographic outputs are more compatible with VOSviewer and allow obtaining more detailed results. To retrieve literature relevant to GNDs, we developed the following broad-based search string that includes different related terms: TS = (“New Green Deals” OR “New Green Deal” OR “Green New Deal” OR “Green Deal” OR “Green Recovery” OR “Green Growth”). Using this search string in the WoS on 5 August 2021, returned 1403 articles. It should be noted that we only searched for English articles and the search period was not restricted (i.e., all papers indexed until 5 August 2021, were considered). We screened the titles and abstracts of these articles and 1174 articles related to the aims and objectives of this study were selected for final analysis in the VOSviewer. Three types of analyses are used in VOSviewer to map knowledge structure and trends. These are, namely, bibliographic coupling, co-citation analysis, and term co-occurrence analysis. Van Eck and Waltman [58] describes bibliographic coupling as “a link between two items that both cite the same document”, where it can be used to identify major contributing countries and institutions and their interactions. Furthermore, co-citation links are described as “a link between two items that are both cited by the same document” [58]. As citation frequency is widely considered as a measure of scholarly impact, results of co-citation analysis are used to identify the most influential authors, publications, and sources. Finally, a term co-occurrence analysis is used to identify major thematic focus areas of the field. In addition to highlighting major terms, this analysis also provides information on important thematic clusters within the field. As one of the aims of this study was to explore thematic evolution over time, we divided the study period into three sub-periods considering major milestones that may have influenced the evolution of the field and the total number of papers published in each sub-period. The first period started on 1995, coinciding with the introduction of the Environmental Bill of Rights to the U.S. Congress [59], this being a major milestone leading to subsequent green policies and increasing research in the area.

As shown in Figure 3, there has been a surge in the number of publications around 2015. This could be linked to the introduction and adoption of international policy frameworks such as the Paris Climate Agreement and the 2030 Agenda for Sustainable Development in 2015. Accordingly, 2015 was designated as the first milestone. The figure also shows another surge in 2020 which could be linked to the emergence of the COVID-19 pandemic. Based on these milestones, the study period was divided into three sub-periods, namely 1995–2014, 2015–2019, and 2020–2021. In addition to an overall term co-occurrence analysis, we conducted separate term co-occurrence analyses for the three study periods to understand

thematic evolution. Outputs of all VOSviewer analyses are presented as a network of nodes and links (e.g., see Figure 4). The node size is an indication of the relative importance. For instance, in case of term co-occurrence analysis, node size is proportional to the frequency of term occurrence. Also, link width is proportional to the strength of connection between the two terms. Terms that are closely linked to each other form clusters that indicate thematic focus areas.

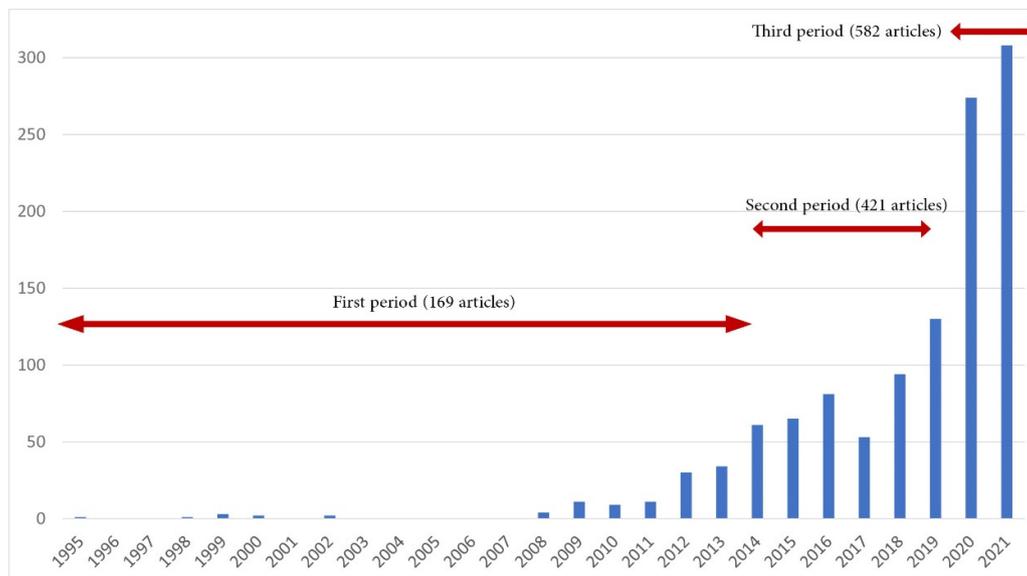


Figure 3. The number of articles published per year. Note that although the literature search was conducted in August 2021, the number of articles in this year is already larger than its previous year. This is a clear indication of increasing interest in this topic and more articles are expected to be published in the rest of 2021 and coming years, especially in view of the impacts of COVID-19 on many economies and the need for prompt recoveries aligning with both economic and sustainability pursuits [57,60,61].

