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Original
Mapping the Just Green Transitions in the Socio-political Virtual Space / Shaker, Y., Persico, S.. - In: EUROPEAN JOURNAL OF SPATIAL DEVELOPMENT. - ISSN 1650-9544. - ELETTRONICO. - 21:1(2024), pp. 61-82. [10.5281/zenodo.13817780]

Availability:
This version is available at: 11583/2992652 since: 2024-09-20T14:13:29Z

Publisher:
Politecnico di Torino

Published
DOI:10.5281/zenodo.13817780

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25 November 2026

EUROPEAN JOURNAL OF SPATIAL DEVELOPMENT

Research Article

Mapping the Just Green Transitions in the Socio-political Virtual Space

Yahya Shaker, Interuniversity Department of Regional and Urban Studies and Planning (DIST) Politecnico di Torino, Turin, Italy.
Simone Persico, Interuniversity Department of Regional and Urban Studies and Planning (DIST) Politecnico di Torino, Turin, Italy.

Abstract

Since the European Green Deal was launched (European Commission, 2019), social media and especially Twitter (now X) has become the one main socio-political virtual space where the European Commission is promoting the European Union's twinned (Just, Green, and Digital) Transitions. This multidisciplinary exploratory research crosscuts Spatial Planning & Territorial Governance (Nadine et al., 2018; Berisha, et al, 2021), and Social Media Studies and Digital Methods (Rogers, 2018; 2019), investigating the existence of the term "Just Green Transitions" on Twitter, highlighting the potential benefits that social media analysis could add to the disciplines of Governance and Policymaking. Utilizing Social Network Analysis, both Mention Analysis and Co-hashtag- Analysis were applied to capture and analyse three million original tweets over the first twenty months since the Just Transition Mechanism entered into force (European Parliament, 2021). The results highlighted the fragmentation of the terminologies and Twitter user communities, discussing the expected transitions of Europe which are expected to be Just and Green (European Commission, 2021).

Keywords

Just Green Transitions, EU Governance, Social Media Analysis, Spatial Planning and Territorial Governance, European Green Deal.

Introduction

Within the framework of the European Green Deal (EGD) (European Commission, 2019), conceptualising and operationalising transitions (Fischer-Kowalski & Rotmans, 2009) pivots on how their policies are communicated (Aagaard, 2023) between decision-makers and the public, ensuring no one is left behind (Sanderson et al., 2024). The EGD communications on social media (Balcarova et al., 2024) not only influence the public's opinions on the so-called Just Green Transitions (JGT) and the paths to achieving them but also influence the nature of their governance and public legitimisation (Aagaard, 2023).

With not much time left to deliver the 2030 goals of the EU transitions and not much room offered to conceptualise still their just dimension (Bouzarovski, 2022), the conceptualisation and operationalisation of the JGT is, to some extent, influenced by the

Corresponding author: Yahya Shaker, Interuniversity Department of Regional and Urban Studies and Planning (DIST) at Politecnico di Torino, yahya.shaker@polito.it, https://orcid.org/0000-0003-3001-7340
Authors:
Simone Persico, Interuniversity Department of Regional and Urban Studies and Planning (DIST) at Politecnico di Torino, simone.persico@polito.it, https://orcid.org/0000-0002-8727-472X

terminologies policymakers use to communicate their policies and ideas which consequently, influence the public perceptions and interpretations (Hall, 1993). As governmental communications are considered a policy tool (Howlett, 2009), this contribution is thus building upon the potential of utilising social media analysis as a tool for governance and policymaking, following its role in European studies and policy communications (Barberio et al., 2020; Müller, 2022) as an instrument of governance (OECD, 2021). This contribution aims to explore one benefit of integrating social media analysis into governance and policymaking toolkits (Deane, 2015) by investigating the existence of the so-called Just Green Transitions on Twitter for its role as a dominant channel for politicians (Castanho Silva & Proksch, 2022) and policymaking (Severo et al., 2015; Şahin et al., 2021).

Since the introduction of the Just Transition Mechanism (JTM) (European Commission, 2021), the novel developments on the "Green Transition" and its "Just Transition" dimension have been growing both in literature and policy documents, while their conceptual combination is not yet agreed upon. Following the discussion of the exigency towards a theoretical framework for the JGT (Shaker & Berisha, 2024), the presence of the term "Just Green Transitions" is rare in academic literature and policy documents, is still not commonly agreed upon neither in the singular or plural forms[1] and is associated with various terms which are often employed interchangeably[2] to indicate the expected transitions. On the one hand, JGT is not yet defined neither at a conceptual nor operational level, on the other hand, it is still not sure whether it constitutes a distinct concept, a new umbrella term, or merely serves as a contemporary fashionable synonym for pre-existing terms (Shaker & Berisha, 2024).

Investigating the presence and the use of terminologies in the public debate on social media is becoming more crucial. Not only for its influence on societal changes (Rogers, 2019) but also for a better understanding of the trends in public debate and how public policies are shaping over time (González-Bailón & Lelkes, 2023). It is worth highlighting that the terminologies used in official policy documents and research papers might contrast the colloquial language used by the public to discuss the expected transitions of Europe. One possible reason could be that ordinary citizens (Mastropaolo, 2009) are more probably inclined to use straightforward and simple language that is easily understood by the citizens[3]

[1] **Terminological Inexactitudes**: "Just and Green Transition" (Huq & Khan, 2023), "Green and Just Transition" (OECD et al., 2022), "Green Just Transition" (EIB, 2021), "Green and Just Transitions" (Langthaler et al., 2021), "Just Green Transition" (Tavares, 2022), "Just Green Transitions" (Shaker & Berisha, 2024).

[2] **Conceptual Fragmentations**: "low-carbon future" (European Commission, 2021), "clean energy transition" (European Commission, 2019), "Carbon-neutral Transformations, and "Sustainability Transition" (EEA, 2020).

[3] **Plain Language in Policy Making**: see the European Commission Accessibility in Publishing https://op.europa.eu/en/web/accessibility/transcript-plain-language

as "energy prices," "renewable energy," "climate change," than using complex technocratic terms as JGT and its variations when expressing their opinion on the transitioning to a climate-neutral future.

Considering that, the justice dimension was not a core issue of the green policies (Kyriazi & Miró, 2023). The introduction of this new terminological combination–green, just, transition(s)–may have fostered a political convergence for a more just, fair, and inclusive transition at the EU level. Yet, it might have simultaneously engendered a level of ambiguity, evident when looking closely at the various public perceptions and interpretations[4] and, more crucially, when it comes to the conceptualisation and operationalisation of the JGT from a Pan-European perspective. We could say that one factor of ambiguity is the lack of clear and precise terminologies which are commonly agreed upon in advance (Moroni et al., 2020). This ambiguity affects the conduct of evidence-based policies (Colquhoun et al., 2014) and amplifies the research noise[5].

Conceptualising and operationalising transitions while ensuring that no one is left behind (European Commission, 2019) necessitates adaptive and social innovation engagement methods and simplified language in policy communication (Moroni et al., 2020). One social innovation engagement tool is social media (Geissinger et al., 2023), it plays a critical role in influencing both the public's trust in public policies (Gil de Zúñiga et al., 2022) and in adopting new societal participation models (Querol et al., 2011; Hadžialić, 2018). In this contribution, the focus is directed towards gauging how the public discussion on the JGT is articulated in the social virtual space over the 20 months since the introduction of the JTM.

Grasping public perceptions remains predominantly relative (Lenk, 2003), especially when the theoretical conceptions and the various societal perspectives[6] are not always aligned when discussing the JGT, neither at terminological nor conceptual levels (Terzi, 2020; Revez et al., 2022; Bouzarovski, 2022). Yet, with the digital transition, policymakers ought to leverage the social media analysis's potential (Driss et al., 2019) in grasping how the public debates are evolving within the framework of government social media (Yuan et al., 2023) shifting from the limits of using social media mainly for dissemination and monitoring (Barberio et al., 2020; Müller, 2022) and more in governance and policymaking (Rathore et al., 2021).

