



OPEN ACCESS

EDITED BY

Xiaohang Ren,
Central South University, China

REVIEWED BY

Miren Gutierrez,
University of Deusto, Spain
Haiqin Fu,
Central South University, China

*CORRESPONDENCE

Yan Wu,
✉ yan.wu@maastrichtuniversity.nl

RECEIVED 04 October 2024

ACCEPTED 18 December 2024

PUBLISHED 09 January 2025

CITATION

Wu Y, Martens P and Krafft T (2025)
Communication, inclusion, and environmental
justice - journalists' attitudes towards low-
carbon city transformation in China.
Front. Environ. Sci. 12:1506313.
doi: 10.3389/fenvs.2024.1506313

COPYRIGHT

© 2025 Wu, Martens and Krafft. This is an open-
access article distributed under the terms of the
[Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/).
The use, distribution or reproduction in other
forums is permitted, provided the original
author(s) and the copyright owner(s) are
credited and that the original publication in this
journal is cited, in accordance with accepted
academic practice. No use, distribution or
reproduction is permitted which does not
comply with these terms.

Communication, inclusion, and environmental justice - journalists' attitudes towards low-carbon city transformation in China

Yan Wu^{1*}, Pim Martens² and Thomas Krafft^{1,3}

¹Department of Health, Ethics & Society, CAPHRI Care and Public Health Research Institute, Faculty of Health, Medicine and Life Sciences, Maastricht University, Maastricht, Netherlands, ²System Earth Science, University College Venlo, Faculty of Science and Engineering, Maastricht University, Maastricht, Netherlands, ³Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China

Cities are recognized as significant contributors to carbon emissions due to their numerous productive enterprises and dense populations. Tackling climate change and achieving the transformation to low-carbon cities requires public participation. News media serve as the primary channel for the public to gain relevant information, and journalists' attitudes significantly influence the content of related news reports. This study focuses on the attitudes of Chinese journalists towards the transition to low-carbon cities, using semi-structured interviews in qualitative research to conduct 31 interviews with participants from Chinese mainstream medias. This research discussed the journalists' attitudes towards the low-carbon city transition, based on our samples studies, we find that (1) low-carbon city development brings some new opportunities for economic development and improving the overall urban living environment, despite challenges like lack of professional knowledge and information gaps. (2) Newsworthiness, audience preferences, journalists' climate scientific knowledge, and management mechanisms, are key factors influencing journalists' choice to cover low-carbon topics. Despite an increase in related reports, many media do not prioritize climate change or low-carbon transitions as core topics, and environmental news have a life cycle. (3) We suggests that media enhance collaboration with stakeholders, increase audience interaction to learn diverse voices, using storytelling and integrating technological innovations to improve low-carbon communication. This study highlights the complex interactions between media, public participation, and environmental policies, offering a holistic view of the challenges and opportunities in promoting more inclusive and equitable low-carbon city transition.

KEYWORDS

Journalists, mass media, low-carbon city transformation, climate change, communication, qualitative research

1 Introduction

In 2023, the global annual average temperature was $1.45^{\circ}\text{C} \pm 0.12^{\circ}\text{C}$ higher than pre-industrial levels (1850–1900) (WMO, 2024). The climate crisis will exacerbate environmental degradation, leading to famine, poverty, health issues, and economic instability (Nguyen et al., 2023; Ren et al., 2024). It will also affect social equity and sustainable development (United Nations, 2024; Urry, 2015), requiring public participation and increased awareness through the widespread availability of information (United Nations, 1992). Mass media serves as the primary channel through which the public learn about climate change (Boykoff and Roberts, 2007), playing a crucial role in raising awareness and influencing government policies and business actions (Naveena, 2015; Happer and Philo, 2013). The media's disclosure of climate risk and exposure of environmental issues not only enhance external monitoring and transparency in climate governance but also influence the industry's economic development (Wang et al., 2024; Zhao et al., 2024; Sun et al., 2024; He et al., 2024). Journalists' understanding and prioritization of climate change issues affect how it is framed and covered, the accuracy and interpretation of related content, and the way to communicate with the public (Painter et al., 2024; Carvalho and Pereira, 2008). Therefore, it is essential to gain insight into journalists' attitudes toward climate change and the low-carbon transition to empower stakeholders in taking collective climate action.

Public perception of climate change is conveyed mainly through media (Wilson, 2000; Moser, 2010), and people's feedback and opinions influence policies (Crawley et al., 2022). Conversely, political, economic, and other interests seek to influence media coverage of climate change, shaping public understanding (Antilla, 2005; Brown et al., 1987; Hindman, 2009). As early as 1895, the New York Times published discussions on climate change, questioning whether a new ice age was imminent (New York Times, 1895). From the 1930s to the 1970s, more media began to discuss whether the climate was cooling or warming (Steven, 2024), although the coverage of climate science was limited. Since the mid-1980s, media attention has grown due to international and domestic climate policies, scientific research, and reports from the IPCC (Intergovernmental Panel on Climate Change) confirming global warming as linked to fossil fuels and human activities since 1988, rather than solely natural variations (Boykoff & Rajan, 2007). Analysis of climate change communication proliferated in the 1990s (Nerlich et al., 2010). Previous studies primarily focused on fluctuations in media attention towards climate change (Gillings and Dayrell, 2024; Major and Atwood, 2004), reasons behind these fluctuations (Brulle et al., 2012), the media's role in climate change communication (Wonneberger et al., 2020; Boykoff and Lueddecke, 2016), journalistic norms (Van Eck et al., 2019; Boykoff and Boykoff, 2007; Rhaman, 2018), and sources of reporters' climate change information (Amu and Agwu, 2012; Strauss et al., 2021; Wilson, 2000). However, most studies have focused on climate media coverage in developed countries like the U.S., U.K., and Europe, with limited research on developing countries (Huo et al., 2023; Comfort and Park, 2018). This article will provide a general overview of Chinese media coverage on climate change and the low-carbon transition as the research background, and explore journalists attitudes of climate change and low-carbon transition in China.

