

News Media Coverage of Carbon Neutrality in Korea and China: A Big Data Analysis[☆]

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ABSTRACT

This study aims to compare the differences in the carbon neutral agendas of the two countries based on the differing interest positions of the media in the two countries, as well as to analyze the carbon neutral media coverage in South Korea and China. It also seeks to identify the major topics emphasized in the carbon neutral news agenda setting process in the two countries. A total of 49,227 news articles from South Korea and 105,680 news articles from China, covering the period from the declaration of carbon neutrality in both countries in 2020 to May 9, 2022, were collected. CONCOR and topic modeling analyses were performed on these texts. The results found that South Korean media showed a preference for covering carbon neutrality from the perspective of its inhabitants, whereas Chinese media demonstrated a preference for covering carbon neutrality from the viewpoint of the nation. The discourses on coverages largely focus on areas such as energy strategy, business strategy, industrial growth, and international cooperation, with an obvious lack of discourse on the environment. The findings of this study expect to serve as a primary reference in establishing a news coverage strategy which is environmentally sustainable for the media.

✉ keyword: carbon neutrality, agenda-setting, topic modeling, concor analysis

1. Introduction

In their 2018 report “Global Warming of 1.5°C,” the Intergovernmental Panel on Climate Change (IPCC) recommended that global carbon neutrality should be achieved by 2050 to avoid irreversible damage to the environment in the future [1]. As a response, many countries have committed to attaining carbon neutrality and are actively striving towards this goal. Carbon neutrality is a widely shared global agenda that countries have agreed upon to address climate change and save ecosystems. Although the allocation of responsibility between developed and developing nations regarding climate change and environmental pollution is not well-defined, it is important for all nations to actively share effective laws and policies and work together towards shared objectives to address these issues [2].

In East Asia, Korea and China are major contributors to carbon emissions. In response, both countries have developed

comprehensive green energy and economic strategies, along with announcing a range of measures, to try to reach carbon neutrality. However, the responsibilities of achieving carbon neutrality and its impacts might differ significantly based on the financial condition of each nation, along with its specific historical accountabilities, availability of resources, and needs for energy [3].

In recent years, many countries have agreed on targets to achieve carbon neutrality. The discourse of carbon neutrality has shifted due to the different policies in response to the announcement of carbon neutrality. The media’s agenda plays a significant role in determining the significance of environmental issues and their potential to become political issues [4, 5]. It is necessary to carefully look at the topics covered by the media about carbon neutrality across various nations, as well as the differences between these topics to make an accurate observation.

Therefore, the present study explores the issue of carbon neutrality in South Korea and China using agenda-setting theory and analyzing big news data, uncovering the differences in media coverage of carbon neutrality between the two countries. Specifically, this study delves into the investigation by analyzing the changes in news topics related to carbon neutrality over time to gain a more comprehensive understanding of the media attention in different countries, as

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well as seeks to reveal the changing dynamics of the carbon neutrality issue in the public sphere, focusing on the media discourse in both countries at different stages.

2. Literature Review

2.1 CarbonNeutrality

Carbon neutrality refers to achieving a state where the amount of carbon dioxide emissions caused by human activities is equal to the amount of carbon dioxide that is removed from the atmosphere by human actions. This state of balance leads to a net total of zero carbon dioxide emissions [1]. It is necessary to make reduction of carbon emissions by adjusting the energy system and industrial structure to attain carbon neutrality.

The energy system largely entails a shift from fossil fuel-based energy sources to renewable and environment-friendly energy sources. The shift from labor- and resource-intensive to technology- and knowledge-intensive sectors is referred to as the “adjustment of industrial structure” [6].

As an important strategy to combat climate change, carbon neutrality is becoming a focus of policy formulation and practice around the world, attracting interest and in-depth research from social scientists. In the process of achieving carbon neutrality, governments play a leading role in promoting low-carbon transformation of enterprises and strictly limiting carbon emissions through administrative means of formulating relevant policies and strategies. Several studies have examined the strategies and chances of achieving carbon neutrality in South Korea and China at a macro level. A study conducted on South Korea’s Green New Deal emphasized three key areas: green urban development, low-carbon distributed energy, and innovative green industries. The study also highlighted South Korea’s commitment to achieving a balance between economic growth and environmental preservation, as well as protecting vulnerable groups during the process of economic transition [7]. A separate study investigating the challenges and conflicts regarding South Korea’s greenhouse gas emission goals discovered that carbon neutrality targets are frequently shaped by the choices of the prevailing political group.

Furthermore, the shift towards a low-carbon society should consider a wide range of concerns, such as social, economic, and environmental factors [8].

Focusing on analyzing China’s policies and institutions related to carbon neutrality, Davidson emphasized the importance of enacting solid strategies and establishing effective institutional frameworks to successfully realize China’s carbon neutrality objectives [9]. In contrast, other studies have analyzed the use of financial methods, such as carbon taxes and carbon markets, by governments to attain carbon neutrality at a micro level. Wu, Zhou, and Zha examined the interactions among the carbon market, the renewable energy certificate market, and the deregulated electricity market in South Korea. It specifically emphasized the impact of the carbon market’s stability and activation on the electricity market and the energy structure [10]. Jia and Lin discover that carbon taxes are more efficient in reducing emissions compared to carbon markets in China, underlining the importance of establishing a suitable instrument [11].