[4] On **public perceptions**: see the fairness perceptions on the Green Transition. (European Commission, 2022) and the perceptions on the European Green Deal through Twitter Analysis (Balcarova et al., 2024).

[5] **Research Noise**: Denotes the retrieving of any superfluous, irrelevant, or out-of-context data that can obscure or distort the analysis. Minimising the noise is fundamental for the reliability of the findings (Andrad, 2023).

[6] On **societal interpretations**: Indigenous perspective of the Sámi people on the EDG (Saami Council, 2024).

Social media and especially Twitter (now X), is one politicised sociopolitical arena (Luhtakallio & Meriluoto, 2022) where public policies are discussed between citizens and decision-makers in what could be called a public debate even if it does not necessarily represent the full spectrum of the opinions of the public who do not engage on social media (Gaisbauer et al., 2021). Beyond its spatiality and territoriality (Aliberti, 2019; Bernal, 2020), social media is thus the space where governments disseminate information and provide real-time interaction on their proposed policies and political decisions (Kamp, 2016), shaping individual and societal ideas on social and political issues (Kelm et al., 2019) regarding the expected future of Europe (Goldberg & Hoffmann, 2023).

The interactions between citizens in such socio-spatial and political–virtual–spaces (Patterson et al., 2017) could present one issue of governance (Hovik & Giannoumis, 2022). Arguably, the EU has been investing in effective and timely communication channels (Silva et al., 2019; Driss et al., 2019), supporting its Member States in becoming more fit for the future of Europe (European Commission, 2017). Social media and its analysis offer an unprecedented real-time interactive governance tool bridging the gap between the physicality and sociality of space, thus invigorating the space between citizens and public administrations (European Commission, 2017).

Social media analysis is becoming a valuable yet underutilised tool for decision-makers and policymakers (Nurmandi et al., 2023) that could help to better understand how public matters are discussed over social media. It, thus, offers a critical lens, magnifying how the public express their opinions on socio-political matters and providing a better understanding of public concerns and priorities (Chen et al., 2020; Al-Omoush, 2023). In 2020, the Nordic Council applied social media analysis to better understand the impact of the green transition in the Nordic regions. One outcome is the doubts among the Nordic populations regarding the implementation of the green transition (Nordic Council of Ministries, 2020).

This contribution presents a multidisciplinary exploration of crosscutting Spatial Planning and Territorial Governance and Social Media studies. It investigates whether the JGT exists on social media and whether this meta-concept or any of its variations have been impactable since the JTM was enacted on July 1st, 2021 (European Parliament, 2021) to open new horizons for further exploration of what social media analysis can offer to the research fields of governance and decision-making.

Research Methodology

The research design, summarised in Figure 1, is based on mixed methods of crosscutting:

(a) Theoretical and conceptual framework of the JGT (Shaker & Berisha, 2024) with a background in Spatial Planning and Territorial Governance (Nadine et al., 2018; Berisha et al., 2021).

(b) Social Network Analysis (Froehlich, 2023) with a background in Social Media Studies and Digital Methods[7].

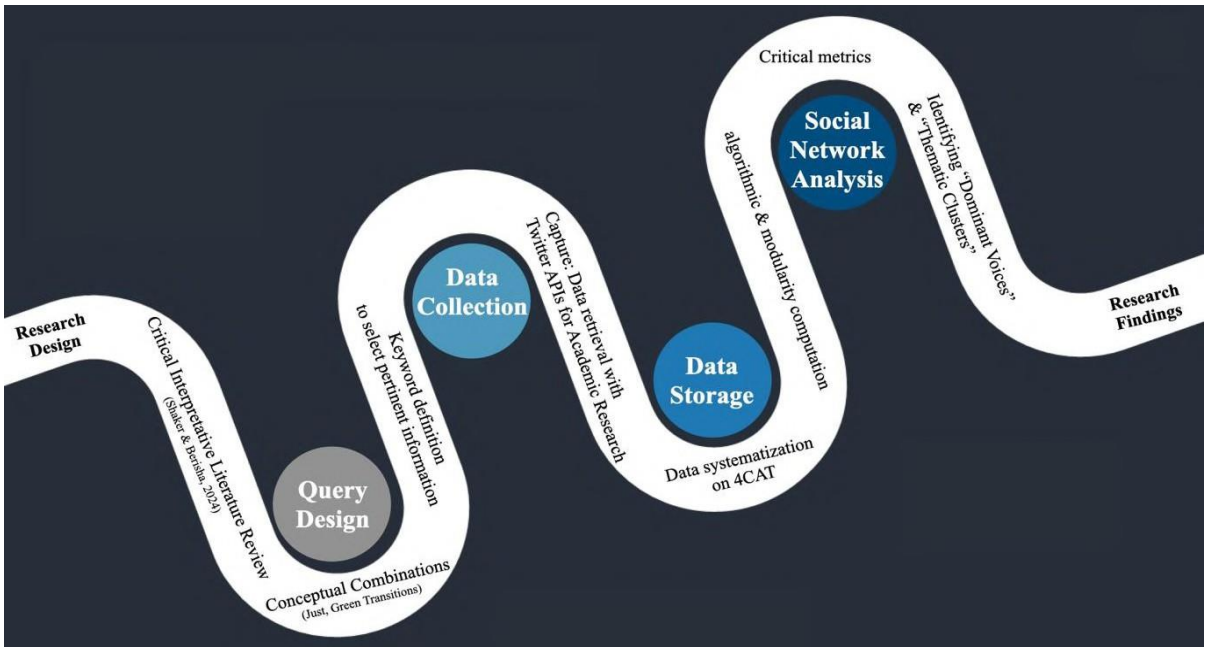

Figure 1 – Research Pipeline and Methods. Source: Authors' own elaboration.

The **query design** is based on the English language to maximise the exposure to a wide range of policy actors, including various EU public authorities, influencers, activists, and followers, since the discussion on the JGT cannot be detached from the global debate on climate justice (Tavares, 2022).

It is based on deconstructing the term Just Green Transitions into the collection of the parts of the definition that could be used in broader contexts (such as Green Transition and Just Transition) while excluding individual terms (Just, Green, and Transition) in the research string to avoid ambiguity and aiming to limit the research noise.

[7] **Digital Methods**: are methods to analyse natively digital data from social media aimed to stand for collective phenomena, social changes, and cultural expressions. The theoretical framework in the field of social media analysis has been shifting towards critical metrics, which not only measure attributes but illustrate relationships between digital objects based on platform affordances (Rogers, 2018a, 2019).

The keywords in the research string are all without spacing to eventually collect content labelled with hashtags, where every tweet has included at least one of the following:

{*Just Green Transitions* OR *Just Green Transition* OR *Just Green* OR *Green Transition* OR *justgreentransition* OR *greentransition* OR *justtransition* OR *justgreen*}

The **Data Collection** was performed on three million original tweets over 20 months between the 1st of July 2021 and mid-March 2023 using 4CAT (Peeters & Hagen, 2022). The keywords were forwarded as parameters of http-request using Twitter API v.2 with academic research access, and the correspondent http-response, containing a JSON (JavaScript Object Notation) file, and is automatically stored on 4CAT as an SQL database.