Cities are recognized as significant contributors to carbon emissions due to numerous productive enterprises and dense populations, which exert a significant impact on climate change (Mi et al., 2019). Since the ratification of the Kyoto Protocol in 2002, some cities in Europe established local carbon dioxide reduction targets and related policies to mitigate climate change and promote sustainable development (Williams, 2016). The media is considered a crucial factor in shaping public perceptions, attitudes, and support for climate policies (Carvalho, 2010). Some countries, such as the Netherlands and the United Kingdom, have used mass media to advocate for waste reduction and energy conservation to mitigate greenhouse gas emissions (Sampei and Aoyagi-Utsui, 2009). However, there is limited research analyzing the relationship between media and low-carbon city transition, although Cherry et al. (2015) discussed media discourses on low-carbon housing in the UK; Eker et al. (2021) used social media data to analyze people's adoption of low-carbon diets; and Hielscher and Sovacool, (2018) demonstrated media coverage of the low-carbon energy transition in the United Kingdom. Additionally, there is also limited literature focusing on the factors influencing media coverage of low-carbon transitions. This research will fill this gap to explore the factors that influence journalists' coverage of climate change and the low-carbon transition. We will also discuss how media can enhance coverage to support the transition to low-carbon cities.

As the world's largest carbon emitter (Li et al., 2024), China has committed to reaching peak carbon emissions before 2030 and aims for carbon neutrality by 2060 (Liu et al., 2021). More than 75% of CO₂ emissions in China originate from urban areas (Li and Zhao, 2024). The country has implemented various measures to reduce carbon emissions in cities in recent years, such as launching the low-carbon city pilot policy, transitioning to renewable energy sources, and developing high-tech industries. Previous research on low-carbon city transformation in China have focused on evaluating the effects of low-carbon policies (Zeng et al., 2023; Zhao et al., 2019; Cheng et al., 2019; Wang et al., 2021), calculating household carbon emissions (Peng et al., 2023; Liu et al., 2021), and examining the factors influencing low-carbon consumption behavior (Cheng et al., 2023; Liu et al., 2019; Jiang et al., 2019; Wu et al., 2023). Although Xue et al. (2022) explored the relationship between government, enterprise, and media in low-carbon production, but fewer scholars discussed media coverage of China's low-carbon urban transition or analyzed the attitudes of Chinese journalists towards climate change and the low-carbon transition.

In the context of addressing global climate change, low-carbon urban transformation has become a focal point for governments and societies worldwide, requiring efforts from various stakeholders. This research will focus on journalists' attitudes toward low-carbon city transformation for several reasons. First, the media is regarded as a crucial link between public daily life and climate change (Appelgren and Jönsson, 2021). Journalists' low-carbon attitudes directly influence what content is reported and how it is conveyed to the public, shaping the narrative and future coverage on low-carbon transformation (Shoemaker and Reese, 2013; Elia, 2021). Second, the attitudes and knowledge of mainstream journalists are essential for the accurate dissemination of low-carbon science, which helps prevent the spread of misinformation (Imuetinyan et al., 2024). Third, the media holds responsibility for supervision, advocacy, and communication in sustainable society transition (Tufté, 2017).

Journalists play a vital role in monitoring high-carbon emission activities, advocating for low-carbon actions, and facilitating dialogue among stakeholders, which can influence policy making and consider the interests of marginalized groups. As Chinese cities contribute a huge amount of carbon emissions, studying Chinese journalists' low-carbon attitudes can provide useful insights into the challenges and progress of low-carbon city transition in China, offering guidance for future policy improvement.

This study will be guided by social constructionism (Holzner, 1972) and agenda-setting theory (McCombs and Shaw, 1972), both of which emphasize the media's influence in framing public perceptions and policy agendas (Nollet, 2020). Social constructionism discusses the relationship between cognitive activity and social development (Holzner, 1972), exploring how society and culture influence individuals' perceptions of reality (Burr and Dick, 2017). In the context of mass media, it suggests that communication plays a significant role in shaping social reality through narratives (Galbin, 2014), influencing social norms, values, and beliefs. For this research, this theory provides a framework to understand how media coverage of low-carbon issues—shaped by journalists' personal attitudes, professional norms, and external influences—can affect public perceptions and the general societal understanding of the need for climate action. Agenda-setting theory, on the other hand, emphasizes the power of the media in influencing the public agenda. Through consistent coverage of specific topics, media outlets increase the salience of certain issues in the minds of the public and policymakers (Protest and McCombs, 2016). This persuasive influence not only raises public awareness but also impacts subsequent behaviors and choices (McCombs, 2005). This theory will be useful for understanding the media's role in promoting low-carbon transition and how journalists' attitudes affect the prioritization of low-carbon issues on the public agenda. In this research, combining social constructionism and agenda-setting theory offers a comprehensive framework. Social constructionism allows exploration of the processes by which journalists frame low-carbon issues within their social contexts, while agenda-setting theory helps us explain how this framing influences public discourse and policy-making.

There are three research questions in this study:

1. What are the Chinese journalists' attitudes towards low-carbon city transformation?
2. What are the factors affecting journalists report about low-carbon transition in China?
3. How can the Chinese media improve public low-carbon awareness and encourage people to join low-carbon lifestyle?

By exploring the above questions, this study will make three contributions for the literature on low-carbon city transformation. Firstly, we adopt qualitative interview approach to deeply explore the attention of Chinese media to climate change through discussions with journalists, enriching the literature related to climate communication research in developing countries. This approach provides a nuanced understanding of how climate change is covered in Chinese media and the factors influencing such coverage. Secondly, we focus on journalists' attitudes towards low-carbon transition, filling a gap in existing research. Understanding their attitudes is important for ensuring that the

information disseminated is accurate and effective in motivating public engagement and behavior change. Thirdly, this research from an interdisciplinary perspective, combining knowledge from environmental science, communication studies, sociology and ethics, discusses media's contribution in low-carbon urban transition, which provides new insights for related research. This study highlights the complex interactions between media, public participation, and environmental policies, offering a holistic view of the challenges and opportunities in promoting low-carbon cities.