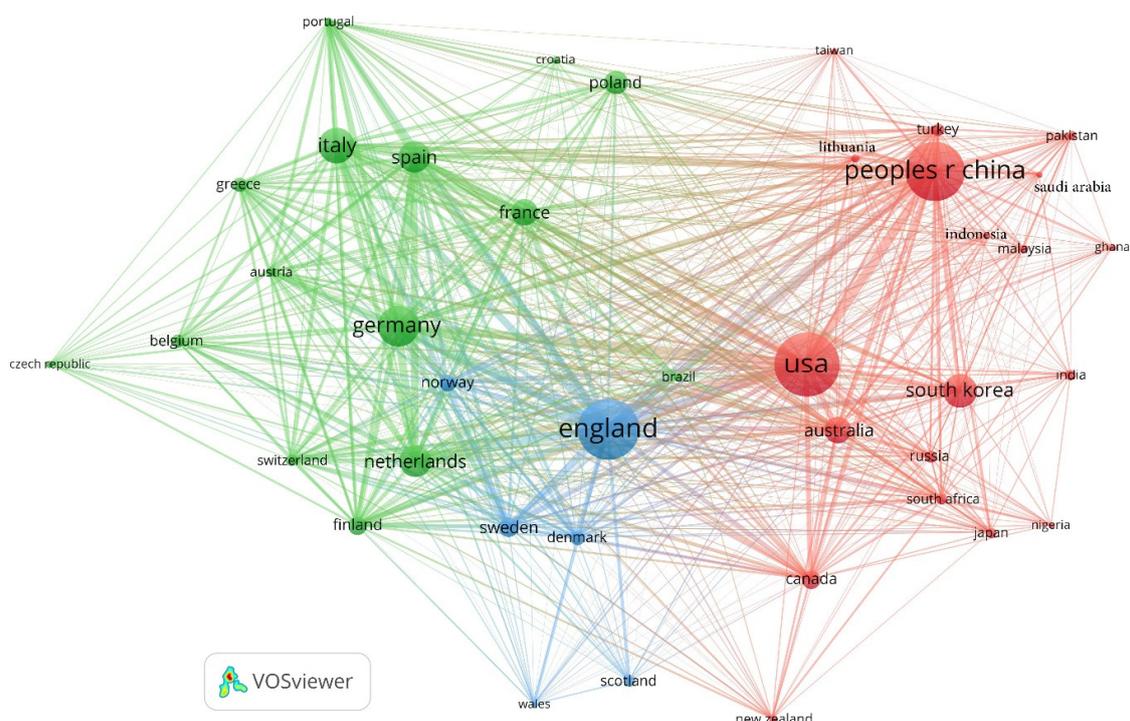


Figure 4. Countries with the most contributions to GND. Illustration by authors.

4. Results and Discussions

4.1. Countries Making the Most Contributions

The analysis supports that, as illustrated in Figure 3 above, the USA, the People's Republic of China, England, and Germany are the most popular contributors to the GND debate with 176, 156, 163, and 99 documents respectively. This is evident by the size of the nodes, which in this case the four countries have the largest (as per the number of documents noted above). The popularity of GND was further observed to be gaining traction in countries such as the Netherlands, France, Italy, South Korea, Australia and Spain and Poland. The green cluster is seen to have received much attention, followed by the red cluster, while the blue cluster comes third.

From the literature, the result obtained in Figure 3 are not surprising as the current global pressures towards the adoption of a Green Deal have been seen to concentrate more in the USA and European zone. For China, as noted by Bradshaw, Ehrlich, Beattie, Ceballos, Crist, Diamond, Dirzo, Ehrlich, Harte, Harte, Pyke, Raven, Ripple, Saltr e, Turnbull, Wackernagel, and Blumstein [47], although there is no formal agenda that can be equated to the Green New Deal, there has been an increase in attention toward activities pointing toward a reduction of carbon footprint. The increased attention and research focusing on China may be due to the fact that it is the leading emitter of carbon emissions, accounting for almost 24% of the global emissions [47]. Further, being the leading country in investment on renewable energy may have contributed to increased attention on its focus on matters relating to the adoption of deeper measures, aligning with the Green New Deal. The attention in the USA also maybe multi-pronged. First, since the 1970s (as reported by Conte) [16], there has been numerous calls, proposals, and agitations for the country to adopt climate actions to avert its impacts on the environment, economy and communities. Secondly, as was expressed by Bradshaw et al. [47], it is ranked the second globally in terms of global emissions, and its commitment to global accords such as the Paris Agreement, especially in view of the previous government policies on the same, may have triggered an increased interest. Thirdly, it is the first country to have a realistic Green New Deal formulated and discussed at a congressional level [14], thus drawing global attention. In the case of England, its contribution to the discourse on GND (or Green Deal as it is known in Europe) ranks it top among European countries. From the literature, it is noted that though the Green Deal will impact the entire of European region and beyond, England, would be a major beneficiary due to focus on areas such as green spaces and improvement of air quality that was noted to be fairly poor compared to its counterparts in the region [28]. Further, being the main trading partner with its European counterparts, it is understandable that the Green New Deal would impact their trading relationship. Thus, interest in understanding how the deal works would influence policies in the country.

4.2. Most Influential Organisations

Organizations were clustered into three groups depicted in distinctive colors, represented in Figure 5. The red cluster comprise of 12 organizations with larger nodes that are closely linked noting the thickness of their link lines. The blue cluster is located far right, with only three organizations (Vrije University, University Autonoma Barcelona and ICREA with 14, 14, and 11 documents each) therein with each of them having fairly large nodes and close link between themselves. However, this cluster is far linked from the rest of the clusters. The green cluster is comprised of nine organizations that are closely linked to each other but with smaller nodes, indicating that the number of publications from those organisations were fairly few compared to those obtained in other clusters. For instance, INHA University, Macquarie University, Beijing Normal University and University Manchester all had eight documents published.

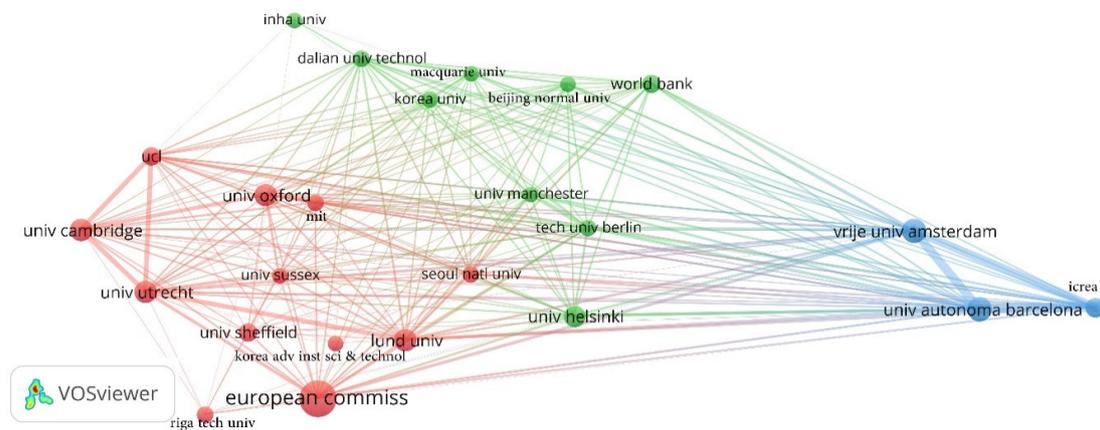


Figure 5. Organizations contributing the most to GND. Illustration by Authors.