The **Data Analysis** based on Social Network Analysis (SNA) was found suitable to identify the dominant voices [8]and thematic clusters[9], which formed a Hashtag Graph-based - Topic Model (HGTM) (Wang et al., 2016; Steinskog et al., 2017). Therefore, SNA focused on two specific entities, users, and hashtags, thus performing mention analysis and co-hashtag analysis graphs to map narratives and communities that help capture more nuanced aspects of the topic. The two graphs have been processed using Gephi (Bastian et al., 2009). On the one hand, a Social Graph by Mentions (mention analysis) describes connections among users by looking at the network of mentions between them. This analysis shows Dominant Voices and their connections, which potentially highlight flows of information inside and between communities. To shape the social graph by mentions (Lutu, 2019), labels were dimensioned by the number of mentions received and filtered by degree, keeping only the profiles with more than twenty-five interactions to highlight the strongest ties. An OpenOrder algorithm has been applied using standard parameters to create the final layout. Thanks to the modularity calculation, it highlighted the twenty largest communities (Darmon et al., 2015) with assorted colours. On the other hand, a Co-hashtag Graph [10]describes the connections among hashtags by correlating them when used in the same tweet. The hashtags are a peculiarity of the platform that can be used to perform an exploration of the main narratives since algorithms help to create thematic clusters and perform HGTM. In this case, an OpenOrder algorithm has also been applied with standard parameters. It also dimensioned labels according to frequency to underline the most prominent hashtags and applied modularity calculation, which allowed it to detect and distinguish different thematic clusters.

[8] **Dominant Voices**: are the profiles considered most impactful within their communities and who stand for a point of reference for their community calculated by looking at the mentions' dynamics (a specific Twitter affordance). They function as a point of reference for the community, channelling most of the attention and influencing the public debate (Rogers, 2018b).

[9] **Thematic clusters**: identified by looking at the hashtags network based on co-occurrences in the same tweet.

[10] **Co-hashtag Graph**: analysis of the network of hashtags' co-citation in the same tweet (Severo et al., 2015).

Research Results

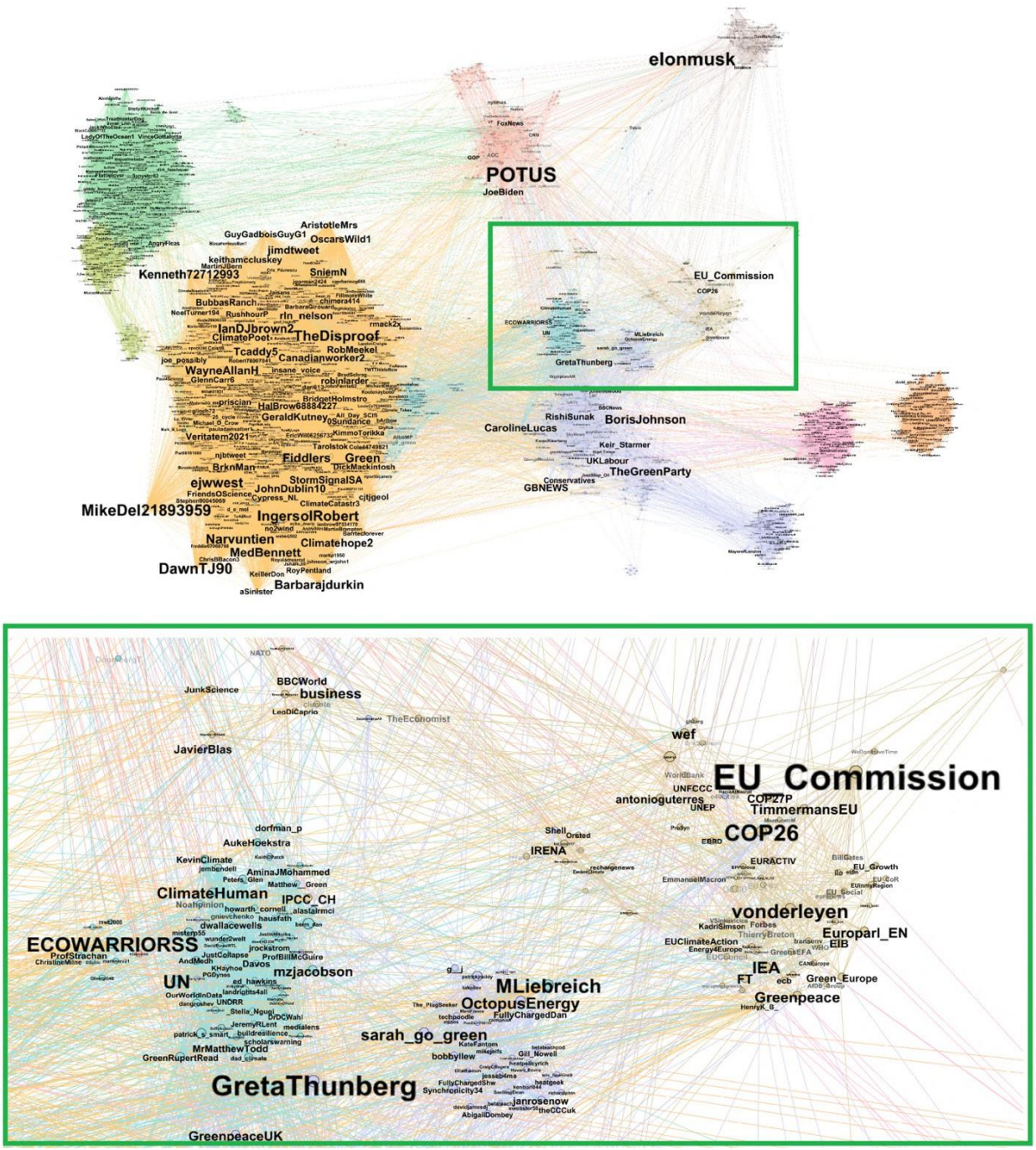

Figure 2 –Mention Analysis of the main communities. Source: Authors' own elaboration.

The Mention Analysis performed for the entire dataset underlines the presence of many fragmented communities. The major interactions are within the common users' communities.

A high presence of dominant voices has been noted (visible in the zoomed section), mainly official institutional and global players (EU Commission, UN, EIB, COP26, Von der Leyen, EU Council, World Bank, UNFCCC, UNDRR, IPCC, WHO), global activists and influencers (Greta Thunberg, Climate Human, Greenpeace, Ecowarriorss).