2 Background

The Chinese media system fundamentally differs from Western media systems, primarily due to the legal prohibition of private ownership (Zhang and Su, 2020). Therefore, most mainstream media in China, whether party-affiliated or market-oriented, are state-run. As environmental and climate change policies in China are implemented from top-down, media coverage of environmental issue, including climate change and low-carbon transitions, often aligns closely with government policies (Geall and Ely, 2018). At the same time, media coverage of these issues can influence policy improvements and environmental governance. Based on the authors' knowledge and a review of previous news and academic literature, this section provides a historical overview of Chinese media coverage on environmental and climate change issues. This background will be the foundation for further exploration of journalists' attitudes toward low-carbon city transitions.

In the 1980s, China implemented its reform and opening-up policies, economic development and population growth were accompanied by environmental pollution. The article 'Dust Storms Hit Beijing' published by Xinhua News Agency in 1979, is one of the earlier discussions of environmental issues in Chinese media (Yang and Wang, 2018), bringing ecological and environmental issues to the public's attention (Ha and Huang, 2012). In 1981, China Central Television (CCTV) launched "Animal World," China's first television program focused on environmental protection. In 1984, China Environment News was founded, is the first professional media outlet in China focusing on environmental issues. The 1987 Daxing'anling wildfire, one of the largest on record in China (Zong et al., 2022), China Youth Daily published a series related reports titled "the Red Warning", "the Black Sigh", and "the Green Sorrow". These reports exposed bureaucratic issues, explored the relationship between human and nature, and encouraged stakeholders to rethink related social problems (Lei, 2017), marking the beginning of environmental investigative reporting in China (Liu and Zheng, 2013). In 1989, China Meteorological News, in conjunction with Reuters, published 'Global Warming Could Lead to Ecological Crisis', was one of the earlier Chinese media focusing climate change.

After the 1992 Rio Earth Summit, China ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1993, and integrated the Agenda 21 into its national policies, started to explore sustainable development. Chinese media started to pay more attention to environmental issues, although still limited (Yang and Calhoun, 2007). In 1995, China Environment News launched the column 'Our Choice, Sustainable Development'. By 1998, with

increasing discussions on the global El Niño phenomenon, China Meteorological News reported that climate warming in China was essentially in sync with global climate warming (Huang, 1998). During this period, most Chinese media primarily focused on the impact of natural disasters on people's lives, such as flood coverage. Between 2000 and 2006, although climate change began to appear in the news—with outlets like China Youth Daily reporting on the El Niño phenomenon and discussing the impact of climate change on daily life and business production (Su, 2002; Wang and Zhang, 2002; Zhang, 2002)—it was still not widely recognized as a public concern.

In 2007, following the release of the IPCC report, some cities in China began exploring pathways for low-carbon transitions. Media reports on environmental, climate change, and low-carbon topics have been increasing. In 2009, Southern Weekend launched the Green Edition, focusing on environment, health, low-carbon energy, and lifestyle, becoming the first Chinese media outlet to engage in in-depth green news reporting. Between 2011 and 2015, as smog pollution became more frequent, Chinese mainstream media focused on air pollution and smog, covering pollution levels, causes, impacts, health risks, and mitigation measures. After the Paris Agreement in 2015, China introduced more specific policies of energy saving and emission reduction, including the formal implementation of the Environmental Protection Law that same year, the completion of the Air Pollution Prevention Action Plan in 2017, and the establishment of the Ministry of Ecology and Environment in 2018 to oversee climate change and emissions reduction. However, media attention to low-carbon reporting remained relatively low until the introduction of the dual-carbon goals in 2020.

After setting the dual-carbon goals in 2020 (peaking carbon emissions by 2030 and achieving carbon neutrality by 2060), there was a significant increase in climate change and low-carbon reporting. These reports covered not only popular science and political issues but also climate risk, low-carbon development from an economic perspective, green transition, ecological civilization, and achieving carbon neutrality. For instance, in 2020, Economic Information Daily (affiliated with Xinhua News Agency) published an investigation titled 'Qinghai's 'Invisible Rich Man' Made Billions from Illegal Coal Mining in Qilian Mountains', revealing massive environmental destruction caused by illegal coal mining by a private enterprise (Zhou and Wang, 2020). Fifteen high-level officials, including the vice-governor, were sanctioned for violating laws and regulations in connection with illegal mining (Yang and Chen, 2023). The impact of this report shows China's high attention to environmental governance and carbon emission reduction. In 2023, The Paper launched China's first climate change column "Tipping Point Monthly", focusing on the latest extreme weather events worldwide, climate science research findings, international climate governance negotiations, and stories of individuals affected by climate change.

Based on the above background, this study employs a semi-structure interview method in qualitative research to discuss Chinese journalists' attitudes towards low-carbon city transitions. We interviewed 31 journalists from influential news media institutions in China. During in-depth discussions with the respondents, we focused on their attitudes towards low-carbon transitions, the factors influencing media coverage of low-carbon transition-related news, and how media can improve public's low-carbon awareness.

3 Methodology

3.1 Semi-structured interviews

This study adopts semi-structured interviews in qualitative research to discuss journalists' low-carbon attitudes. As a method widely used in data collection of qualitative research, semi-structured interviews are well-suited for understanding "why," "how," and "what" questions regarding behavior, attitudes, and barriers (Neergaard et al., 2009). We chose semi-structured interviews for their flexibility, interaction, and ability to facilitate in-depth discussions between the interviewer and interviewee (DiCicco-Bloom and Crabtree, 2006). By allowing for open-ended questions, semi-structured interviews align with the principles of social constructionism, encouraging participants to reflect on how their social environments and personal experiences shape their perspectives. Therefore, this method is useful for gaining a comprehensive understanding of journalists' concerns about the low-carbon transition. Additionally, it provides insights into journalists' experiences and the thought processes behind their news reporting, which are critical for understanding media agenda-setting and media's roles in low-carbon transition.

3.2 Sampling strategy and participate recruiting

The context of this research is the low-carbon city transition in China. The media is one of the important stakeholders in this transformation, but there is limited research related to their exact role. We focus on journalists' attitudes about low-carbon transition mainly because journalists' attitudes towards climate change and low-carbon transition could affect the topic selection and news production (Brüggemann and Engesser, 2017). Effective media communication can help the public understand climate issues, encourage low-carbon behavior (Moser, 2010), and provide valuable insights for government policy improvement (Lyytimäki, 2011).