A fundamental restructuring of the worldwide energy system is required to achieve carbon neutrality, which is anticipated to significantly affect current power generation systems [12], leading to a surge of interest in understanding the correlation between carbon neutrality and economic progress. Jiang’s analysis showed that there were significant differences in economic growth and air pollution between different regions of South Korea and China. Furthermore, there is an association between income levels and environmental deterioration, especially in metropolitan and non-metropolitan areas [13]. Carbon neutrality has also prompted discussions on the shift of the energy industry and structural changes. The studies of fossil fuels (e.g., natural gas and petrol) and clean energy (e.g., solar energy) have been conducted from various perspectives, including households, urban planning, and energy replacement. These research indicated a widespread interest in different types of energy [14, 15, 16, 17, 18].

Finally, several studies on the growth and challenges faced by businesses in achieving carbon neutrality emphasize the need of declaring and effectively managing carbon emissions for businesses. These studies claim that sharing carbon information can help businesses organizations to achieve sustainable development and to increase their values [19, 20].

Studies on carbon neutrality have increased significantly across the field of social sciences, but, there is a lack of research on the topic in a field of communication research. Hence, this study aims to investigate the discursive formation about carbon neutrality through the lens of environmental journalism to investigate potential strategies for achieving carbon neutrality in media coverage.

2.2 Environmental Journalism

2.2.1 Environmental Journalism and Public Opinion

Carbon neutrality has emerged as a major environmental issue that is attracting more media and public attention due to the announcement of carbon neutrality, as well as associated laws and regulations by many governments. The influence of environmental news on public opinion is an effective way of regulating, directing, and monitoring the efforts of stakeholders to reduce emissions, ultimately contributing to the achievement of carbon neutrality [21, 22]. Public perceptions and attitudes towards environmental issues, such as carbon neutrality, are shaped by a wide array of media sources, including popular entertainment, news outlets, scientific papers, films, and political discourses [23]. Of all the available sources, the news is the main and most important way that the general populace gets knowledge about environmental issues [24]. The public understanding of complicated topics such as environmental concerns, is strongly influenced by the media [25, 26].

Several studies have explored how environmental news coverage affect in shaping and influencing public perceptions of environmental topics. For example, Brulle and Carmichael' study the correlation between media reports on climate change and the level of attention from the American population found a direct association between the amount of media attention given to climate change and the level of popular interest in the topic [27, 28]. In addition, based on the agenda-setting theory, the environmental news coverage influence shaping the public concerns. Vu and colleagues revealed that the substantial and emotional aspects of issue attributes in climate change news contributed to shaping of public opinions [29]. Nevertheless, these studies mainly focus on climate change concerns and don't fully pay attention to

other environmental challenges.

2.2.2 Comparative Study on Environmental Journalism

Research that sheds light on the various cultural, economic, and political factors that limit media discussions on global environmental change is highly valuable in the field of environmental communication [30]. Cross-national media comparisons can provide a reference for cultural exchange and cooperation between countries, freeing them from the limitations of domestically focused studies. The media plays a significant role in providing environmental information. However, it is crucial to note that both Korea and China have distinct political, economic, cultural, and social contexts that shape how the media focuses on certain events, chooses what to cover, and interprets and comments on them. South Korea possesses a dual media system consisting of both private and public media entities, whereas China is distinguished by the exclusive ownership of all media enterprises by the public sector [31]. Media market in South Korea is characterized by a high level of diversification, with a mix of prominent media organizations and several smaller ones. In contrast, China's media market is largely controlled by government and state-owned media entities. Consequently, the Korean print media has no direct association with political parties, but the Chinese media is government-owned, establishing a more robust connection with politics [31].

The influences mentioned have led to distinct characteristics in media coverage of carbon neutrality in Korea and China. The differences in media coverage between the two countries can be attributed to variations in agenda, perspective, and national community interests [32]. There has been some research on the differences in coverage between South Korea and China. Lee and Wang's study examined the source structure of the media in three countries - South Korea, China and the United States - in their coverage of the North Korean missile crisis [33]. Their coverage serves the interests of each country, and thus their framing of the issue is an extension of each country's domestic politics. Jiang demonstrated that the characteristics of a country can potentially act as a conditional factor in agenda-setting [34].

International collaboration and the exchange of knowledge are crucial means to address environmental issues. Nevertheless, existing comparative analyses of media representation in China and Korea fail to prioritize the examination of environmental issues. Hence, it is imperative to conduct a comparative analysis on carbon neutrality from an environmental standpoint.

2.3 Agenda Setting

Introduced by McCombs and Shaw in 1972, Agenda Setting Theory posits that the media shapes public perception and concerns by assigning varying importance to different agendas through repetitive coverage of specific issues [35]. Essentially, the media's organization and selection of news content play a pivotal role in determining the public's perceived significance of issues.