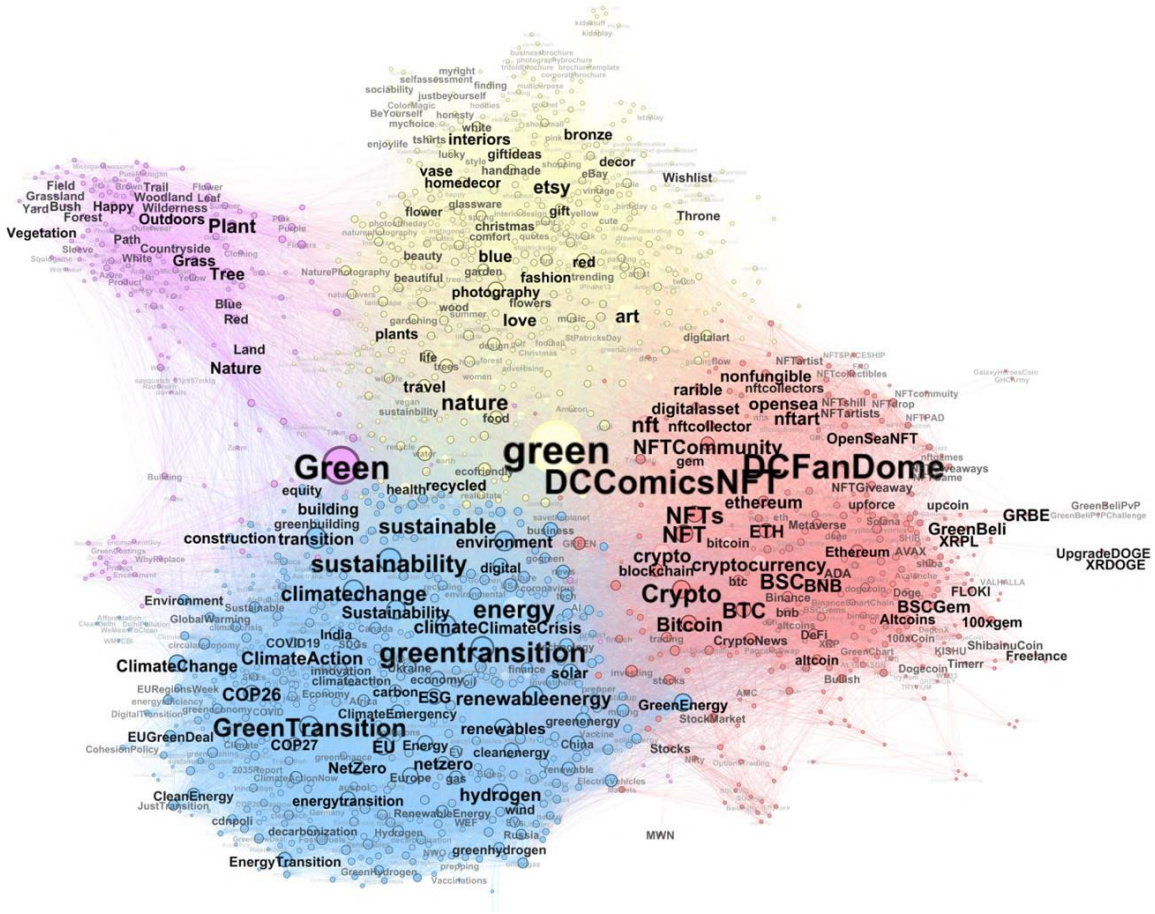

Figure 3 –Co-hashtag Analysis to highlight the main topics. Source: Authors' own elaboration.

The co-hashtag analysis performed on the entire dataset shaped four thematic clouds. The first noted aspect is the presence of thematic clouds not strictly related to the JGT: the violet cloud encompassed some discussions related to (nature, land, plants, and vegetation), and the yellow cloud encompassed topics related to (art, design, and fashion), and the red cloud included topics related to (marketing, bitcoin, crypto and NTFs) were limited from the analysis process.

A predicted level of research noise was expected in the query design phase because of the polysemic nature of the terms (Just, Green, and Transition), which could be used in multifaceted contexts. Therefore, it was found suitable to focus the analysis only on the blue cloud, which held clear references to the "Green Transition" and the topics related to its notions. The blue cloud has been analysed and categorised into different thematic clusters and sub-clusters, as in Figure (4). The graph above is the result of reiterating the hashtag analysis of the blue cloud from Figure (3) using the circular layout plugin algorithm of Gephi to represent the Twitter data in the form of a sphere. This allowed to set the graph shape with ranking and degree distribution to avoid nodes' overlapping and enhancing the readability of the Graph, highlighting four main thematic clusters:

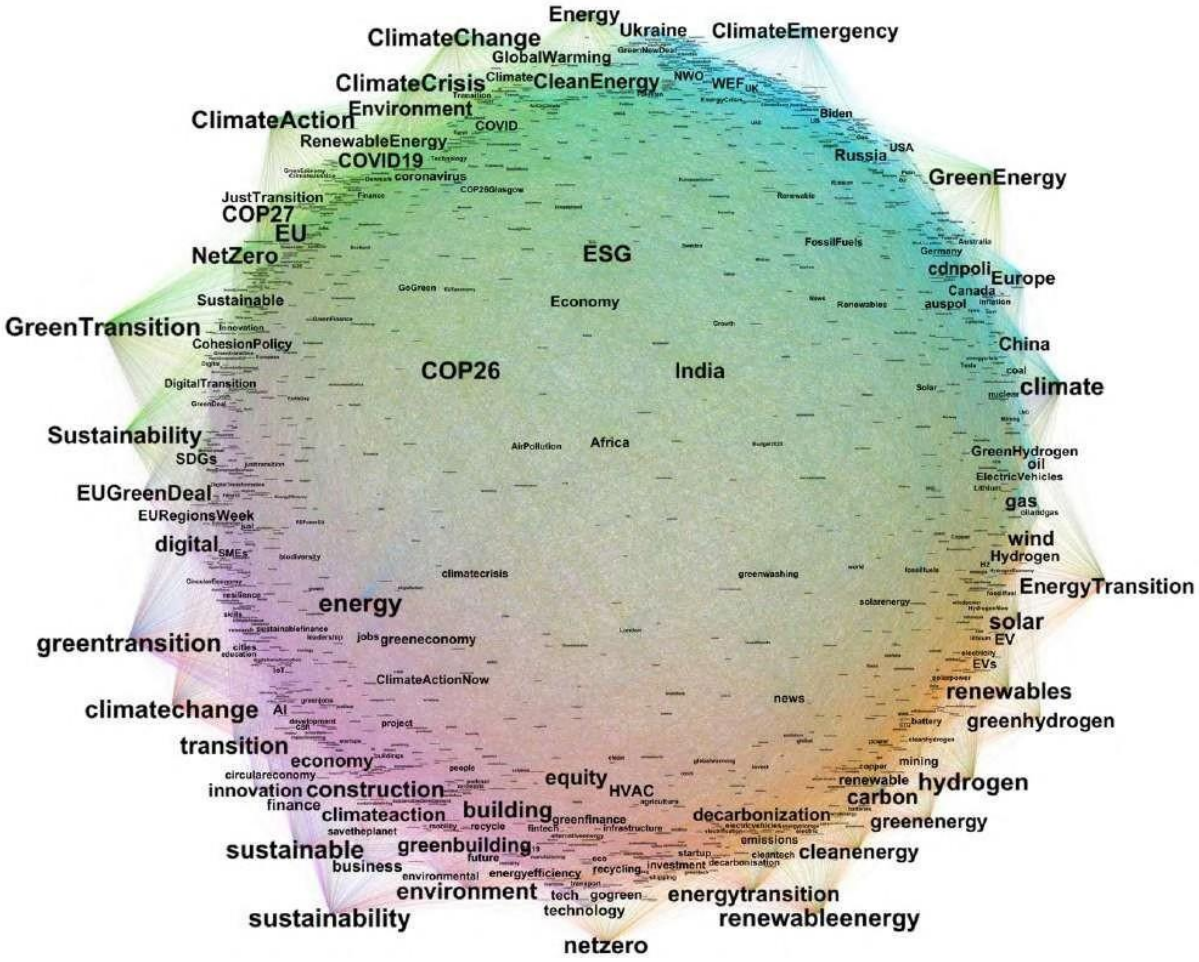

Figure 4 –Reiteration of the analysis on the blue cluster to highlight subtopics. Source: Authors' own elaboration.

- **Light blue**: Geopolitical dimension of the JGT

Sub clusters: Global Governance, Global Players, and Global Emergencies.

- **Orange**: Energy dimension of the JGT

Sub clusters: Energy Transition, Decarbonisation, Renewable Energy Resources, and Energy Storage.

- **Violet**: Policy dimensions of the JGT

Sub clusters: Socio-economic, Just, Technological, EU Governance dimensions.

- **Green**: Green dimension of the JGT

Sub clusters: Climate Change, Sustainability, and Climate Governance.