Based on the background of climate change-related news reporting in China, we used purposive sampling and snowballing methods to recruit participants. Purposive sampling, commonly used in qualitative research, helps identify participants who can provide valuable insights relevant to the research aims (Patton, 2014). This approach ensures a deep understanding of the study questions and allows for sample diversity (Schreier, 2018; Robinson, 2014). Considering that organizational structure affects journalists' outlets and their ways of work (Shoemaker and Reese, 2013), we aimed to recruit journalists with diverse backgrounds from television, newspapers, online editions, and magazines of mainstream state media and well-known markets' commercial media in China. We targeted journalists from national, provincial, prefecture, and county levels who have reported on climate change, low-carbon transitions, and environmental issues, and who are likely to provide deeper insights into our research questions based on their experiences (these are also our sample selection criteria). Based on our review of media coverage on low-carbon development, we compiled a preliminary list of potential participants from our personal network.

Additionally, we also use a snowball sampling approach to access and recruit participants from hard-to-reach or 'hidden' populations (Faugier and Sargeant, 1997). The characteristics of this method are networking and referral (Parker et al., 2019). Therefore, following the initial round of interviews on the list, we asked participants to recommend other participants who would be suitable for this study. Furthermore, we used social platforms such as WeChat, LinkedIn, and Weibo to search and reach out to potential participants identified through their related news articles.

According to previous research regarding sample size in qualitative studies, the concept of data saturation is frequently discussed by researchers (Guest et al., 2013). According to Glaser and Strauss, data saturation occurs when no new relevant information emerges during subsequent interviews (Glaser and Strauss, 2017; Francis et al., 2010). Sample size guidance suggested that a sample size of 20–30 interviews is generally sufficient to achieve saturation in qualitative research (Crouch and McKenzie, 2006; Mason, 2010; Hennink and Kaiser, 2022), ensuring comprehensive insights without unnecessary redundancy. Unlike the larger samples typically used in quantitative research surveys, qualitative interviews rely on smaller, deeply engaged samples, emphasizing interaction and depth to view the complexities of the social world (Lim, 2024). This approach captures the participants' experiences and allows for the emergence of unexpected insights, providing rich data through the depth and duration of the discussions. We initially conducted 7 online interviews between 1 August 2022 and 16 September 2022, using video and voice calls due to COVID-19 travel restrictions. To further achieve our research objectives, an additional 24 interviews were conducted from 15 December 2023, to 15 March 2024, reaching data saturation, where no new information emerged and redundancy in responses occurred. In total, 31 interviews were conducted. We sent invitations to 45 interviewees, and 14 journalists declined due to time constraints or concerns about sensitive issues.

3.3 Data collection

Before the interviews, we sent an invitation letter detailing the study's purpose, data usage, interview questions, confidentiality measures, privacy protection, and information collection. After the participants agreed, we scheduled the interviews. At the start of each interview, we reintroduced the research background, clarified the interview process, and reaffirmed anonymity. Participants were encouraged to share personal stories, with the understanding that their responses represented individual viewpoints.

In qualitative research, semi-structured interviews, guided by predetermined open-ended questions, often serve as the primary data source, with additional questions emerging organically during the dialogue (DiCicco-Bloom and Crabtree, 2006). Our interviews began with general questions about the participants' roles and years of media experience. We then asked the specific questions listed in Appendix 1, designed according to our research questions, and asked in a flexible order. Each interview lasted between 30 min and 2 h, with the duration and questions adjusted based on the conversation flow and participants' individual styles and

experiences. With consent, interviews were recorded on cell phones, and important details were noted.

This research received ethical approval from the authors' institution. To ensure privacy and anonymity, we used a coding structure with numbers instead of names in the transcripts.

3.4 Data analysis

We employed an inductive approach (Thomas, 2003) based on qualitative interview content (Elo and Kyngäs, 2008) and grounded theory (Corbin and Strauss, 2015) for data analysis. Since the qualitative data are primarily represented as spoken or written language rather than numerical data (Polkinghorne, 2005), Atlas.ti (version 22.2.0 for Mac) assisted in analyzing the texts. The content analysis process involved four phases:

Firstly, pre-analysis. We fully transcribed the interviews from Chinese (the original language) and reviewed all documents twice to identify main codes, categories, and themes, ensuring accuracy. We then created a project in Atlas.ti and added the 31 transcribed interview documents.

Secondly, open coding. We thoroughly read the transcripts and selected relevant paragraphs, fragments, and quotes. Initial codes were generated using 'in vivo' terms from participants' actual words to maintain the original meaning (Rivas, 2012). We revisited the codes to ensure accuracy, adding new codes as needed and removing duplicates.