The media's choice of topics and reporting methods is notably influenced by external factors such as politics, the economy, and power dynamics [36]. Carbon neutrality has emerged as a prominent global concern, with both the South Korean and Chinese governments adopting it as a target. They have implemented administrative measures to formulate relevant policies and strategies while enhancing international cooperation. These activities heighten media attention to carbon neutrality, indirectly impacting the media's agenda-setting and reporting practices.

During information processing, individuals tend to store vocabulary hierarchically and categorically, forming a structured semantic system in the brain [37]. Audience reading patterns are influenced by elements like keyword selection, positioning, visibility, and frequency when consuming news [35]. The media's vocabulary choices and phrase arrangements in discussing contentious topics notably impact audience perceptions, shaping social understanding and awareness of these issues [38]. Through discourse selection and manipulation in news coverage, the media can shape individuals' perceptions of phenomena. Analyzing lexical co-occurrence patterns in media texts aids in identifying discourses surrounding specific topics.

Therefore, grounded in the framework of agenda-setting theory, this study pursues two primary objectives. Firstly, it seeks to comprehend the key topics emphasized in defining

the agenda for carbon neutrality news in both nations, examining specific vocabulary and discourse patterns. Additionally, differences in the media's portrayal of carbon neutrality are compared based on distinct interest positions in the two countries.

Thus, this study raises the following questions by employing topic modeling and CONCOR analysis in semantic network analysis.

RQ1: What are the primary topics and differences in Chinese and Korean media reporting on carbon neutrality during a specific time frame?

RQ2: What discourses are formed and what differences are present in the media portrayal of carbon neutrality in South Korea and China?

3. Methods

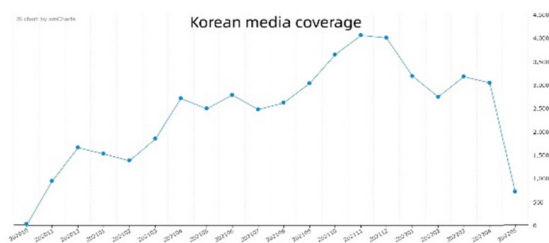
3.1 Data Collection

The analysis of South Korea's coverage extended from October 28, 2020, when President Moon Jae-in announced the goal of achieving "2050 Carbon Neutrality," to May 9, 2022, when President Moon Jae-in completed his term as president. Analyses were performed on Chinese news reports from September 22, 2020, when Chinese President Xi Jinping announced the goal of achieving "2060 Carbon Neutrality," to May 9, 2022. A topic modeling analysis was performed to investigate the media coverage of carbon neutrality in China and Korea throughout the same timeframe. A total of 49,227 coverages from South Korea were collected using a keyword search for "탄소중립" (carbon neutrality) in Bigkinds. A total of 105,680 coverages from China were collected by performing a keyword search for "碳中和" (carbon neutrality) in the wisearch database.

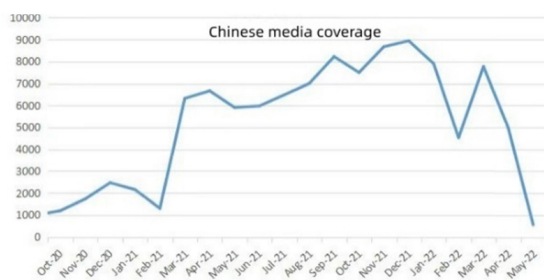
To track the long-term shifts in the main topics discussed in the media as a result of the implementation of various carbon neutrality laws, the present study observed the patterns in the amount of media coverage for both South Korea and China. The findings showed comparable patterns in the portrayal of carbon neutrality in both Chinese and Korean media as seen at <Figure 1>.

There were few news reports, but the number of reports

steadily increased from when the national leader announced carbon neutrality until February 2021. The frequency of carbon neutrality news reports experienced a significant increase from March 2021, reaching its highest point in December 2021. This occurred as a result of the enactment of strong national policy and the adoption of long-term operational strategies aimed at achieving carbon neutrality. As of January 2022, initial devotion for achieving carbon neutrality began to decrease, yet it still remained at a significant level. subsequently, ministries and local areas have commenced the execution of targeted initiatives. Hence, this study considers the timeframe from the announcement of carbon neutrality to February 28, 2021 as period 1 and identifies it as the <discussion period>. The second period, named as the <expansion phase> covers from 1 March 2021 to 31 December 2021. Lastly, the period of time between 1 January 2022 and 9 May 2022 is referred to as the <mature period>.



Trends in Korean media coverage (a)



Trends in Chinese media coverage (b)
(Figure 1) trends in media coverage

3.2 Data analysis

The analytic procedure of this study consisted of two steps. In step 1, data preprocessing involved eliminating

unnecessary parts. The LDA analysis model required breaking down sentences from the collected texts into separate words [39], which is considered as the act of converting text into an appropriate structure for analysis prior to carrying out the actual research. BigKinds employs its own algorithms to do pre-processing and morphological analysis on Korean media data. This procedure involves extracting noun keywords from news articles, which are then made available to users. In China, the process is as specified: At first, in the word segmentation phase, a Chinese word segmentation program called “jieba” was applied in the Python environment to divide words. In addition, during the elimination of stop words, terms that do not adequately represent the features of the text were eliminated. Ultimately, considering terms with synonymous meanings as indistinguishable enhanced the reliability of the analytic results.