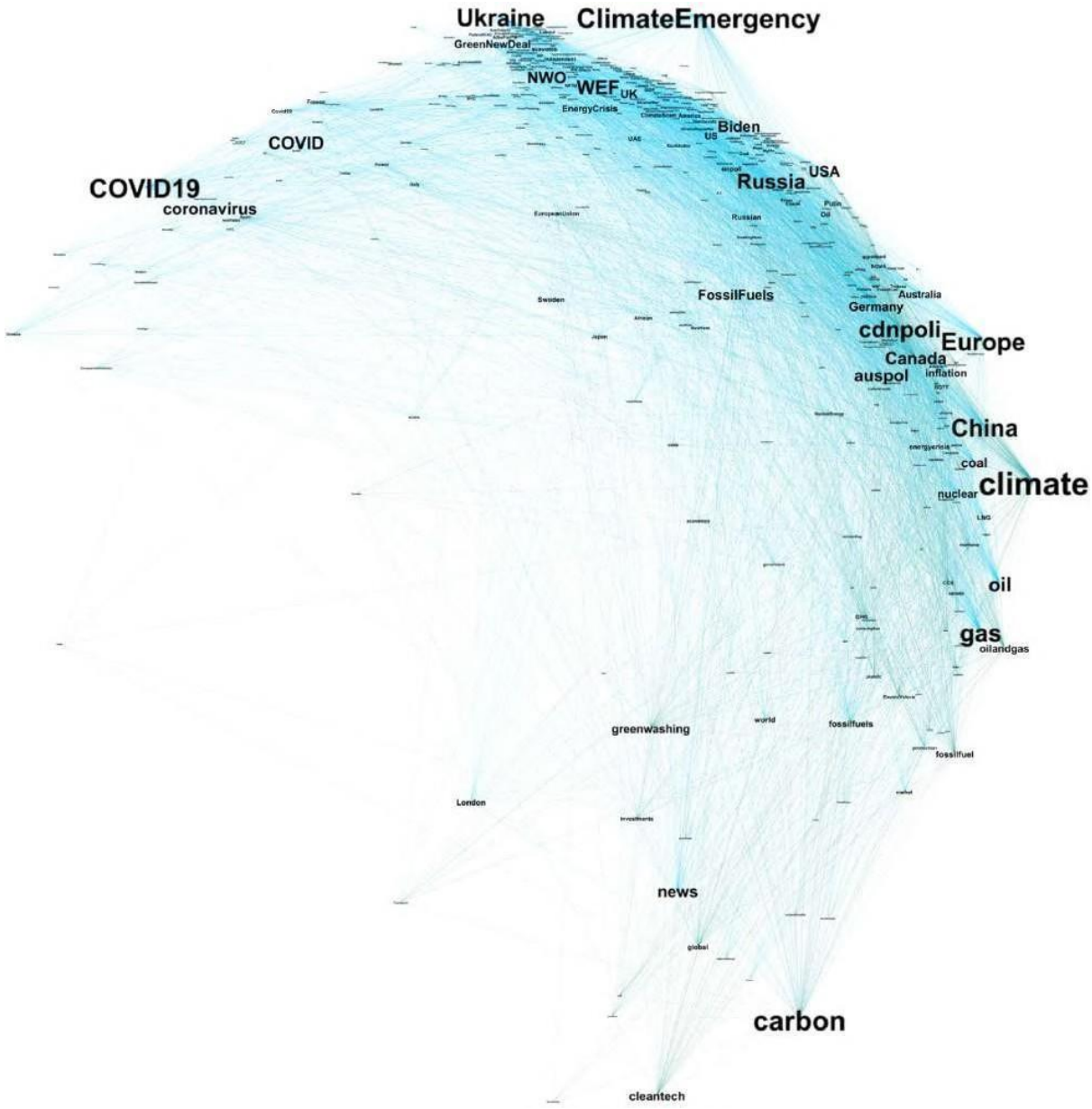

Figure 5 –Light-blue thematic cluster: JGT related to Geopolitics. Source: Authors' own elaboration.

The light-blue thematic cluster includes references related to international geopolitical actors that contribute to the discourse of the following:

- **Global Governance** (#fossilfuels, #greenwashing, #greennewdeal, #gas, #oil, #nucelar).
- **Global Players** (#Europe, #Ukraine, #Russia, #USA, #China, #WEF-#WorldEconomicForum).
- **Global Emergencies** (#covid19, #COVID, #coronavirus, #pandemic, #inflation, #energycrisis).

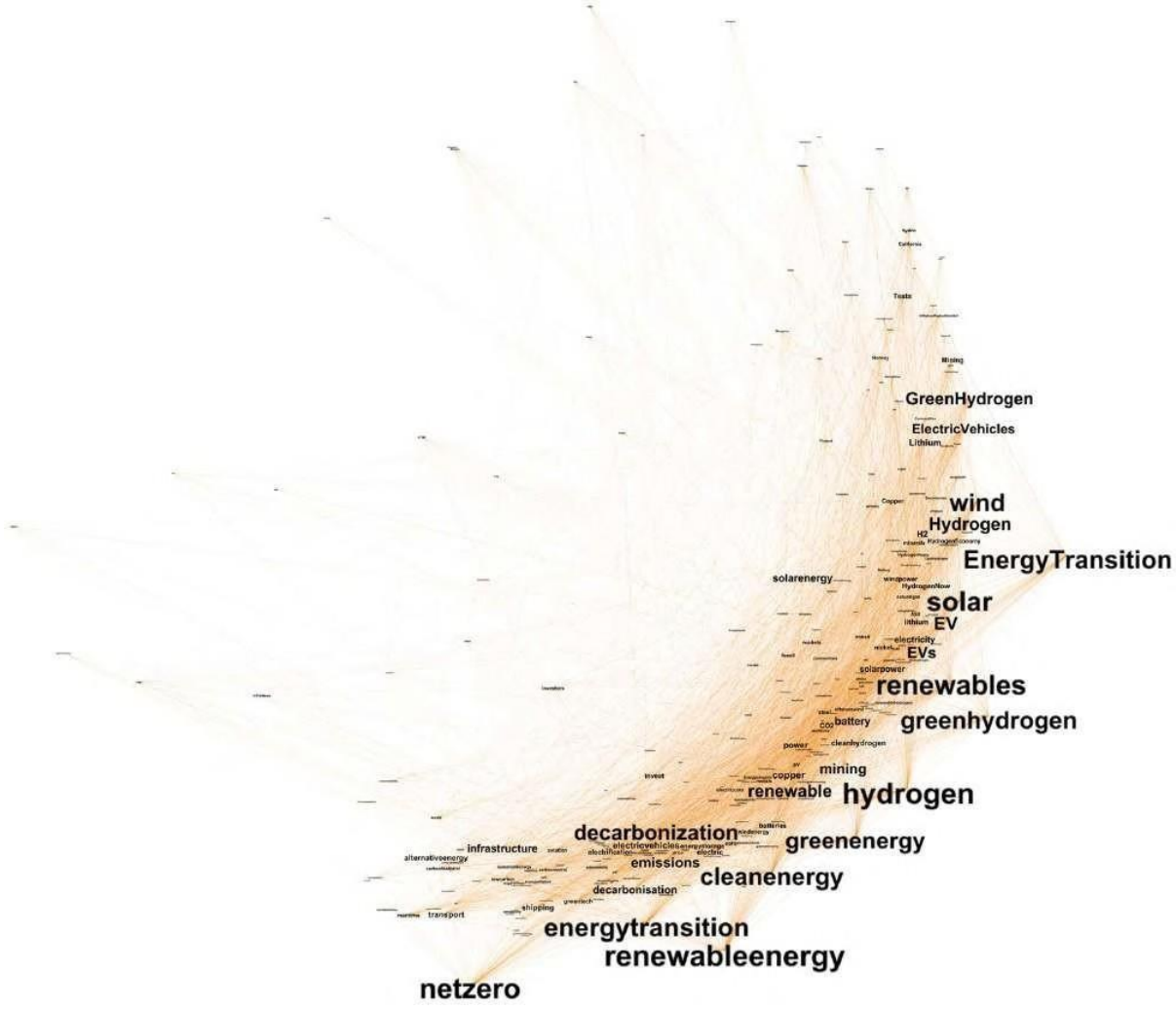

Figure 6 –Orange thematic cluster: JGT related to Energy Transitions, Renewable Energy, and Energy Security. Source: Authors' own elaboration.

The orange thematic cluster includes references to issues of:

- **Energy Transitions** (#cleanerenergy, #alternativeenergy, #energytransition, #renewableenergy, #greenenergy).

- **Decarbonisation** (#co2, #emissions, #mining, #netzero, #transport, #infrastructure, #shipping).

- **Renewable Energy Resources** (#wind, #hydrogen, #H2, #greenhydrogen, #solar, #greentech).

- **Energy Storage** (#electricvehicles, #EVs, #lithium).