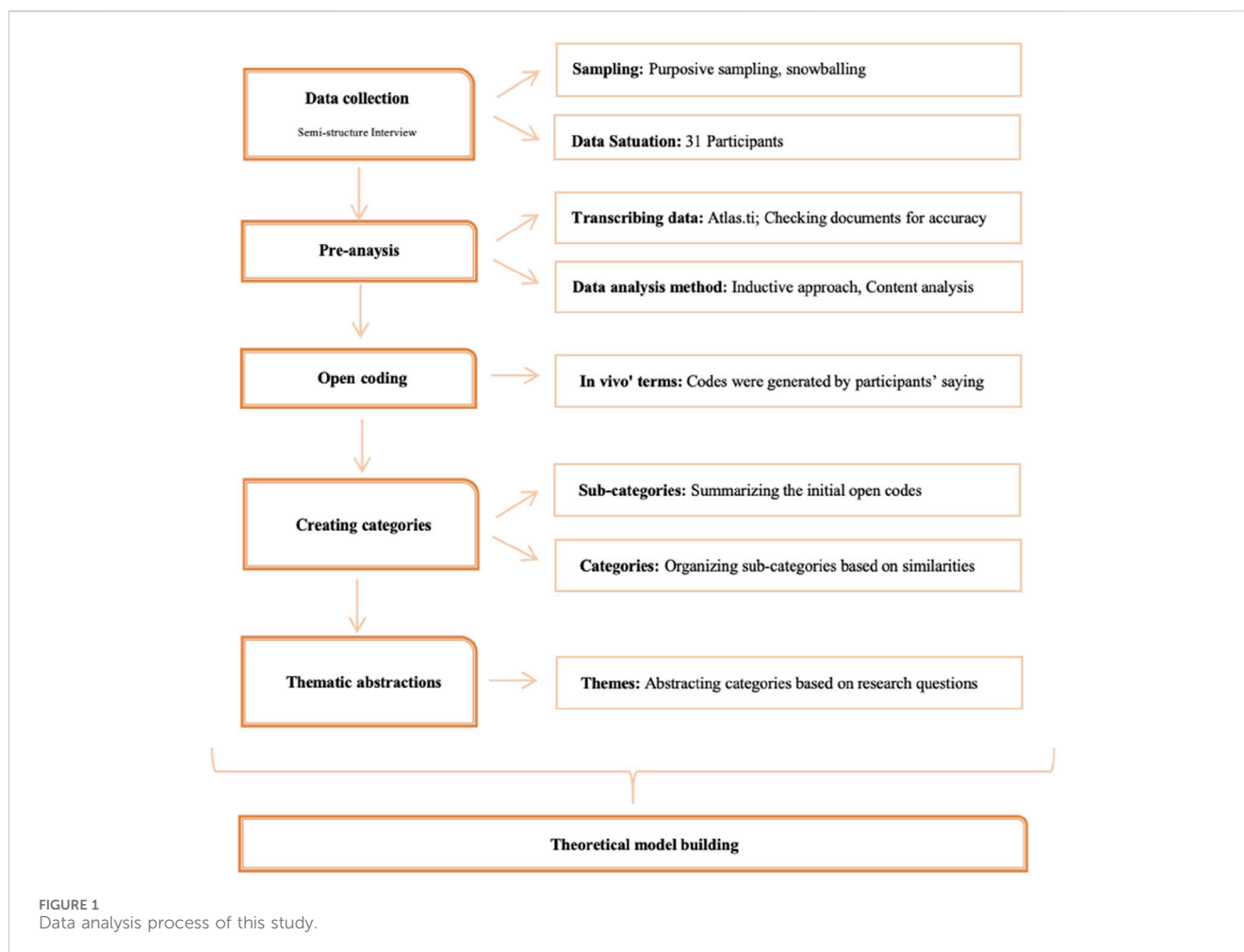
Thirdly, creating categories (axial coding). After completing the open coding process, we summarized the initial codes into sub-categories by comparing and grouping similar codes. We refined these sub-categories, merging them where appropriate or splitting them to capture data nuances. The purpose of grouping the data is to reduce the number of categories required to describe the phenomenon (Cho and Lee, 2014). We therefore grouped these sub-categories into broader categories according to their similarities and differences to deepen understanding.

Fourthly, thematic abstraction (selective coding). In this process, the categories were abstracted under three themes corresponded to our research questions. The aim is to reveal the interconnections between categories and develop a comprehensive thematic framework. After finalizing the themes, we reviewed all texts and codes, extracting key information and translating them in English. Figure 1 shows the process of data analysis for this study.

Finally, the analysis resulted in 114 codes, integrated into 11 categories and grouped into 3 themes. To ensure these accurately reflect the research phenomena, we employed respondent validation (Torrance, 2012) by inviting participant feedback. We also asked a colleague to review our data analysis results to further improve validity and enhance the credibility of the findings (Johnson et al., 2020). The data structure of categories and codes can be seen in Figure 2.

3.5 Sample description

The study sample consisted of 31 participants, including 26 journalists/reporters, 2 correspondents, and 3 project managers. Their work experience in media ranged from 2 to



24 years, over half of the participants have over 10 years working experience. 77% of the participants have a master degree. Our participants came from various media platforms, including television ($n = 5$), newspapers ($n = 17$), magazines ($n = 2$), and websites ($n = 7$). (Note: with the rise of the internet and new media, traditional Chinese media (TV, newspapers, magazines) have adopted an integrated model spanning print, online platforms, apps, and social media (Weibo, WeChat, video channels). As a result, news content from these institutions is distributed across multiple platforms, not limited to just one.). Table 1 provides the basic demographic information about the respondents.

Our 31 participants are from 23 media institutions. Regarding the levels of their institutions, 15 participants are from mainstream state media (8 institutions), 7 are from well-known market commercial media (6 institutions), and 9 are from local government-supervised media, including provincial TV stations (3 institutions), daily newspapers (4 institutions), a city-level newspaper (1 institution), and a county-level media center (1 institution). (Note: To protect privacy, the name of institutions and provinces were removed. The views expressed by the interviewees are their own and do not represent their organizations). Figure 3 shows the type of their institutions.

Regarding participants' specialized fields, there are 3 environmental reporters, 5 investigative reporters,

2 international reporters, 12 social news reporters, 3 financial reporters, 1 technology reporter, 2 correspondents focused on meteorological science communication, and 3 project managers experienced in organizing low-carbon and environmental protection communication activities. All participants are familiar with and have reported on low-carbon transitions, climate change, or environmental issues. Figure 4 shows our participants' professional fields.

4 Results

4.1 Attitude towards low-carbon transition

4.1.1 Visible and invisible

Participants observed that the general public has a superficial understanding of low-carbon concepts, mainly derived from daily news. They noted that digital technologies help spread relevant information quickly, but most low-carbon related news focus on policy announcements.