In step 2, this study implemented the Latent Dirichlet Allocation (LDA) method in Python for topic modeling which is a probabilistic technique that identifies potential topics from a set of unstructured documents [40]. Topic modeling helps to select important keywords from the data and perform clustering. Using the analysis allows us to identify the main topics covered in the texts and compare the topics associated with carbon neutrality in media narratives from China and Korea. The number of topics was established by considering both the topics’ interpretability for the topic modeling study and their perplexity and coherence scores.

In Step 3, a matrix of word \times word was extracted by considering the co-occurrence frequency of the top 50 keywords. The GESEEKER program was used for Chinese news coverage. After that, the data was analyzed using Ucinet for CONCOR analysis. The CONCOR analysis was performed to assess the similarity among each keyword, and a correlation analysis was employed to classify the keywords [41].

4. Result

4.1 Topics Modeling

4.1.1 Topic of Korean Media Coverages

The results of the topic modeling of Korean and Chinese media coverage are shown in Table 1.

During the first period In the Korean media in period 1,

(Table 1) Topics of Korean & Chinese media coverages by period

	Topic of Korean Media Coverages				Topic Of China Media Coverages			
	NO.	Topic	%	Keywords	NO.	Topic	%	Keywords
1st period	1	Policy	24.2	Forest, Candidate, Carbon Tax, Trees, De-Nuclearization, Forest Service, Forest Fires, Scenario, Han Jung-Ae, Adaptation	1	Public Meeting	25.6	Development, Economy, Work, Construction, Meeting, Innovation, Science Technology, Xi Jinping, State, Construction
	2	Energy Industry	22.1	Jeonnam, Fare, Sea, Ship, Ulsan, Gwangju City, Gw, Korea Electric, Branch, The Ocean	2	Industrial Development	25.4	Development, Green, Construction, Promote, Industry, Accelerate, Ecology, System, City, Improve
	3	Public Meeting	19.5	School, Vice Minister, Seoul City, Science, Standard, Deputy Prime Minister, New Year's Address, Ministry of Agriculture and Food, Small and Medium Size, Busan	3	Community With a Shared Future for Mankind	15.2	China, World, Development, Mankind, International, Xi Jinping, Economy, Global, Cooperation, Corona
	4	Corporate Strategy	17.7	Hyundai Motor Group, Hyundai Motor Company, Green Hydrogen, Bond, Issuance, Posco Group, Lg Chemistry, Customer, Director, SK	4	Energy Industry	14.9	Company, Energy, Market, China, Sunlight Development, New Energy, Technology, Enterprise, Project, Industry
	5	Presidential Election	16.6	Korean Peninsula, Reform, Budget Bill, Inoculation, Candidate, Prime Minister, Trump, Opposition Parties, Income, The Prosecution	5	International Community	12.2	Development, China, Global, Economy, World, Corona, State, International, Cooperation, United Nations
					6	Addressing Climate Change	6.7	China, Global, Climate Change, Development, Response, Emission, Climate, Objectives, United States, Biology
2nd Period	1	Economy Situation	17.9	Increase, Charge, Classification, Price, Cop 26, NuclearRatio, Measures, Supply and Demand, Korea Electric	1	Industrial Development	28.9	Development, Construction, Promote, Work, Ecology, Accelerate, Economy, Innovation, High Quality, Green
	2	Presidential Election	17	Candidate, Australia, Presidential Election, Two Countries, Vaccine, Prime Minister, Cheong Wa Dae, NuclearPeace, Politics	2	Energy Industry	23.9	Development, Energy, Green, Enterprise, Project, Industry, Technology, Low Carbon, China, New Energy
	3	Practical Activities	15.7	Agriculture, Village, Prime Minister, Busan, Village, Schools, Rubbish, Sports, Welfare, Application	3	Chinese Dream	14.3	Development, China, Xi Jinping, General Secretary, History, Lead, Construction, Politics, Times, Economy
	4	Financial Markets	13.8	Section, Data, GeneralAi, Minister, Team Leader, Funds, Venture, Start-Up, Small and Medium-Sized Enterprises	4	Corporate Strategy	11.4	Company, Limited, Company, Project, Stock, Investment, Shareholder, Funds, Board of Directors, Transaction, Announcement
	5	Regional Development	13.6	Sightseeing, Mountain Forest, Jeonnam, Ulsan, Gwangju, Branch, Trees, Bulid, Daegu, Traffic	5	International Community	11.1	China, Development, Global, Economy, World, International, Cooperation, Xi Jinping, Mankind, State
	6	Energy Industry	13.5	Ship, Ammonia, Oceans, Capturing, Green Hydrogen, Biology, Commercial, Waste Plastics, Transport, Oceans	6	Financial Market	10.5	Finance, Economy, Market, Enterprise, Green, Investment, Policies, Growth, Fund, Development
	7	Corporate Strategy	8.5	Posco, Hyundai, Charging, Charging Station, Hydrogen, Kia, Hhyundai Group, Driving, P4g, Session				
3rd Period	1	Presidential Election	23	Transition Committee, Candidate, The State of State, Eu, Security, Russia, Tenure, Greetings, Member of Parliament, Cheong Wa Dae	1	Industrial Development	46	Development, Construction, Promote, Green, Enterprise, Work, Innovation, Industry, Economy, Accelerate
	2	Practical Activities	20.8	School, Village, Trees, Rubbish, Plastic, Experience, Student, Teenager, Diet, Countryside	2	Corporate Strategy	29.5	Company, Limited Company, Life, Funds, Consideration, Project, Board of Directors, Shareholder, Report, Medical Records
	3	Corporate Strategy	19.3	Posco, SK, Raw Material, Ammonia, LNG, S M R, Ship, Re100, Steel, Capture	3	Chinese Dream	13.9	China, Development, Xi Jinping, World, General Secretary, Times, Economy, State, History, Global
	4	Regional Development	18.5	Forest, Ulsan, Chungcheongnam-Do, Gwangju, Industrial Complex, Railroad, Cluster, Branch, Wide Area, Preliminary	4	Winter Olympic Games	10.6	Bei Jing, China, Xi Jinping, Winter Olympics, General Secretary . Green, Ecology, Ice and Snow, State, Development
	5	Economy Situation	18.3	Impression, Coal, Fare, Housing, Funds, Small andMedium Size, Korea Electric, Subsidy, Venture, Report				