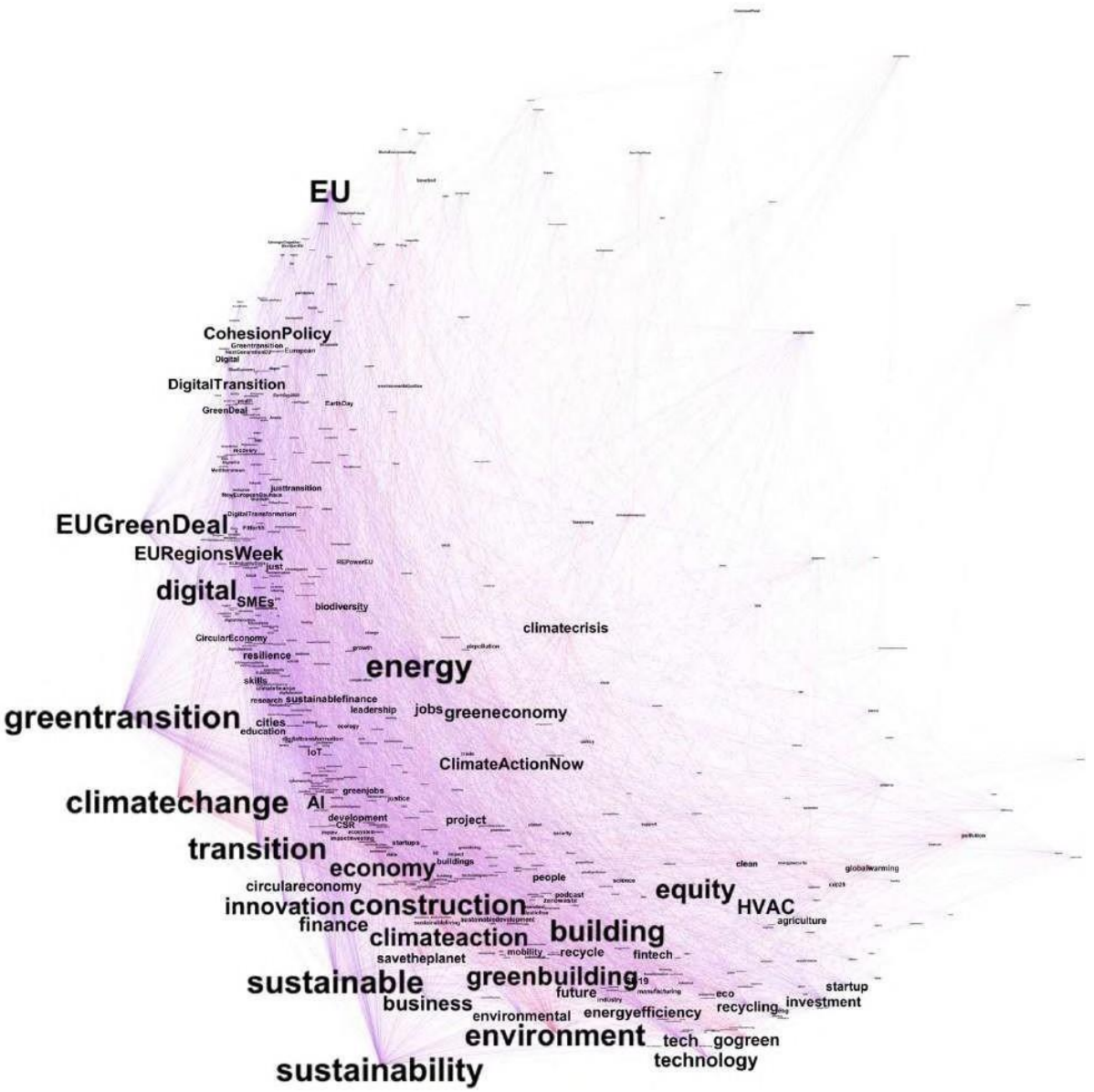

Figure 7 – Violet thematic cluster: Policy dimension related to the JGT. Source: Authors' own elaboration.

The violet subcluster includes references related to various subtopics of the Green Transition:

- **Socio-economic Transition** (#sustainablefinance #greenjobs, #circulareconomy, #digitaltransition, #greeneconomy, #finance, #SMEs).

- **Just Transition** (#justice, #climateaction, #climnatecationnow, #savetheplanet, #Earthday, #globalwarming, #sustainability, #environment, #innovation, #equity).

- **Technological Transition** (#digitaltransition, #digitaltransformation #techgogreen, #IoT, #AI, #greenbuilding, #innovation, #tech, #technology, #greentech, #HVAC, #startup).

- **EU Governance dimension** (#EU, #EUGreendeal, #GreenDeal, #cohesion policy, #EURegionsWeek, #REPowerEU, #recovery, #NewEuropeanBauhaus).

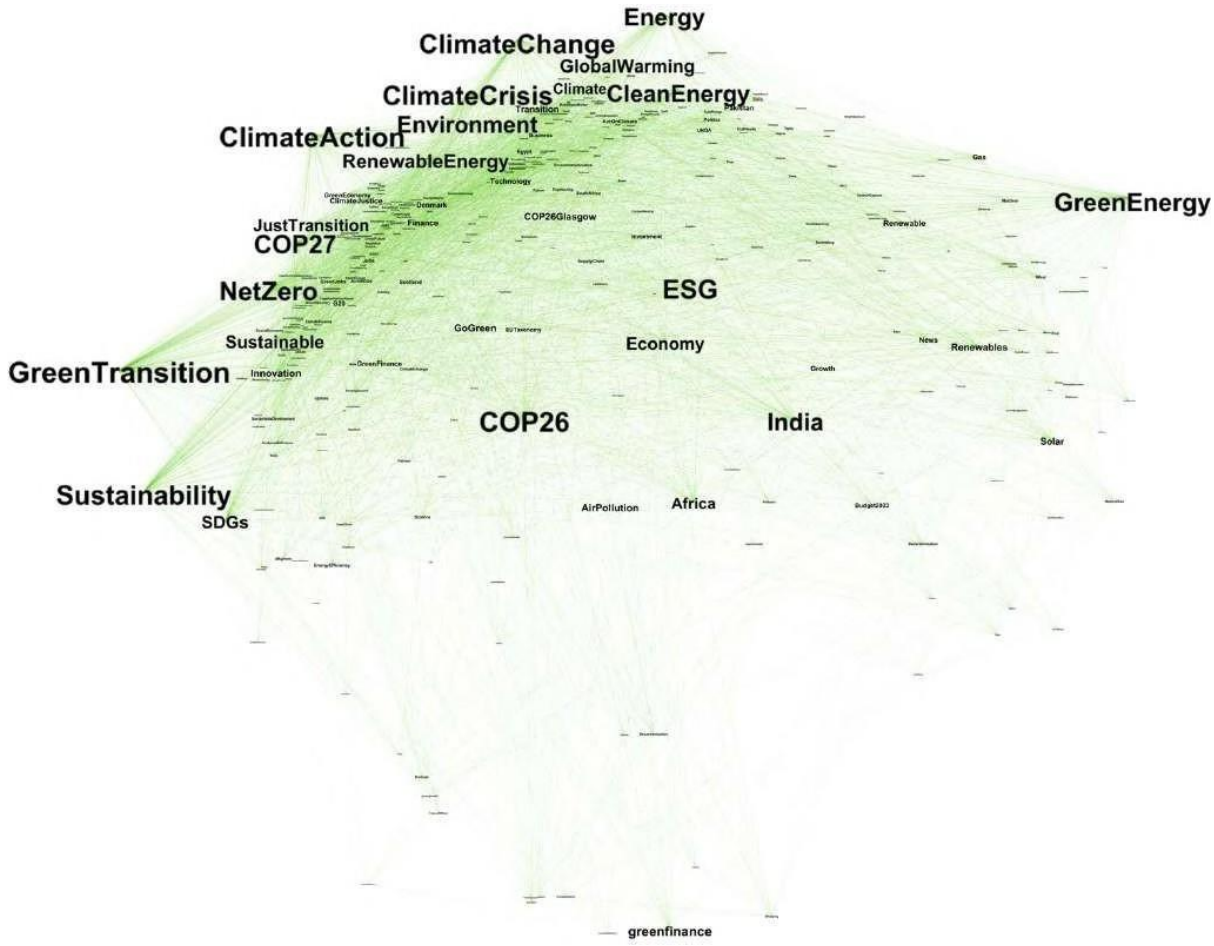

Figure 8 –Green thematic cluster: Green dimension related to JGT. Source: Authors' own elaboration.