According to participants, the public is more concerned with immediate, tangible issues that directly impact their daily lives, such as high temperatures, precipitation, extreme weather, and haze. These are more familiar to the public than the broader concept

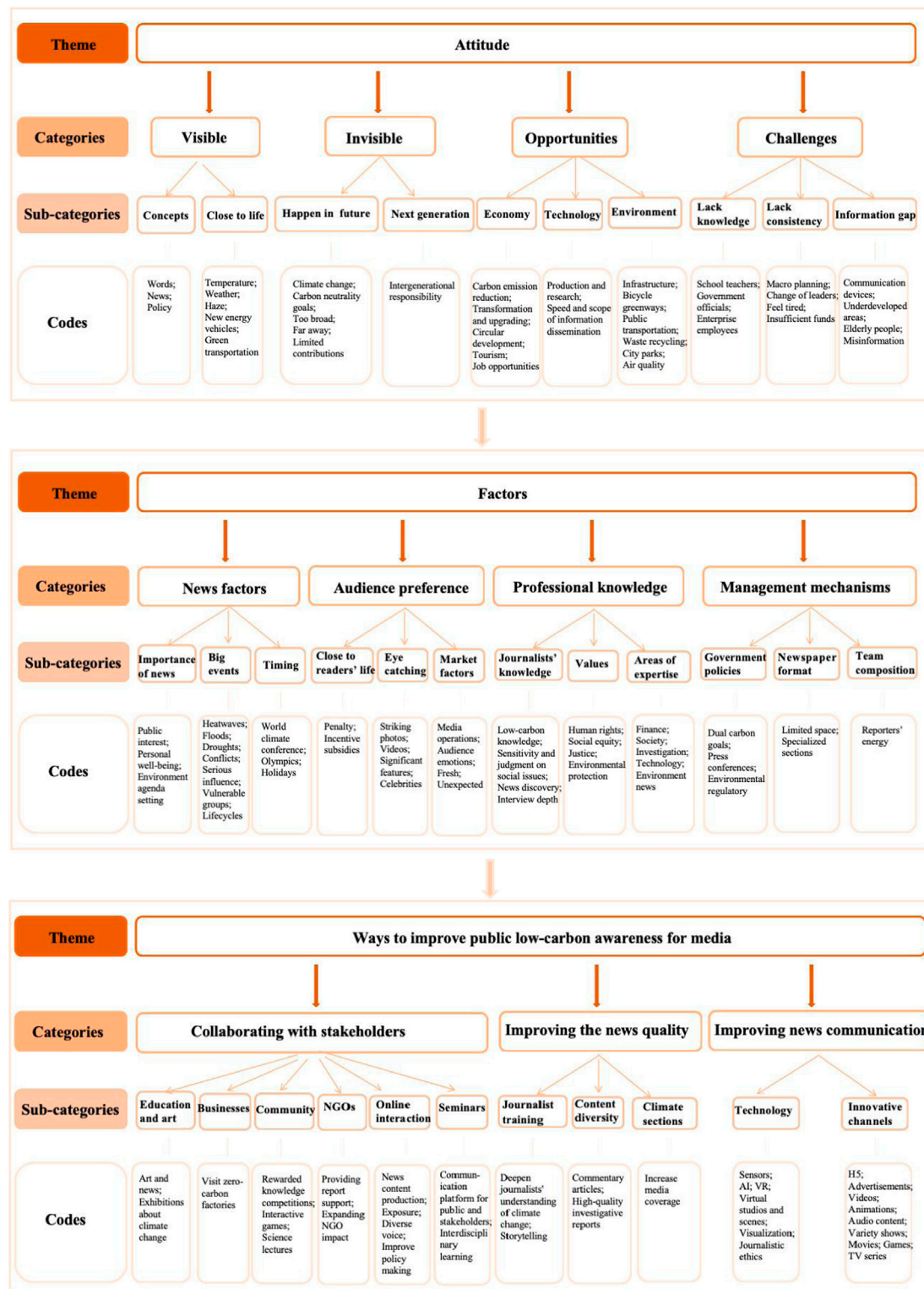


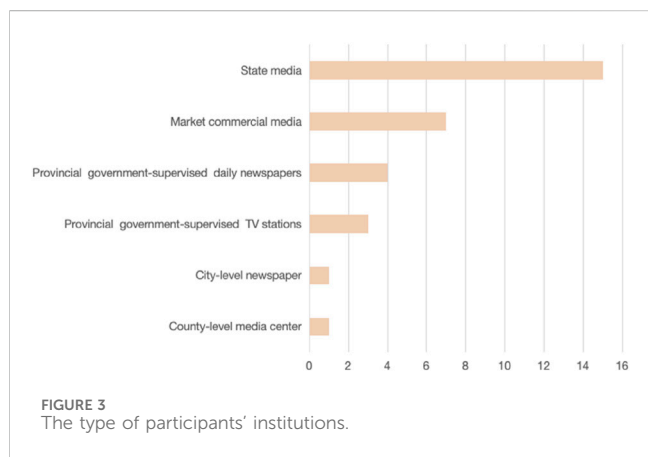
FIGURE 2 The structure of categories and codes.

of low-carbon transition. When it comes to low-carbon lifestyles, participants believe that the public is more familiar with concepts like new energy vehicles and green transportation, as these are closely tied to economic benefits, personal comfort, and health.

Some participants believe that concepts like 'climate change' and 'carbon neutrality' are too broad for most people, as the effects of climate change are not immediately visible and may occur in the future. This leads to a lack of motivation for them to

TABLE 1 The basic demographic information about the respondents.

Type	Details	Frequency	Percentage (%)
Total participants		31	100
Gender	Male	15	48.39
	Female	16	51.61
Education degree	Bachelor	7	22.58
	Master	24	77.42
Age group	25–29	9	29.03
	30–34	11	35.48
	35–39	5	16.13
	40–44	3	9.68
	45–50	3	9.68
Working years	1–5	6	19.35
	6–10	12	38.71
	11–15	7	22.58
	16–20	3	9.68
	21–25	3	9.68
Media platforms	Television	5	16.13
	Newspapers	17	54.84
	Magazines	2	6.45
	Websites	7	22.58



take action now. Participants noted that many people view climate change and the low-carbon transition as primarily the government's responsibility, with limited individual contributions. Additionally, many people are unsure of what actions to take, and even if they do participate, they are uncertain of the impact they can make without seeing significant changes. Participants also mentioned that while addressing climate change is a gradual process with implications for future generations, it is not seen as an urgent issue by many people, leading to a lack of proactive involvement.

4.1.2 The opportunities of low-carbon transformation

Participants regard the low-carbon city transition as an economic opportunity that fosters new activities and innovative development models for urban sustainability. They point out that business companies need to reduce emissions, upgrade, and pursue circular development, which can lower production costs and enhance economic efficiency. They also emphasize that climate change and emission reduction require global cooperation, though varying goals and standards across countries and industries prompt export-oriented enterprises to adopt energy transformations, especially in international markets. Additionally, the transition can revitalize resource-depleted cities, with some shifting towards low-carbon tourism or tech innovation, attracting talent and creating job opportunities.