From the literature review, the European Commission (EC) has been identified as one of the organizations that eventually managed to bring into fruition the Green Deal agenda in Europe, and from the diagram above, it had very close link with numerous learning institutions. This could explain why most of the documents that could have shaped the GND document emanated from the institution. From the results obtained, the close link between EC and other organizations clustered in red is not surprising as most of these are mostly based in Europe, save for Seoul University. This confirms that the European Green Deal emanated from different environmental knowledge shared, exerted from different quarters in the region, specially from learning institutions. This is true following realization that, indeed, there are notable concerns with issues such as increasing emission levels from the region [47], the unsustainability of the economy due to some sectors still relying on non-renewable energy sources [62], and the increasingly observable cases of social inequalities in the region as document in a report by Bubbico and Freytag [63]. One clear observation from the results above is that most of the organizations are learning institutions drawn from Euro-zone save for the few drawn from Korea, the World Bank, and the European Commission. From the analysis, the U.S. and Europe can be noted as the only two to have clear-cut GNDs. In America, the political class drawn from both the Democrats wing and other smaller parties have been credited for pushing for the realization of GND and this could be due to the fact that other institutions, such as NGOs and learning institutions are not as coordinated in research and policy work, as is the case with Europe. However, the results from Europe highlight the influence the learning institutions can have in shaping and influencing for meaningful changes in the society. Whereas it may be construed that the topic on GND is not widely understood in the public domain, hence, justifying why most organizations pushing for actions to be taken are learning institutions, evidence from the literature show otherwise. On this, youth movements [64,65], UN bodies such as the UNFCCC [66–68] and the IPCC [5,69], and other bodies, have been clear on their position on climate change. However, it is also important to appreciate that adopted GND models do not only concern the environment, but encompasses other cross-cutting issues, that learning organization, the World Bank, the EC and other organizations keenly supporting. This showcases a global consensus on expanding the GND to touch on socio-economic dimensions, hence using the rational for approaching the environment as an underlying foundation to regenerate societies.

4.3. Most Influential Journals

As depicted in Figure 6 below, the influential journals are grouped into three clusters depicted in green, blue, and red colors. The red cluster represent those associated with energy, where journals touching on this topic were popular. For instance, journals ‘Energy Policy’ and ‘Journal of Cleaner Production’ had 1810 and 1496 citations, respectively. This cluster contained 20 journals represented by nodes that closely linked, except for the journal

'Energy and Buildings'. The green cluster contained 17 journals, represented by nodes that also fairly closely linked. The most popular journal in this cluster was that of 'Ecological Economics', cited over 1078 times and had over 29,224 links. The blue cluster contain nine journals, with the most popular being 'Energy Economics' with 589 citations and a total of 18,148 links. This cluster had most of the journals with least citations, with most of them seen to be more linked to the green cluster than with the red cluster.

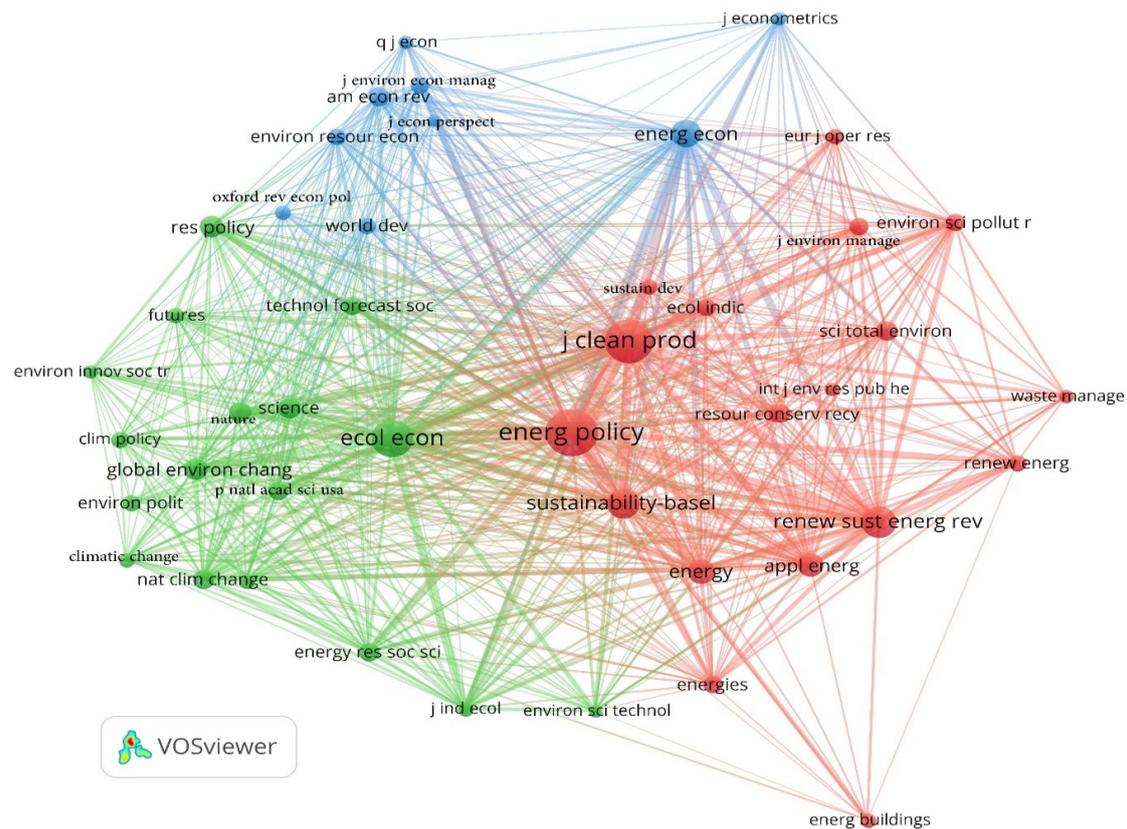


Figure 6. Journals influencing the GDN discourse. Illustration by authors.

The concentration of activities in the journals related to the energy sector is unsurprising considering the amount of effort, mobilization, and resources that have been directed toward a global shift from fossil fuels to renewable energy. In particular, from the literature, it is evident that global efforts are now amassed with energy policies, especially emanating from COP meetings, which started as early as the 1990s, the popular policy frameworks being the Kyoto Protocol (1997) [66] and the Paris Agreement (2015) [67]. These groundbreaking policies are aimed at guiding global economies in their pursuit to addressing climate concerns to ensure that global temperatures do not rise above 2 °C pre-industrial level by 2030 [6]. While the two popular GND models (American and European) covers more than just the energy sector, it is clear than the debates and publication on the energy sector greatly shaped and will further influence policies on existing and emerging Green Deals. The increasing popularity of journals related to energy in terms of citations and linkages shows that over the years, scholars have increased their attention on matters environment more so on the impacts of emissions from the energy sector. What is surprising from the results obtained is the reduced popularity of journals inclined to social and economic aspects, especially noting that Green Deals are also focused on how pursuits of social welfare in areas such as housing, water extraction and consumption and others contribute to sustainable environments. Further, it is evident (as documented in the Circular Economy Action Plan for Europe [13]) that the GND, especially the European Green Deal, is focused on changing the economic model of the region to accommodate a

circular to advance the concept of sustainability, innovation, and technology use in the energy production and others.