Topic1 covers the government's carbon neutrality policy with media coverages related to "forest", "carbon tax", "trees", "de-nuclearization", "forest service", and "scenario", indicating that it is a topic on the "Policy". Topic 2 pertains to the application of electrical power in marine industries, including terms related to "maritime", "ship", "offshore", "GW", "KEPCO", "branch", and others. The name given to this is "Energy Industry". Topic3 includes government-related terms such as "vice minister", "deputy prime minister", "New Year's address", and "Ministry of Agriculture and Food", and covers content related to "Public Meeting". Topic4 pertains to "Corporate Strategy," and includes corporation names and terms such as "green hydrogen", "bond", and "issuance", and covers bond issuance by companies related to green hydrogen energy. Topic5 is related to the "US Presidential Election" and includes terms such as "Korean Peninsula", "reform", "budget bill", "inoculation", "candidate", and "Trump." These words in topic5 indicates that the pursuit of peace on the Korean Peninsula is a major topic during the U.S. presidential election.

In period 2, Topic 1, terms such as "increase", "charge", "price", "nuclear power", "Supply and demand", and "KEPCO" are mentioned, indicating that the topic focuses on the escalation of prices resulting from the discontinuation of nuclear power plants. Therefore, it is named "Economic Situation." In Topic 2, terms related to "Presidential Election", "candidate", "presidential election", and "Blue House," indicating that this is a topic related to presidential election. Topic 3 is "Practical Activities" for carbon neutrality, with words such as "village", "school", "rubbish", "sports", "welfare" indicating that people are engaging in organized activities to reduce carbon emissions in their daily lives. The terms related to "agriculture", "awards", and "rural" refer to awards in agricultural competitions related to carbon neutrality. Topic 4 is "Financial Market", which includes terms related to corporate officials such as "Section Chief", "Minister", "Department Head", "Team Leader", as well as "data", "AI", "funding", "venture", "start-up", and "small and medium-sized enterprises", which refer to investments in important areas related to the future development of enterprises. In Topic 5, various industries such as "Sightseeing", "forests", and "trees" were mentioned, and regional names such as "Jeonnam", "Ulsan", "Gwangju",

and "Daegu" were mentioned, indicating that the theme is related to "Regional Development". Topic 6 is related to green energy through terms such as "ammonia", "green hydrogen", and "commercialization", while terms such as "ship", "nautical", "transportation", and "marine" indicate that the topic is related to the "Energy Industry". Topic 7 is "Corporate Strategy", indicating that the company is paying attention to the development of new energy vehicles.

In period 3, Topic 1 is about "presidential elections", which mentions terms such as "transitional committee", "candidate", "tenure", "member of parliament", and "Cheong Wa Dae". In Topic 2, terms such as "school", "village", "rubbish", "plastic", "experience", and "student" appear. The topic is "Practical Activities" to achieve carbon neutrality, with a focus on villages and schools. Topic 3 is related to "corporate strategy", with terms such as "POSCO", "SK", "raw materials", "ammonia", "LNG", "SMR", "ship", "RE100", "steel", and "capture". The topic is the energy strategy for enterprises to achieve carbon neutrality. In Topic 4, terms such as "forest", "Ulsan", "Chungnam", "Gwangju", "industrial complex", "railroad", and "cluster" appear, indicating that this topic is about "Regional Development". Topic 5 mentions terms such as "increase", "coal", "rate", "funding", "small and medium-sized enterprises", "KEPCO", and "subsidy". This topic is about the negative impact of carbon neutrality leading to an increase in energy prices on people's livelihoods and small and medium-sized enterprises. Therefore, Topic 5 is named "Economy Situation".