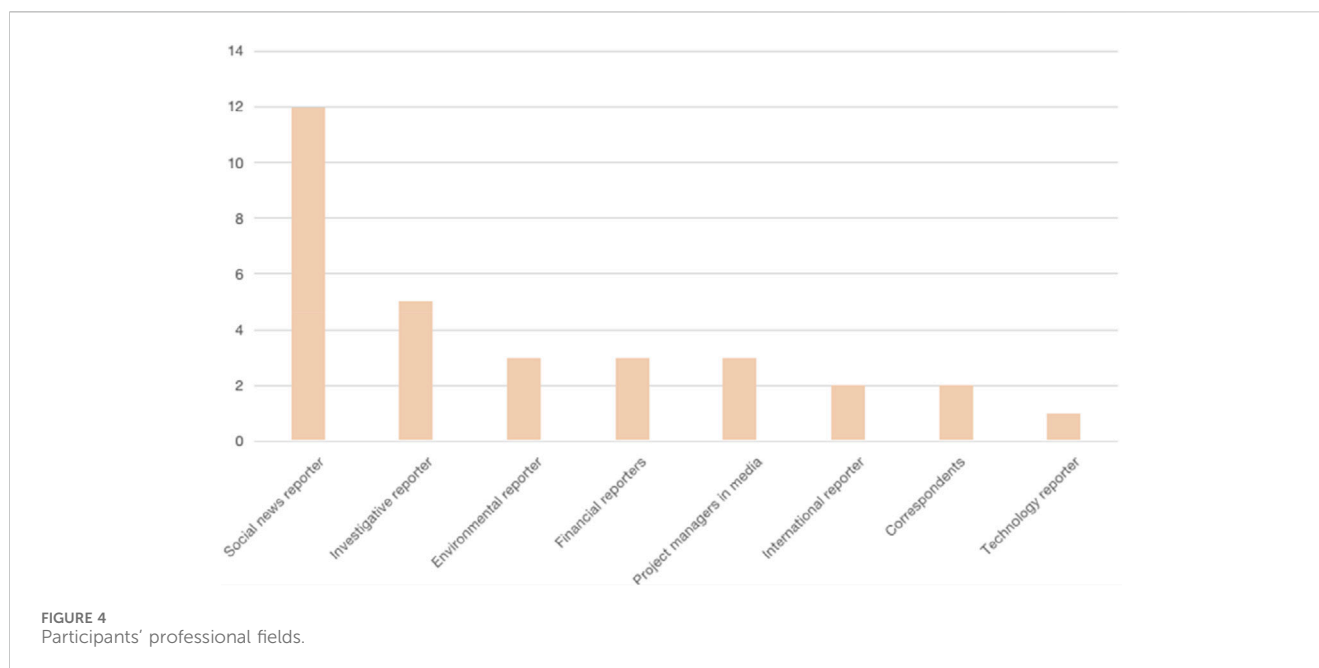
Participants believe that the transition to low-carbon cities will drive technological innovation. They point out that enterprises' low-carbon transition relies on technological advancements and the improvement of low-carbon production and research. This can help improve energy efficiency, reduce carbon emissions, and foster more environmentally friendly products and services. Additionally, some participants believe that the growth of digital technology is accelerating information dissemination and broadening the scope of the public's participation in the low-carbon transition.

Furthermore, participants believe that low-carbon urban transition contributes to improving urban environments and enhancing residents' living satisfaction. They highlight that this process involves upgrading infrastructure, such as building bicycle green lanes, improving low-carbon public transport, setting up waste recycling facilities, and creating green parks. They believe that these green transformations will improve urban air quality and overall living environments, benefiting residents' health and increasing satisfaction with urban living.

4.1.3 The challenges of low-carbon transformation

Participants believe that the lack of expertise in low-carbon practices and management skills across different industries is slowing the transition. They argue that acquiring this knowledge takes time and advocate for enhanced training by schools, government agencies, and businesses. They emphasize the importance of educating school teachers in low-carbon practices to foster environmental education and set examples for students. Participants also believe that the government plays a vital role in formulating and implementing effective low-carbon policies, requiring officials to be well-versed in these practices. Additionally, they believe that training employees in low-carbon skills can drive technological innovation, leading to more effective carbon reduction in production processes.

Participants state that low-carbon city transformation requires systematic management, effective macro planning and sustained, phased actions, which can be challenging. Some note that leadership changes may disrupt continuity, as new leaders might shift priorities and strategies, affecting ongoing transformation efforts. Additionally, people may feel tired due to the long-term nature of transformation process, leading to reduced commitment. Financial constraints also pose a challenge, as companies may struggle to secure the funds needed for updating equipment,



conducting research, and training employees, making transformation difficult.

Participants argue that the information gap poses challenges to low-carbon city transformation. Some noted that while communication devices are widely used and help people access information more quickly, many in western China, who are more vulnerable to climate change, still face difficulties in obtaining accurate, timely, and critical information, making them less willing to engage in low-carbon actions. Additionally, the elderly often struggle with new technologies, affecting their ability to participate in or support low-carbon initiatives. Moreover, participants express concerns about misinformation, such as exaggerating the adverse effects of low-carbon transformation, spreading false scientific viewpoints, or green washing by companies, also undermining public confidence and participation in low-carbon efforts.

Table 2 shows example quotes from participants' views about the above results. They believe that, many people tend to prioritize immediate benefits over long-term gains. Low-carbon transformation process presents both opportunities and challenges, requiring scientific communication and enhanced low-carbon education.

4.2 Factors influencing journalists' reporting on low-carbon transition

4.2.1 News factors

Participants state that the newsworthiness is a key reason for their choice to report on related topics. They believe that assessing newsworthiness is primarily tied to social issues that impact public interest and personal wellbeing. Some participants argue that environmental news, even if it does not attract a large readership, should be reported because of its significance to the public. They believe that media should not simply chase after daily hot topics, as

doing so would diminish their competitive edge compared to social media. Instead, they believe journalists should focus on agenda-setting by presenting important issues from new perspectives.