4.4. Most Influential References

A total of 38 most influential references were identified and listed for this analysis. The results are presented in Figure 7, which has three clusters identifiable by three colors (red, blue and green), with 15, 10, and 11 references, respectively. Two references, (Dowson, et al. [70] and European Commission [71]) had zero links. Thus, they are not present in the diagram. In terms of influence, documents by the United Nations Environment Programme [72] and the World Bank [73], having a total of 158 and 171 citations respectively, are seen to dominate. All these are identified under the blue cluster just near the center of the diagram due to the extensive relationship that the energy sector (blue cluster) has with themes such as climate change and sustainability (red cluster) and the concept of green growth (green cluster). Table 3 below maps the major references, showcased in Figure 7.

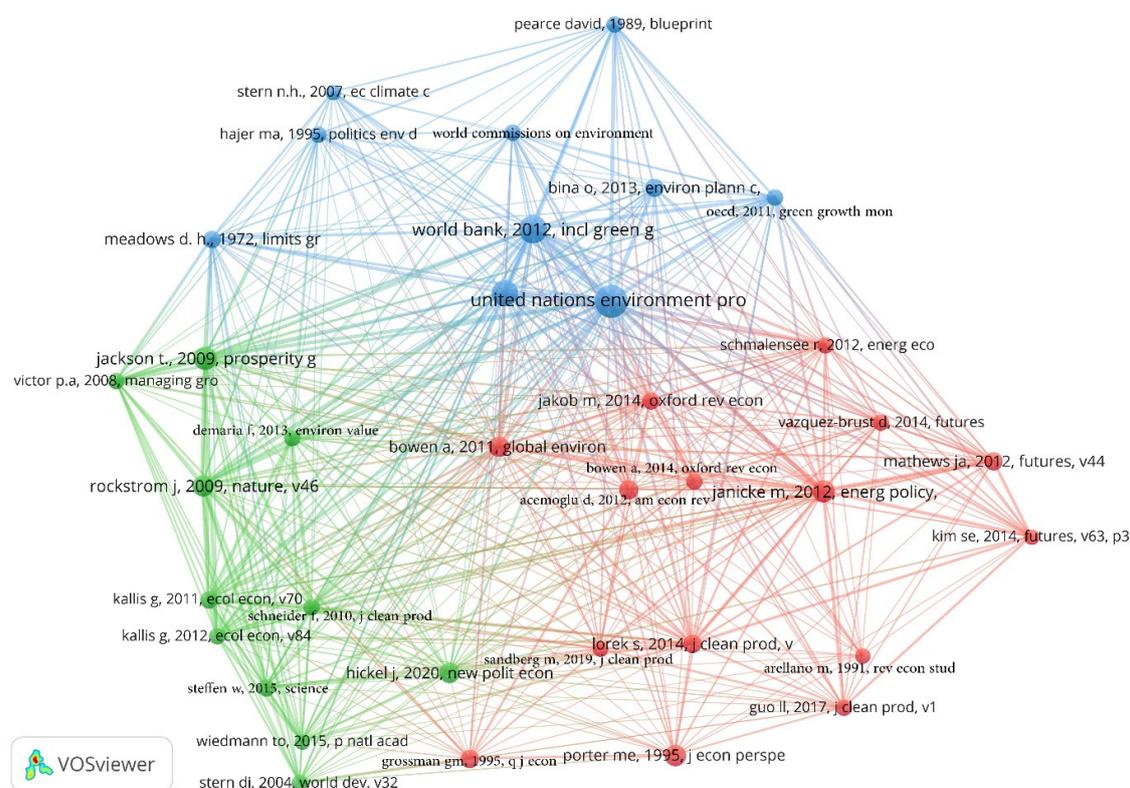


Figure 7. Major references influencing the GDN discourse. Illustration by Authors.

From the literature, it is evident that while themes in sustainability and green growth are gaining in popularity, they are guided by policies and frameworks emanating from bodies such as the United Nations Environment Program (UNEP) and the World Bank, thus justifying their influence in shaping the discourse on GND. In particular, these bodies have been observed to be consistent in advocating for green growth and have been financing diverse programs and projects across the globe aligning with the Green concept. For instance, in the article by the World Bank [73], the clarion call is for an inclusive Green Growth that would ensure that the 9 billion people that will occupy the world by 2050 would not be disadvantaged by agendas of the current generation. Adding to this, is the noticeable need to include the private sector in the common objective of sustainable transitions [74], and to introduce ‘Corporate Social Responsibilities’ (CSR) as key agendas [75]. To ensure that the objective of having a sustainable future is achieved, those noted organizations are observed to advocate for policies that not only address the environment and climate

issues alone but extend to social and economic dimensions to ensure that prevailing issues such as inequalities, exacerbating unsustainable pursuits are minimized. In support of the discourse advanced by those institutions, many publications touching on sustainability, more so in the energy sector are seen to be increasing; thus, justifying why the red cluster has a substantial number of influential references. From the literature, it is evident that there have been numerous calls, including through global accords such as the Paris Agreement for economies to shift to use of renewable energy as alternative for the fossil fuel to reduce emissions, at least to guarantee that temperatures would not rise beyond 2 °C. This increase on publication on energy, as from 2014, as shown in Figure 7, showcases that as talks about the Paris agreement intensified, researchers worked to complement to policies to potentially influence future directions, such as the formulation of the GND, gaining traction in this dispensation.

Table 3. Major references influencing the GDN discourse, with number of citations and link strength.