The variations in Korean media coverage topics across these three periods demonstrate the evolution and diversification of media focus. In the first period, media coverage primarily concentrated on the government's carbon neutrality policies, encompassing key measures such as carbon taxes and nuclear disarmament in the field of environmental policies. Additionally, attention was given to topics like energy industry, corporate strategies, and the US presidential elections. Moving into the second period, media coverage topics became more segmented and diversified, with a new focus on the economic situation, highlighting the economic issues related to rising prices and the shutdown of nuclear power plants associated with carbon neutrality. The presidential elections remained a focal point, but there was also a significant increase in attention towards corporate

strategies, financial markets, and regional development. Carbon neutrality practices became a specialized theme, emphasizing organized activities in reducing carbon emissions. Lastly, in the third period, media coverage continued to diversify, with the presidential elections becoming the most important topic and carbon neutrality becoming an inevitable subject for presidential candidates. There was a growing focus on corporate strategies, carbon neutrality practices, regional development, and economic situations. Overall, this evolution reflects the diversified and deepened societal concern for carbon neutrality and environmental sustainability.

4.1.2 Topic of China Media Coverages

In the Chinese media in period 1, Topic 1 mainly focuses on China's "economic meeting", using words such as "economy", "work", "meeting", etc. Words such as "construction", "innovation", "Xi Jinping", and "construction" are all related to China's carbon neutrality goals, hence the name "Public Meeting". In Topic 2, words such as "construction", "industry", "acceleration", and "system" appear, while words such as "green" and "ecology" reflect content related to carbon neutrality. Therefore, we named it "Industrial Development". Topic 3 matches Topic 5 with 8 words, indicating that it deals with international relations through terms such as "world", "international", "global", and "cooperation". Specifically, "humanity" and "Xi Jinping" appear in Topic 3, followed by "community" in 13th place and "destiny" in 15th place, implying coverage of China's values of a "Community with a Shared Future for Mankind". Topic 5 is named "International Community". Topic 4 consists of words such as "company", "energy", "market", "solar", "new energy", "technology", "enterprise", "project", "industry", etc., involving "energy industry". Topic 6 is called "Addressing Climate Change" because it includes words such as "climate change", "response", "emissions", "climate", and "biology".

In period 2, Topic 1 is related to development as it includes terms such as "development", "construction", "promote", and "work". Words such as "ecology", "high quality", and "green" indicate that it is closely related to carbon neutrality and industrial development. Therefore, we

will name topic one as "Industrial Development". Topic 2 consists of words such as "development", "energy", "green", "enterprise", "project", "industry", "technology", "low-carbon", "new energy", etc., and is related to the use of green energy and the development of low-carbon technologies by enterprises. Therefore, Topic 2 is named "Energy Industry". Therefore, Topic 3 was named "Chinese Dream". Topic 3 is named as the "Chinese Dream," encompassing terms such as "China," "Xi Jinping," "General Secretary," "history," "leader," "politics," and "era." Topic 4 is "Company Strategy", which includes terms such as "company", "limited company", "project", "stock", "investment", "shareholders", "fund", "board", "transaction", and "announcement". Topic 5 includes words such as "global", "world", "international", "cooperation", and is related to the "international community". Topic 6 is carbon neutral investment in the financial market, with terms such as "finance", "economy", "market", "company", "green", "investment", "fund", etc.

In period 3, Topic 1 consists of words such as "development", "construction", "enterprise", "work", "industry", "economy", etc. It is about "Industrial Development", as industrial development has become a key theme in Chinese media coverage of carbon neutrality. Topic 2 involves "Corporate Strategy", and its coverage seems to have increased, especially in the third period. This may be related to an increase in the number of companies affected by net zero or an increase in the number of business announcements in 2021. Topic 4 is related to the "Beijing Winter Olympics", as the goal of hosting the Winter Olympics is carbon neutrality.

The evolution of media coverage topics during these three periods reveals the dynamic changes in the focus of Chinese media on the carbon neutrality issue. In the first period, the themes encompassed Chinese conferences, carbon neutrality goals, and international relations. Specifically, terms directly related to China's carbon neutrality goal appeared in the "Public Meeting" topic, highlighting a close attention to China's economy and carbon reduction plans. International cooperation and China's global responsibility were also reflected in the theme of the "international community." As time progressed, the focus of media coverage further subdivided in the second period, covering topics such as industrial development, energy industry, the Chinese Dream,

the first stage, themes such as “Policy” and “Public Meeting” were significantly popular in media coverage, indicating that the governments of South Korea and China have officially committed to achieving carbon neutrality and are actively considering implementing strategies. In addition, both South Korean and Chinese media have discussed the topic of “International Community” in the context of carbon neutrality. However, South Korean media mainly focuses on the “U.S. Presidential Election”, while Chinese media places greater emphasis on international cooperation in “Addressing Climate Change” and the concept of a “Community with a Shared Future for Mankind” within the framework of carbon neutrality.