The green thematic cluster holds references related to:

- **Climate Change** (#ClimateChange, #climatecrisis, #GlobalWarming, #GoGreen, #CleanEnergy, #ClimateAction).

- **Sustainability** (#GreenTransition, #JustTransition, #Sustainability, #Sustainable, #Environment, #NetZero, #Renweable, #Renewables, #GreenEnergy)

- **Climate Governance** (#COP26, #COP27, #ESG, #SDGs).

Discussion

The public debate on Twitter on the JGT has been multifaceted and fragmented. The clusterisation showed various narratives, dimensions, and terminologies that were used in the public debate to discuss the expected transitions. The Mention Analysis highlights different communities of assorted sizes, returning the discussion to the fragmentation of the debate. The presence of distinct dominant voices presenting global institutional, social, and political actors, using various terminologies related directly or indirectly to the discussion on the JGT, has been multifaceted and articulated at various degrees, represented in the size of the terms used in the hashtags.

The results have also demonstrated that the public debate has suffered a level of research noise resulting from (a) the abundance of near-synonyms gaining ground on the expected transitions, (b) the various meanings that each term (concept) of the JGT (Just, Green, Transitions) holds, (b) their conceptual combinations of the JGT are rarely used either by the official institutional accounts (dominant voices) or by the general public (Twitter users), (d) the terminological inexactitudes has contributed to their lack of presence.

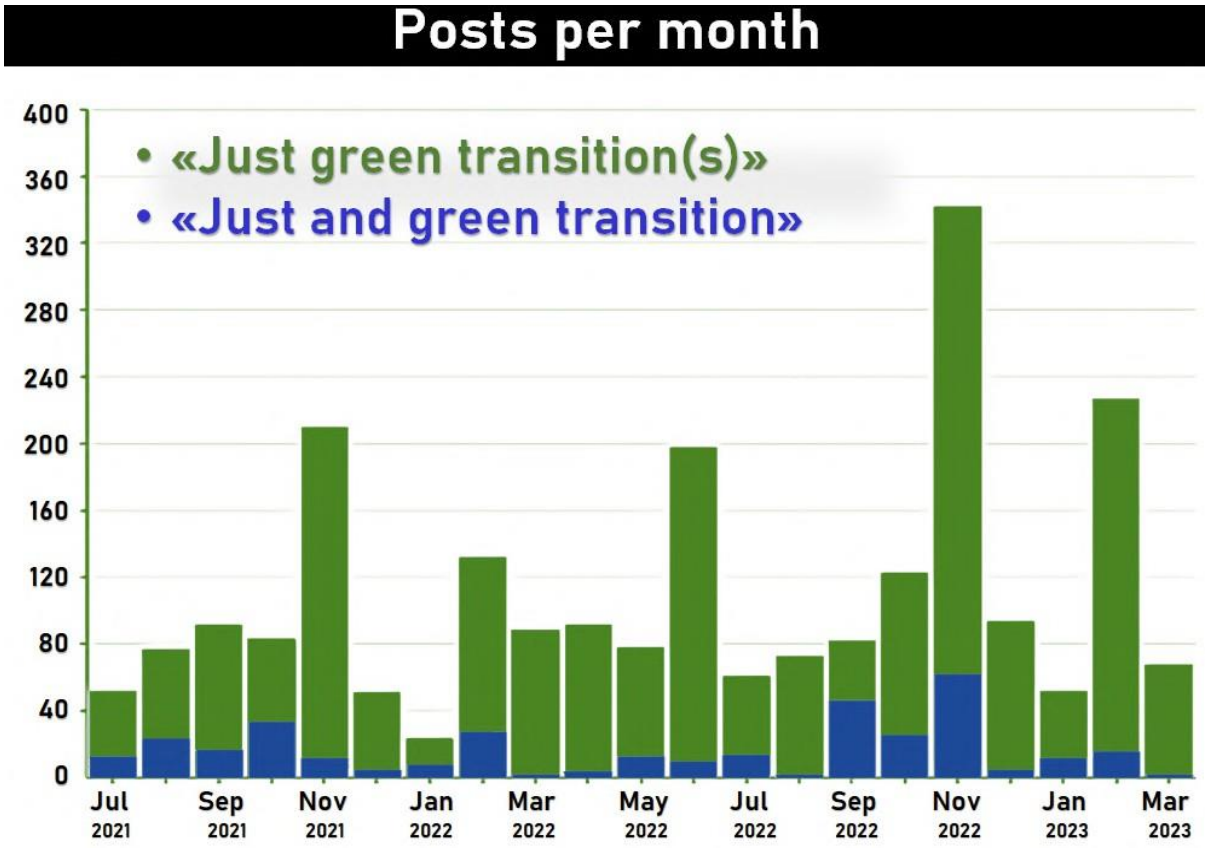

Figure 9 –Histograms showing the frequency of use of "Just Green Transition(s)" and "Just and Green Transition". Source: Authors' own elaboration.

Among the hashtags described in the results, the absence of the terms "Just Green Transition" and "Just and Green Transition" has been noticed, terminologies that are not primarily evident in the hashtags, as demonstrated by the histograms below that show the usage of the above- mentioned definitions.

To calculate the frequency of the JGT both in the form of a hashtag and as a word string, 4CAT were used to analyse text fields of original tweets and found that the term "Green Transition" was used 45.000 times (1.5%), while the term "Just Transition" was used 4.500 times (0.155%). The term "Just Green Transitions" is 2.300 times (0.076%), and "Just and Green Transition" is 357 times (0.0119%).

Terms such as "Green," "Energy", and "Sustainability" are actively used in public debates on social media, while "Just Green Transition" and Just Green Transitions" are not as impactable.