Title	Authors	Journal/Organization	No. of Citations	Link Strength
The environment and directed technical change	Daron Acemoglu Philippe Aghion Leonardo Bursztyn David Hemous	American Economic Review	2243	54
Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations	Manuel Rellano Stephen Bond	Review of Economic Studies	11,368	25
The Green Economy and Sustainable Development: An Uneasy Balance?	Olivia Bina	SAGE Journals	293	61
The green growth narrative: Paradigm shift or just spin?	Alex Bowen Samuel Fankhauser Federico Demaria	Global Environmental Change	48	117
What is degrowth? From an activist slogan to a social movement	Francois Schneider Filka Sekulova Joan Martinez-Alier Mark Dowson	Environmental Values	693	86
Domestic UK retrofit challenge: Barriers, incentives and current performance leading into the Green Deal	Adam Poole David Harrison Gideon Susman	Energy Policy	267	0
European Commission		European Commission	21	0
Economic growth and the environment	Gene M. Grossman Alan B. Krueger	The Quarterly Journal of Economics	8497	47
The interaction effects of environmental regulation and technological innovation on regional green growth performance	Ling Ling Guo Ying Qu Ming-Land Tseng	Journal of Cleaner Production	138	51
The Politics of Environmental Discourse: Ecological Modernisation and the Policy Process.	Maarten A. Hajer	Oxford University Press	9423	47
Is green growth possible?	Jason Hickel Giorgos Kallis	New Political Economy	515	66
Prosperity without growth? The transition to a sustainable economy	Tim Jackson	UK sustainable development commission	1042	134
Green growth, degrowth, and the commons	Michael Jakob Ottmar Edenhofer	Oxford Review of Economic Policy	128	87
“Green growth”: From a growing eco-industry to economic sustainability	Martin Jänicke	Energy Policy	319	149
In defence of degrowth	Giorgos Kallis Giorgos Kallis	Ecological Economics	1004	115
The economics of degrowth	Christian Kerschner Joan Martinez-Alier	Ecological Economics	610	99
A new approach to measuring green growth: Application to the OECD and Korea	Satbyul Estella Kim Ho Kim Yeora Chae	Futures	71	58
Sustainable consumption within a sustainable economy—beyond green growth and green economies	Sylvia Lorek Joachim H. Spangenberg	Journal of Cleaner Production	556	106
Green growth strategies—Korean initiatives	John A. Mathews	Futures	129	68
The limits to growth: The 30-year update	Dennis Meadows Jorgan Randers	Taylor and Francis	4577	75
Towards green growth	OECD	OECD	79	171
Towards green growth: Monitoring progress	OECD	OECD	12	87
Blueprint 1: for a green economy	David Pearce Anil Markandya Edward Barbier	Francis and Taylor	4997	67
Toward a New Conception of the Environment-Competitiveness Relationship	Porte Me	Journal of Economics Perspectives	34	39
A safe operating space for humanity	Johan Rockström, Will Steffen Jonathan A. Foley	Nature	10,911	127
Green growth or degrowth? Assessing the normative justifications for environmental sustainability and economic growth through critical social theory	Maria Sandberg Kristian Klockars Kristoffer Wilén	Journal of Cleaner Production	85	56

Table 3. Cont.

Title	Authors	Journal/Organization	No. of Citations	Link Strength
From “Green Growth” to sound policies: An overview	Richard Schmalensee	Energy Economics	107	76
Crisis or opportunity? Economic degrowth for social equity and ecological sustainability. Introduction to this special issue	François Schneider Giorgos Kallis Joan Martinez-Alier Will Steffen Katherine Richardson Johan Rockström Sarah E. Cornell Ingo Fetzer Elena M. Bennett Reinette Biggs Stephen R. Carpenter Wim De Vries	Journal of Cleaner Production	1116	108
Planetary boundaries: Guiding human development on a changing planet	Cynthia A. De Wit Carl Folke Dieter Gerten Jens Heinke Georgina M. Mace Linn M. Persson Veerabhadran Ramanathan Belinda Reyers Sverker Sörlin	Science	7611	70
The rise and fall of the environmental Kuznets curve	David I Stern	World Development	3587	53
The economics of climate change: the Stern review	Nicholas Stern Nicholas Herbert Stern	Cambridge University Press	1705	36
Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication—A Synthesis for Policy Makers	UNEP	UNEP	259	254
Managing the transition to critical green growth: The ‘Green Growth State’	Diego Vazquez-Brust Alastair M. Smith Joseph Sarkis	Futures	60	55
Managing without growth: slower by design, not disaster	Peter A. Victor Thomas O. Wiedmann Heinz Schandl Manfred Lenzen	Edward Elgar Publishing	1291	76
The material footprint of nations	Daniel Moran Sangwon Suh James West Keiichiro Kanemoto	Proceedings The National Academy of Sciences of the United States of America	1235	79

4.5. Most Influential Authors

The authors who have had more influence on the GND discourse are presented in Figure 8 below. These are clustered in four distinctive groups symbolized by red related to sustainability and climate change, blue representing energy themes, green encompassing issues on green growth and yellow on the subject of climate neutrality with direct links to Green New Deals. The results showcase that the most popular authors are institutions such as European Commission, OECD, the World Bank, and UNEP. However, on average, the blue cluster is seen to have larger nodes, that are closely linked, followed by the green cluster and red cluster, respectively. The yellow cluster encompassing only five authors has EC as the most active author. Others in this cluster (CBC, Eurostat, FAO, and UN) are cited only the least, and are also least linked. Individual authors are seen to be more popular in matters of Sustainability, Climate Change, and Green Growth.

The results presented above showcases that the theme of Green New Deal comprises of diverse thematic areas, and those academicians drawn from different fields enrich the discourse on this matter. In particular, authors interested in Green growth, sustainability and climate change are seen to be more popular, than those concentrating on new Green Deals. Probably, the reason for this inclination is due to the fact that the three popular themes are more inclined on impacts, which are well known, unlike the GND, which can be argued to be still new and is yet to gain a widespread recognition by most people, organizations, and institutions. For instance, Steffen, et al. [76] who were exploring matters of planetary boundaries in response to sustainability agendas are seen to have been cited over 7743 times despite their article having been published in 2015. Same case with an article by Guo, et al. [77] who exploring the relationship between technological innovation

and the environmental regulations in influencing green economic growth. The article has been cited over 132 times and linked over 54 times though it was published in 2017. This shows that topics related to sustainability, green growth, climate change and energy are becoming popular, especially in relation to how modern trends such as technological applications are incorporated. This augurs well with the proposals in the GND models, especially in the economic dimension, where the circular economic approach is being pursued [78]. It is evident that circular economy pursuits highly supported an extensive application of technologies in areas such as production, extraction of resources and in recycling processes to ensure an extended lifecycle of products [79], and even though the concept is noted to receive increasing global attention. In view of its merits, there are notable challenges as to its inclusion in vulnerable groups [80].