In the second period, as carbon neutrality policies shift from theoretical concepts to practical policy implementation, the coverage themes undergo a shift. In South Korea, the government’s carbon neutrality policy focuses on the impact of carbon neutrality on the “Economy Situation” and “Practical Activities” of various departments such as the government, enterprises, and communities, becoming a major topic. At the same time, Chinese companies have also begun to develop growth strategies that consider carbon neutrality policies, which have always been linked to national led economic development goals.

In the third period, both South Korea and China attach great importance to “Corporate Strategy”, leading to an increase in the proportion of reports mentioning this topic. However, South Korean media mainly emphasizes the implementation of ESG management within the private sector, while Chinese media mainly emphasizes the formulation of corporate strategies to comply with the government’s carbon neutrality policies and align with national development strategies. On the contrary, in the third period, the media coverage of both countries no longer focused on the topic of “Financial Markets”. This indicates that although carbon neutrality may have economic potential, further development is still needed to be recognized as investment value by financial markets.

4.2 CONCOR Analysis

4.2.1 CONCOR of Korean Media Coverages

The CONCOR clustering analysis results for media

reporting in South Korea and China are presented in Table 2. The CONCOR clustering analysis for the period 1 of Korean media reporting yielded the confirmation of four distinct statements: Energy Strategy (G1), Environment (G2), Industrial Development (G3), and International Cooperation (G4). In response to President Moon Jae-in’s declaration of carbon neutrality, the government has formulated a series of policies aimed at achieving carbon neutrality and protecting the environment. These policies have had a significant impact on the industrial and energy sectors, leading to substantial transformations. The conference further emphasizes the necessity of achieving carbon neutrality and underscores the importance of fostering international cooperation.

Synthesizing the media coverage formed in period 2 can be analyzed in terms of Energy Strategies (G5), Corporate Strategy (G6), Environmental (G7), and International Cooperation (G8). Compared to the results of the first period, a clustering of corporate strategies emerged in the second period. This is due to the alignment with the corresponding carbon neutral policies and the planning of future low carbon development routes.

The discourses identified through the cluster analysis of media coverage in period 3 reaffirm the prominence of certain thematic clusters in Korean media discourse on carbon neutrality. These clusters include Energy Strategies (G9), Industrial Development (G10), Environmental Considerations (G11), and International Cooperation (G12). The recurrence of these themes, similar to the findings from the first period, it can be observed that South Korean media coverage of carbon neutrality primarily revolves around these four aspects. This indicates a deepened focus on environmental sustainability and global cooperation by South Korea in the process of achieving carbon neutrality.

In the three periods of media coverage on carbon neutrality in South Korea, the discourse clusters of energy strategy, environment, and international cooperation persistently appeared throughout each period. In the first period, media coverage focused on the government’s establishment of carbon neutrality commitments and highlighted key environmental policies, emphasizing the importance and influence of the government’s involvement in carbon neutrality initiatives. In the second period, the emergence of discourse clusters related to corporate strategies

was due to the significant role that businesses play in carbon neutrality practices. Their participation and strategic planning are crucial for achieving carbon neutrality goals. Media coverage gradually expanded from government policies to the corporate level, emphasizing the responsibilities and roles that businesses have in the carbon neutrality process. In the third period, energy strategy, international cooperation, and environmental development were still considered critical elements for achieving carbon neutrality goals. The discourse on international cooperation reflects media awareness of the global nature of carbon neutrality issues and the need for cross-border collaboration.

4.2.2 CONCOR of China Media Coverages

The findings from the CONCOR analysis of Chinese media during period 1 indicate four discernible clusters: Innovation (G13), Energy Strategies (G14), Carbon Neutrality Declaration (G15), and Carbon Neutral Development Prospects (G16). Notably, this period primarily featured news coverage related to China's announcement of its commitment to achieving carbon neutrality by 2060. The media reports placed a distinct emphasis on reforms within interconnected fields, transformations in the energy sector, and the prospective developmental trajectories stemming from the endeavor to attain carbon neutrality.

Clusters identified as Green development (G17), Corporate carbon neutrality (G18), International cooperation (G19), and Corporate strategy (G20) characterize Chinese media discourse during period 2. Notably, this period witnessed heightened attention to Chinese companies' initiatives in carbon-neutral technology and strategies. Similar to developments in Korea, Chinese companies have undertaken various measures, both in technological advancements and strategic planning, aligning with the goal of achieving carbon neutrality and anticipating sustainable green development in the future. Concurrently, media coverage has underscored the significance of international cooperation in the context of carbon neutrality, highlighting the cooperative efforts essential for addressing global environmental challenges.

The findings from the CONCOR analysis of Chinese media in period 3 reveal distinct discourse clusters, namely, Industrial Development (G21), Green Development (G22),

Corporate Investment (G23), and Corporate Carbon Neutral Skill (G24). Chinese media coverage during this period primarily accentuates the transformative changes within industrial sectors in the pursuit of carbon neutrality. Additionally, the media emphasizes discussions related to corporate investment. Businesses exhibit a strong interest in the carbon neutrality sector, as they perceive it to offer significant opportunities for future growth.