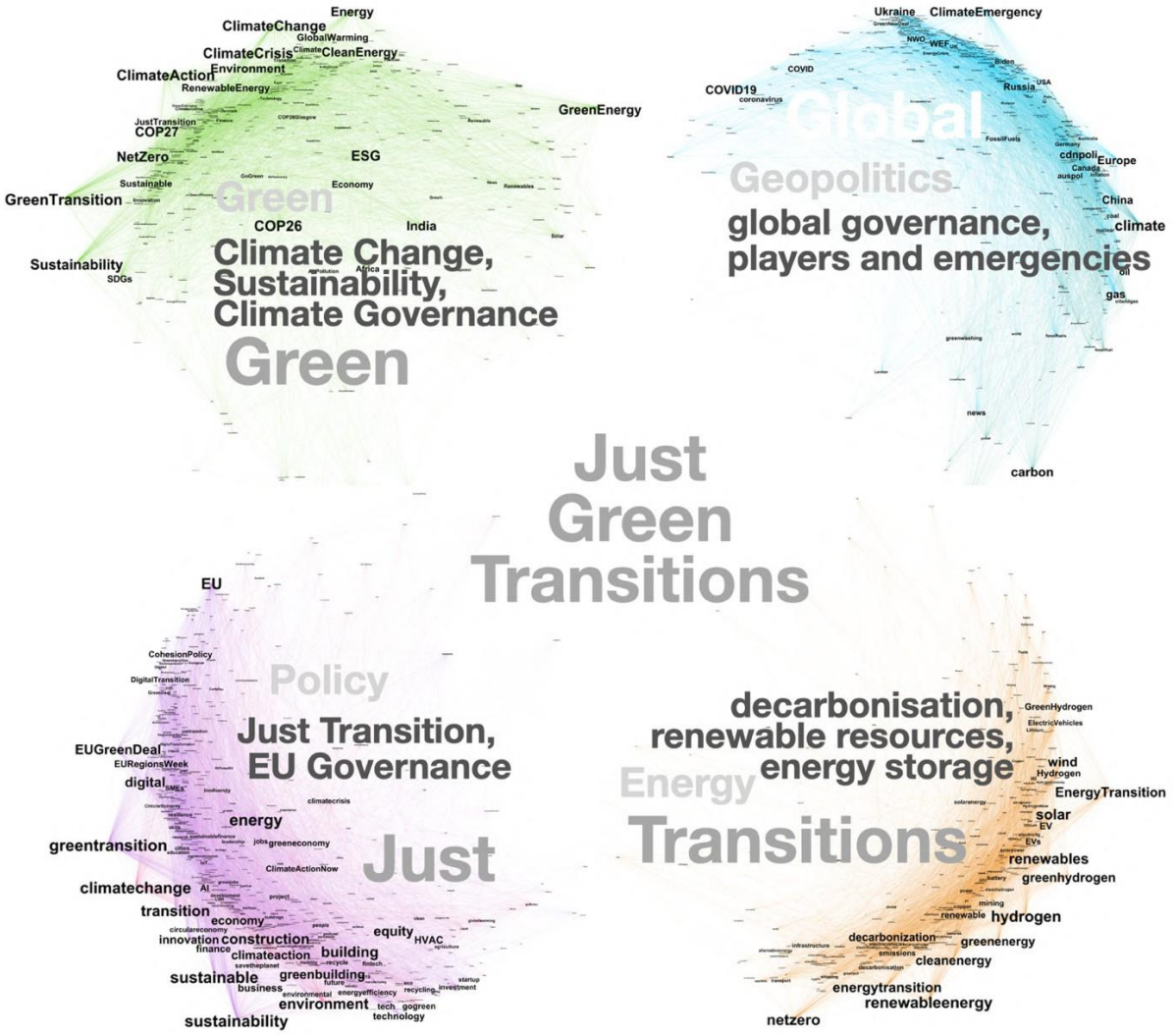

Figure 10 –Clusterisation of the JGT narratives on Twitter. Source: Authors' own elaboration.

When looking closely at the four thematic clusters, sub-clusters, including various terms, were shown in the hashtags. In the light-blue thematic cluster, the discussions seem more oriented toward the role of geopolitics (Kamruzzaman, 2022) as a tool for shaping and mobilising the global actors and events leading to the necessity for decarbonisation (Strambo, 2022), as confirmed in the literature. Moreover, fossil fuels and climate emergency crises are directly connected to global governance, players, and crises. The orange thematic cluster drew attention to the energy transitions, which is one pillar of the EDG. More specifically, this cluster focused more on the "Transition" dimension. The violet cluster highlighted the main policy dimensions of the debate, especially the ones related to the EU and the Cohesion Policy. While in the Green cluster, the discussion has given more attention to global climate governance (COP26, COP27, ESG), reconnecting to the international dimension in the light-blue section. Despite its minimal relevance of a direct narrative inherent to JGT, the graph has shown that, in addition to the three core dimensions of the JGT (Just, Green, Transition), there is a fourth one: their geopolitical dimension.

Conclusions

This contribution aimed at shedding light on the importance of using social media not only for dissemination purposes but in governance and decision-making. The results highlighted the role of social media as a socio-political virtual space where policy communications are becoming crucial, especially when it comes to social and political topics (López-Ornelas et al., 2017). In conclusion, this contribution has arrived at the following conclusions:

- Social media analysis could offer some room for better grasping the public debate on prompt political issues. It offers a critical analytical tool for policymakers and could help the disciplines of governance and decision-making.

- The introduction of new terminology, which is not commonly agreed upon, might take more time to grow, evolve, and saturate in literature and public debates.

- The use of plain, direct, and simple terminologies could narrow the gap between the official language used in policymaking and the colloquial language used by the public to discuss the same phenomena; the term “Just Green Transitions” is barely used in the public debate on social media; nevertheless, the debate related to its notions is yet active.

Avenues for future research

It is worth highlighting the various research limitations, for it is important to make sure that the results of this contribution do not present the full public debate on the JGT as the topic is prompt and ongoing.

First, the **methodological limitations**: the main limitation lies within using social media as the main field of inquiry as its reach is socially and spatially relative. Thus, the data analysed is limited to a relatively small group of participants, considering the continental scale of the JGT and the EDG agenda. Another limitation is using a single platform for the analysis (Twitter) and not all the social media platforms. The choice for limiting the inquiry to Twitter has been based upon its reputation in literature for being the main social media political arena, an aspect which fits the requirements for our research aim. Nevertheless, Twitter (now X) does not cover all the voices on social media, not to mention the role of fake news, misinformation, disinformation (Gil de Zúñiga et al., 2022), and the radical influence of the below-the-radar platforms on the political debates on Twitter (Monaci & Persico, 2023). Another issue is that social media reach is socially and spatially relative. Thus, the data analysed is, to some extent, limited to a small group of participants, considering the continental scale of the expected transitions.

Second, **confirmational biases**: It is crucial to highlight that this research has been undertaken in an independent, neutral manner, meaning that each author has been undertaking the data collection and analysis independently and within their field research

field. This was found adequate to prevent any potential influences that might have affected the research design, data collection, data analysis, and findings. Nevertheless, the individual results have been almost undistinguishable both from theoretical (Governance Studies) and empirical (Social Media Studies).

Third, **language limitations**: the research is entirely based on the English language, which has allowed us to capture the most out of the public debate on Twitter, considering the EGD and its JGT play a vital role in global geopolitics (Leonard et al., 2021). With more accessibility to data in different languages, it would have been possible to run a content-based-geo-localisation of the Tweets (Cheng et al., 2010). If combined with EU datasets, the EIB climate survey, and the Eurobarometer on the perception of citizens on Decarbonizing Europe and the Renewable Energy Transition of the EGD (Panarello & Gatto, 2023), Climate Change (EIB, 2024), and the Fairness of the Green Transition (European Commission, 2022), a possibility for a more profound reading on the perception. Of the EU citizens on the JGT, it could be possible to use sentiment analysis (Balahur & Turchi 2013).

Fourth, **time limitation**: the time limit for this study is cross-sectional (20 months), which cannot give a full image of the real-time debate on the JGT until reaching their climate targets by 2030 and the assumed 100% climate neutrality by 2050. It is an ongoing discussion, and any matters of perceptions and terminological uses are subject to change over time. Nevertheless, there are various avenues yet to be explored: (a) How do the terminologies used in the official language of the public administration affect the public perceptions and interpretations of contemporary global policies? (b) How could the EU Governance benefit from social media analysis to better conceptualise and operationalise JGT considering public opinion?

This contribution's primary focus has been to critically examine the presence of the JGT in the socio-political virtual space and grasp the inaccuracies surrounding their terminological use. This research suggests that the JGT are better perceived as socio-political constructed realities that are exposed to an elevated level of relativity and uncertainty and are subject to ideological, political, philosophical, societal, and environmental interpretations. Addressing the conceptualisation of the JGT as one issue of the commons and forging commonly agreed-upon terminologies in EU policymaking could guide our societies towards achieving the once-in-a-lifetime opportunity of becoming climate-neutral but without leaving no one behind (European Commission, 2019).

Acknowledgements

This research is funded by the research project European HORIZON -WIDERA-2021-ACCESS-02-01 | Foster Research Excellence for Green Transition in the Western Balkans - GreenFORCE Twinning of the Western Balkans, grant number: 101059411. The Authors

would like to extend their gratitude to the anonymous reviewers and the editorial board for their insightful comments and constructive critiques, which have significantly enhanced the quality and rigour of this manuscript.

Conflict of interest

The authors declare that there is no conflict of interest in their knowledge nor financial or personal interests that might have influenced the ideas presented in this paper.

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