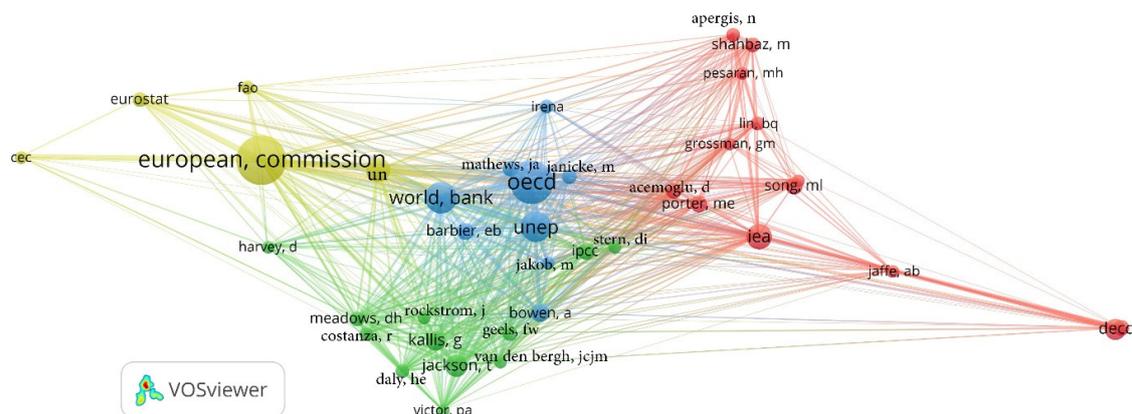


Figure 8. Authors influencing the GDN discourse. Illustration by the authors.

4.6. Term Co-Occurrence

4.6.1. All Periods

Results of the term co-occurrence analysis for the whole study period are shown in Figure 9 below. The terms were categorized and clustered into three groups. The red cluster categorizes terms associated with climate change and sustainability, while the blue cluster encompasses terms associated with green growth. The green cluster was dedicated for terms associated with application of technologies and policies to foster economic growth. The red cluster had a total of 25 terms, with key terms (according to size of their node) including sustainability, which deemed to be more closely associated with terms such as green growth and green economy from the blue cluster. The term climate change was almost centrally positioned as shown in Figure 8 and is seen to be associated with terminologies from both the green and blue clusters. The green cluster had a total of 15 terms, with policy, economic growth and efficiency being the main ones and seemed to be closely linked with other terms in this cluster and from the blue and red cluster as well. Other terms that were popular in this category include efficiency, innovation, impact, technology, renewable energy, China, and CO₂. The blue cluster had only six terminologies, with the key one being green growth, which is seen to be closely associated with major terminologies such as sustainability, climate change, energy, Green New Deal and others from the Red cluster. Likewise, it has close links with terms such as Economic Growth, Impacts, Model Performance, Innovation, and Efficiencies from the green cluster.

From the literature, it is not surprising that terms such as green growth, sustainability, climate change, policy, economic growth and energy seem to have been very popular and closely associated over the period in question (1995–2021). It is worth noting that it is within this period that global community had come together to form the COPs with the first meeting happening in March 1995 [81]. Therefore, it is no coincidence that the key terminologies especially in regard to climate change and need for green growth seem to be predominant. Further, the co-occurrence of the terms such as policy, energy eco-

change intensified, prompting the formulation of the Kyoto Protocol that came into force in 1997 [66]. The economic growth that was being experienced prompted emergence of housing programs, especially low-cost housing in many developing regions, especially in Asia and North America; as disposal income following increase in wages started to rise [88]. Through innovations, affordable housing became the trend, and countries such as the U.S., Canada, Singapore, and others were in a rush to ensure their citizens, whose numbers were also increasing, especially in urban areas were housed [88]. However, in the course of pursuing housing projects, it is noted that concerns arise on energy efficiency and the need for the adoption of alternative clean energy. That being said, it is noted that the concept of 'green' was still not popular during this first period as showcased in the diagram (Figure 10) above.

4.6.3. Second Period (2015–2019)

During this period, as depicted in Figure 11 below, the number of terminologies increased significantly to cover emerging issues. These terms are categorized in three groups, represented by red, blue and green clusters. The red cluster captures all the terminologies directly associated with sustainability and climate change while the blue cluster is dedicated for all terminologies with greater inclination to Energy Production, Consumption, and Impacts. The green cluster encompasses terms focusing on Green Growth, as influenced by factors such as Technology, Policies and Innovations. During this period, it is evident that all the terms recorded in the first period (1995–2014) are still present here and have been reinforced by the emergence of new terms. In the red category, it is evident that new terms such as: Impacts, Cities, Power, Productivities, Transmission and others had become common, and are occurring in document focusing on all three thematic areas. Similarly, in the green cluster which was presented as the Blue cluster in the first period, in addition to the six terms that were recorded then, numerous more terms emerged during this second period. Notable new terms here include Green Economy, Europe, Renewable Energy, Emissions, Scenarios Behaviours, SDGs and others. In the Blue cluster, the number of terms that emerged were not many compared to other clusters. They include Innovation, Buildings, Retrofit and UK. This aligns with the need of not only introducing more sustainable policies for new building stock, but also to retrofit existing ones, so as to ensure a more sustainable built environment [89].

The terms Policy, Efficiency, Innovation, Green New Deal however are seen to have become slightly more popular during this period, and also highly linked with terms such as Energy, Renewable Energy, Technology, Impacts, Green Growth and others.