In the Chinese media coverage of the three period of carbon neutrality, in the first period, the reports mainly focused on describing China's announcement of achieving carbon neutrality by 2060, emphasizing the reform in various sectors, the transformation in the energy industry, and the future development prospects associated with the process of achieving carbon neutrality. In the second period, as the issue of carbon neutrality progressed, the carbon neutrality technologies and strategic measures of Chinese enterprises received considerable attention, highlighting the multiple actions taken by Chinese enterprises in terms of technology and development strategy to achieve carbon neutrality, and emphasizing the importance of international cooperation. This shift reflects the media's focus from the carbon neutrality target itself to the enterprise-level and international cooperation. In the third period, the reports emphasized the transformation of industrial sectors related to achieving carbon neutrality, while highlighting discussions on enterprise investments. Enterprises have shown a strong interest in carbon neutrality, believing that it provides enormous opportunities for future growth. The primary factor driving the concentration of discourse relating to firms in Chinese media coverage of the carbon neutrality issue is the pivotal role that enterprises play in implementing carbon neutrality strategies, their significance in technological innovation and green development, and the media's recognition of growth opportunities in the future carbon neutrality field. This reflects the media's strong interest in the crucial role of enterprises in the process of carbon neutrality and opportunities for sustainable development.

4.2.3 Comparison of CONCOR between Korea and China

A comparison of CONCOR results between Korea and

China shows that in all periods, media coverage in both Korea and China focused on the core areas of energy strategy, environment, industrial development, and international cooperation, highlighting the prevalence and importance of these issues in the carbon neutrality debate.

During the first period, both nations implemented various governmental measures in response to the carbon neutrality proclamation, which had a significant impact on transformations within the industrial and energy domains. Both governments are employing policy mechanisms to actively support the objective of achieving carbon neutrality.

During the second period, the media in both Korea and China emphasized the significance of corporate strategies and technologies. Companies have initiated collaboration with carbon neutral policies and are strategizing future low-carbon development trajectories, showcasing their active engagement and contribution to the carbon neutral endeavor.

During the third period, the Chinese media not only prioritizes coverage of the industrial sector, but also places significant emphasis on discussions around corporate investment, particularly highlighting firms' keen interest in the carbon neutral industry.

5. Discussion and Conclusion

This paper explored the process of strategically adopting the widespread agenda of achieving carbon neutrality in South Korea and China, characterized by different political systems that are motivated by their own national interests. This study employed semantic network analysis and topic modeling methods to investigate the differences in carbon neutrality coverage between South Korea and China.

First, the media in both countries emphasized the topics such as "Policy," "Energy Industry," And "Corporate Strategy," but they assigned an array of relevance to these matters. The Korean media gave attention to addressing specific sectors of "practical activities" and the "Economy Situation" related to the goal of achieving net-zero emissions. The focus here was on topics that directly affect everyday lives for individuals. This specific feature was given priority because of the dominance of privately-owned Korean media, which emphasizes treating news as a commodity and actively

fulfilling reader expectations. Chinese media outlets promoted a strong association with political matters [33]. Chinese media mainly focused on the path and goals of national development when reporting on net-zero emissions, emphasizing keywords such as "industrial development," "international community," and "Community with a Shared Future for Mankind." Although a few media sources in China highlighted commercial values, most of Chinese media concentrates on topics at the macro-level.

Second, though the goal of achieving carbon neutrality was to reduce the risk of climate change and protect eco-system on the Earth, environmental issues were not a prominent aspect of the media discourse in China and South Korea. The media discourse in both China and South Korea primarily focused on significant factors such as such as energy strategy, environment, corporate strategy, industrial development, and international cooperation, as shown at the CONCOR analysis.

Based on the above analysis, the present study further discusses and suggests the following implications.

First, when examining global environmental issues such as carbon neutrality, it is important to carefully consider the entrenched interests and positioning of the media. Understanding the features of different media companies, their ownership structures, and their roles in disseminating information helps to better understand the reasons behind media coverage, which in turn helps to comprehend the goals and viewpoints that shape media coverage.

The goal of state-owned media, with its strong political ties, is to promote national policies and visions, while private media, driven by the commercialization of news, seeks to draw in a wider audience.

Second, when striving for carbon neutrality, it is necessary to recognize the interdependence and importance of achieving a balance between preservation of the environment and economic growth. A key aspect in achieving this goal is the dissemination of environmental awareness among the general population. Increasing the public's comprehension of environmental sustainability encourages people and organizations to embrace more eco-friendly behaviors. Throughout this process, the media has significant influence. However, the current media coverage tends to heavily emphasize economic concerns, while giving relatively little

attention to environmental challenges. Media outlets need to embrace a comprehensive and fair reporting manner to enhance public understanding of the urgency of attaining carbon neutrality.

Third, the scope of cross-border study in environmental communication remains relatively restricted, mostly due to language and cultural barriers, despite the worldwide importance of environmental issues. To a certain degree, it reduces the limitation of depending exclusively on domestic examples as a point of reference. This offers an innovative perspective on the future progress of carbon neutral policies, which has significant policy implications.

The main limitation of this study is in its narrow focus on media agendas, paying little attention to public agendas. The incorporation of observations from public agendas into future research is anticipated to provide more valuable findings.

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