From the analysis, it is observed that this second period experienced major breakthroughs in the discourse on Sustainability, Equitability and Economic Growth. It is during this period that the Paris Agreement (2015), Sustainable Development Goals (SDGs) 2015, the Agenda 2030 for Sustainable Development (2015), the New Urban Agenda (2016), the Green New Deal (American model) 2019, and others were formulated, and where some are already in force. In fact, there has been numerous meetings on different agendas, especially on environment and sustainability during this period, with a large number of publications published, including notable documents such as the SDGs and the Paris Agreement. During this period still, it became apparent that the world was experiencing increasingly pressures from the (still) unprecedented challenges of climate change, impacting mostly vulnerable economies such as least developed countries (LDCs) and small island developing economies (SIDS) [4]. It is during this period also that sustainability agendas increased more with areas such as urban planning being at the forefront, with urban models such as sustainable smart city models being adopted in numerous geographies, including Songdo, South Korea [90]. Other cities include Singapore [91], Barcelona [92], and other parts of the world that have transformed, courtesy of the proliferation and ubiquity of smart technologies [93–95]. Such activities saw an increase in the academic arena with numerous co-occurring terminologies increasing and covering different aspects of Sustainability, Growth, Economy, Climate Change, Technologies and more. With the global

population increasing at an average of 140 million per year since 2015 as expressed by Roser, et al. [96], substantial changes in different global sectors were observed, especially as demand for services such as energy, transport, manufactured products and other increased. These then prompted the need for policy interventions to ensure that as consumption continued, identified themes such as sustainability, Conservation, and Supply Chain Management were noted, as captured in the Paris Agreement and the New Urban Agenda (NUA) documents [82].

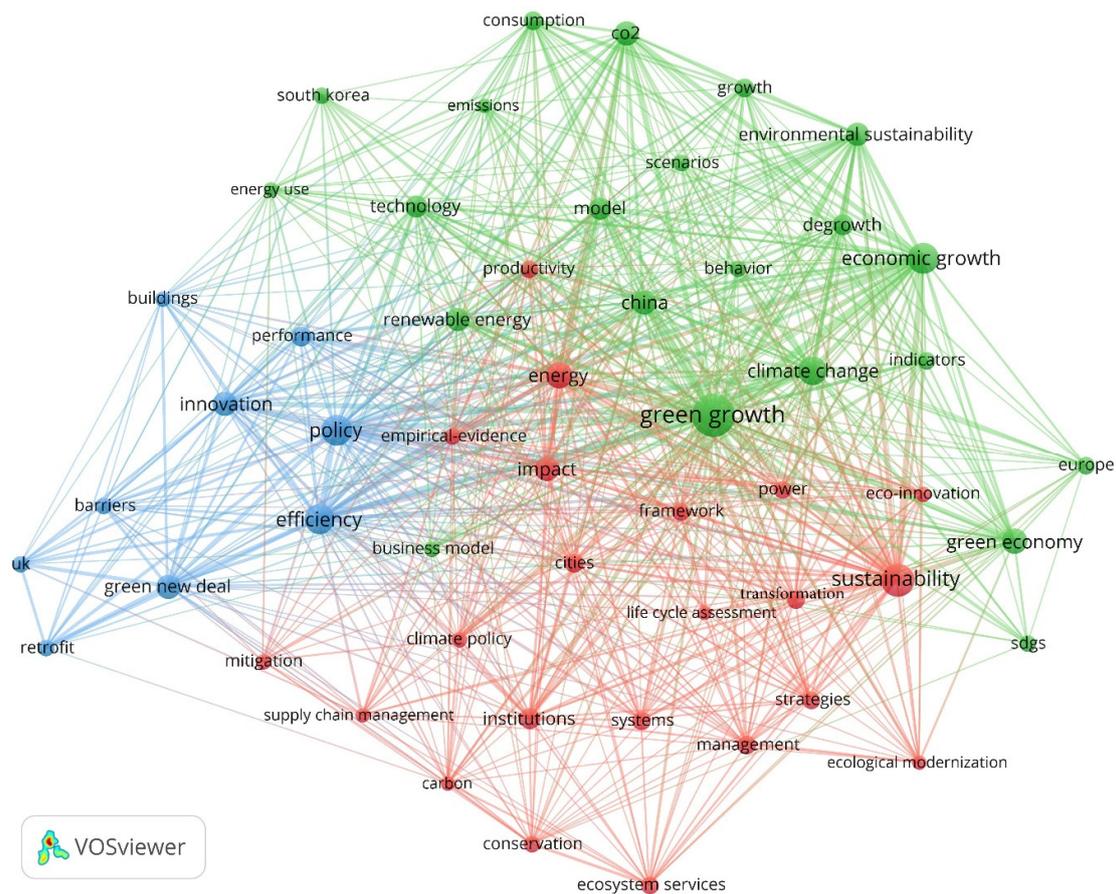


Figure 11. Analysis of terms co-occurrence from 2015 to 2019. Illustration by Authors.

4.6.4. Third Period (2020–2021)

Analysis of the period 2020–2021, as shown in Figure 12 below, further highlighted the consistency of increased terminologies shaping the discourse on GND, within the three thematic areas of sustainability and climate change categorized under the red cluster. The second thematic area is energy and renewable energies highlighted in the blue cluster, while the third thematic area categorized under the green cluster encompassing terms focusing on Green Growth, Economic Development and Technologies. The results here show that like in the previous periods (1995–2014 and 2015–2020), new terms arising from global trends emerged. These include Green Recovery, COVID-19, Agriculture, Biodiversity, Bioeconomy, Circular Economy, EU-Green Deal, Storage, Photovoltaics, Energy Transition, GHGs, LCA, Determinants, Countries, Empirical Evidence, Panel Data, Environmental Kuznets Curve and Decoupling among others. Some other terms that were common in the previous period but were no longer popular include South Korea, Behavior and Productivity.

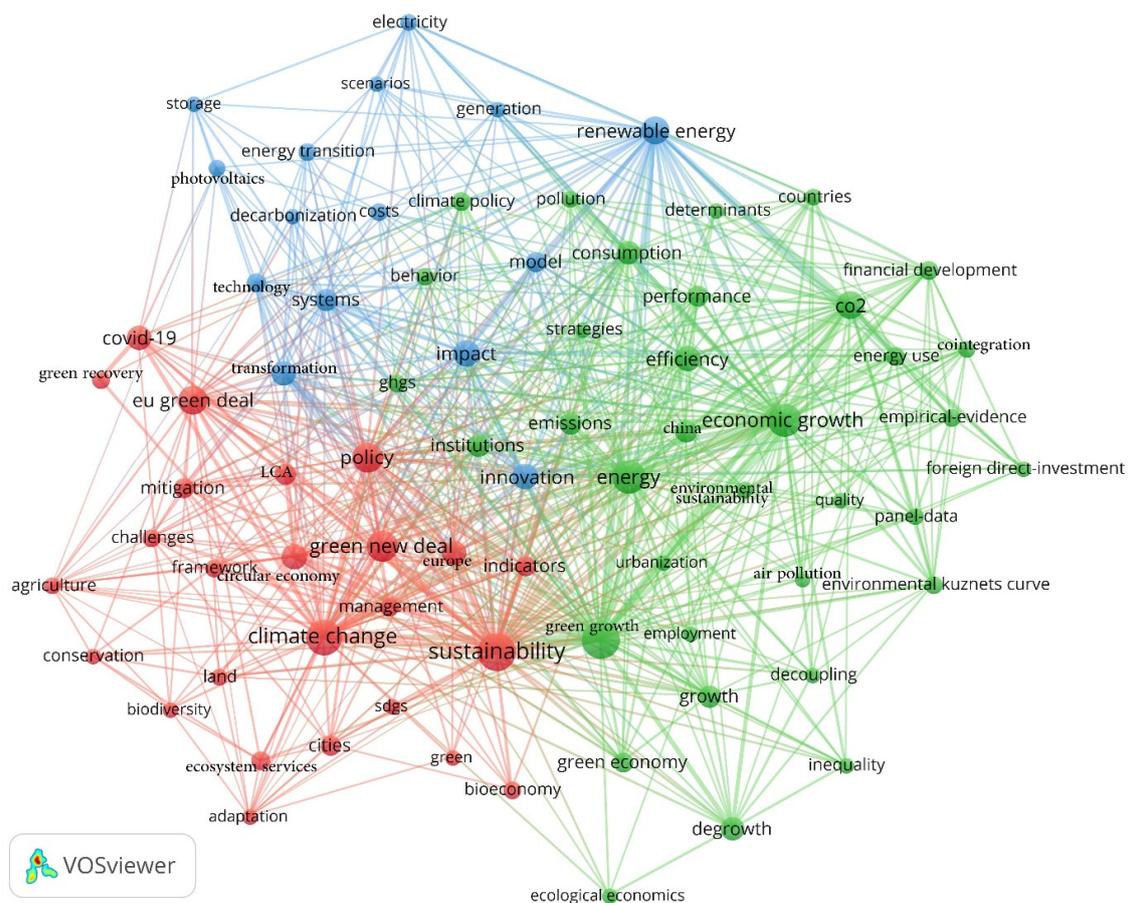


Figure 12. Analysis of terms co-occurrence from 2020 to 2021. Illustration by Authors.

From the analysis, this period portrayed mixed results for the global environment, and the discourse on sustainability, as a result of outbreak of COVID-19 early 2020 [57,60]. On the one hand, measures instituted in different countries and regions saw a reduction of activities in major sectors such as tourism, transport, manufacturing, education, hotels and hospitality industry and in retail among others, resulting into drastic reduction in emissions; by approximately 6.4% equivalent to 2.3 billion tons of CO₂ [97]. However, the pandemic also resulted into unprecedented plummeting of the global economic growth; estimated at around 3.5% by IMF [98], and more so in developed economies. Thereafter, in the third quarter of 2020, countries started to ease COVID-19 restrictions and gradually started to strategize on how to get back their economies into track, thus sparking fears that some would overlook their climate commitments and revert to the use of non-renewable energies. This may explain why terms such as Energy Transition, Decarbonization, Photovoltaic Climate Policy, GHGs, Environmental Sustainability, Panel Data and others have emerged co-concurrently with the existing ones. On this, there has been calls for economies to consider embracing renewable energies in their COVID-19 recovery plans, with solar photovoltaic being championed, especially after notable advancements in the technologies used in making solar panels and other components such as storage batteries helped reduce the prices thereof [99]. During this period also, the EU Green Deal was proposed [15], with proposals of formally adopting the circular economy concept as a means to changing the economic profile of the EU region. According to Dartford [48], this deal impacts the relationship between the EU and its trading partners, more so in respect to the sustainability aspects of raw materials and products exported from and to Europe. The bottom line during this period was for economies to emphasize on green growth, posing as a strong approach for positive impacts even for LCDs and SIDS, observed to be struggling financially due to the debt crisis exacerbated by the impacts of COVID-19 [100,101].

The focus is on implementing policy frameworks that would encourage economies to continue investing in sustainable pathways, as in renewable energy and increased use of technologies in areas such as urban planning. This, as noted by the World Bank [102] will promote a gradual economic recovery, while at the same time ensuring that the global 2030 targets for reduction in emissions are not overlooked. This, as highlighted in Figure 11, could explain why terms such as Impacts, Policies, Green Growth and Innovations are co-occurring almost at the center, showing that issues on Sustainability, Economic Growth, and Social Pursuits are gaining more popularity and co-occurring in cross-cutting in different disciplines.

5. Conclusions

This study, through the performance of a bibliometric analysis, explores the theme of Green New Deals and maps out their theoretical conceptualizations, knowledge structure, and trends across different time scales and publications. One limitation of this approach is that it caters for documents only indexed in academic milieus, in this case Web of Science, and hence omits grey literature. However, this focus on academic literature does not skew the results, as the large sample size of 1174 articles provides a robust dataset which, when analyzed, provided a deeper understanding of the evolution of the concept and can further provide researchers and policy makers with knowledge on how to better craft effective and contextually appropriate GND models. It is noted that GND adoption at a policy level is still in its infancy stage and is expected to keep gaining in popularity in the coming years, especially in view of the challenges brought about by the COVID-19 pandemic, underlining adequate and urgent economic responses aligning with national and international commitments to sustainability policies and agendas, including the Paris Agreement and the 2030 Agenda for Sustainable Development. This subject is thus expected to gain in popularity among academic circles, which will lead to further popularization and adoption. The paper further underlines that while the subject of the Green New Deal varies in interpretation, there is a strong convergence towards universally agreed principles, such as 'green growth' and 'green economy', thereby showcasing foundational precepts to the concept which can then be tailored to varied contexts in accordance with their needs and agendas. As avenues for future research, the mapping of the foundational elements of varied GND models and frameworks could be extremely interesting, and could potentially lead towards a global GND framework and application roadmap, contextualized for implementation in different economies. Finally, in view of global discussions on deep decarbonization needs at the Conference of Parties (COP) 26 at Glasgow in November 2021, aligning with the increasing need for climate financing at both local and regional levels, it could be topical to engage in meta-analyses of sustainability transition models along with GND evolutions to try to map and understand what would be the most contextually appropriate GND models (accompanied with financial tools) per geographies and socio-economic groups. The topic of financing sustainability transitions will be made extremely important, and it will provide adequate research attention on this subject, rendering more effective policy outcomes aimed at accelerating much-needed sustainability transitions.

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