Participants believe that news events with significant influence are a key focus of their reporting, particularly those linked to climate change, such as heatwaves, floods, and droughts. These events often lead to damage, conflicts, and negatively impact nature, the environment, and economies, affecting people's lives. In covering such events, they prioritize reporting facts, analyzing causes, assessing impacts, and exploring solutions. Different media outlets offer varied perspectives, with some highlighting the experiences of vulnerable groups. Participants also note that these topics often have a life cycle, with coverage decreasing once the event concludes, such as when air quality improves, leading to diminished public concern over air pollution.

Participants also note that timing influences journalists' coverage of low-carbon related topics. They observe that during global events like the World Climate Conference, media focus on such content increases. Additionally, major events such as the Olympics or large sports competitions, which incorporate green initiatives, low-carbon actions, and new energy technologies, also heighten media interest. Some participants also mention that thematic activities organized during certain holidays, such as World Meteorological Day, World Water Day, and Earth Day, prompt the media to produce related thematic reports.

4.2.2 Audience preference and market demands

Some participants believe that audience preferences and click rates are also influence their choice of low-carbon related news content. They tend to select topics closely linked to readers' daily lives, such as how high temperatures and precipitation affect travel or news about penalties or subsidies that directly impact economic interests. Participants mention that they focus on eye-catching content related to the urban environment and climate change, such as striking photos, videos, or stories involving celebrities,

TABLE 2 Sample quotes from participants' perspectives on low-carbon transition.

	Categories	Example of quotes
Section 4.1.1	Visible	In cities with serious haze, people tend to be more concerned about air quality. However, in cities without haze issues, concern is lower because it does not directly impact daily life, leading some to be less interested in learning about carbon reduction. P26
	Invisible	News often discusses 'carbon neutrality', but these concepts look a bit distant and abstract. It's difficult for people to directly connect them with their own lives, understand specific actions for a low-carbon lifestyle, or how much their behavior can contribute. P7
Section 4.1.2	Opportunities	Economic: For export-dependent enterprises and multinational corporations, meeting the carbon emission standards of host countries is crucial. While the initial transition may be challenging, it presents long-term development opportunities and benefits for the environment. P30 Resource-depleted cities transition: Energy-dependent cities, particularly those relying on local natural resources, low-carbon transition will be their development path due to resource depletion and environmental protection policies. P8 Technology innovation: Changzhou is a good example of low-carbon city transformation, evolving into a new energy capital. Although my family currently uses traditional fuel vehicles, with the establishment of carbon-neutral gas stations in the city, the carbon emissions generated during their operation, management, and operation processes will be offset through energy-saving and emission reduction measures, as well as green electricity. P3
Section 4.1.3	Challenges	Lack of expertise and skills: I discussed with some business managers about low-carbon transformation and emission reduction. While they believe it is good for the environment, they are uncertain about how to apply these concepts and techniques to their own businesses. Even after consulting experts, they find that the expert advice, though comprehensive, does not always translate well into practical steps for their specific situations. P15 Systematic management: Low-carbon transformation requires efforts in the short, medium, and long terms to approach emission reduction goals. However, traditional heavy industries often prioritize short-term economic gains. For some departments, once management changes, the direction and priorities of work will also change. P18 Misinformation: Some companies, aiming to boost market competitiveness and enhance their image, exaggerate and fabricate environmental information about their products and services. P22

because this type of content often attracts high audience engagement. Given the current bottleneck in media operations and survival pressures, journalists are increasingly mindful of audience preferences and readership. They write these types of news stories using a lighter, more accessible language style to provide readers with freshness and unexpectedness, for evoking emotions and increasing clicks.

4.2.3 Professional knowledge of journalists

Participants believe that journalists' professionalism impacts the reporting of low-carbon news. Their understanding and knowledge of climate change and low-carbon issues influence the content and topics they choose. Additionally, journalists' professional qualities, such as sensitivity to social issues, news discovery skills, and depth of interviews, affect the quality and impact of their reporting. Some interviewees also note that journalistic ideals and values play a crucial role; for instance, those focused on human rights and social equity may prioritize environmental news that highlights the interests of vulnerable groups. They believe that good climate report should combine value judgment with professional technical knowledge. Furthermore, journalists' areas of expertise shape their news choices; for example, financial journalists might concentrate on carbon finance, climate financing, renewable energy transitions, and the circular economy.

4.2.4 Management mechanisms

Participants believe that media coverage is closely connected to government policies. When government introduce policies related to climate change and low-carbon initiatives, often invites media to press conferences. Recently, the Chinese government has prioritized climate action and environmental protection, setting dual carbon goals. Environmental regulatory agencies also involve journalists to participate in environmental investigation on high-emission, high-

pollution enterprises. Participants believe that relaxing certain reporting restrictions and providing journalists more freedom to cover low-carbon transition could improve environmental oversight, promote more effective climate action from stakeholders, and enhance transparency and public awareness.

In addition, participants recognized that media coverage of low-carbon topics is also influenced by the (newspaper) format and team composition. They note that only a few media outlets, such as Southern Weekend, The Paper, and China Environment News have dedicated climate change and green columns. Most media do not have specialized sections or teams that consistently cover these topics unless there is a major public event or breaking news. Participants believe that climate change was not yet a core issue that regularly occupies space in most media outlets, although the number of related reports increased. Compared to climate change issues, they are more focused on economic trends and social affairs. Table 3 shows example quotes from participants on factors influencing journalists' coverage of low-carbon transition.

4.3 How to improve public low-carbon awareness through media

4.3.1 Collaborating with stakeholders to organize activities

Participants believe that media plays an important role in communication between public and stakeholders. They suggest that collaborating with stakeholders to organize offline activities can enhance public understanding of low-carbon transformation and climate change by providing first-hand experiences. For instance, media could partner with universities, museums, and artists to host exhibitions featuring photography, videos, and documentaries on these topics, which could help people more

TABLE 3 Example quotes of participants about factors influencing journalists' coverage of low-carbon transition.

	Categories	Example of quotes
Section 4.2.1	News factors	<p>News worthiness: We can't just follow the daily trending topics; we need to find new angles to cover significant social issues. P23</p> <p>Significant new events: Events related to climate change, such as the floods in Zhengzhou where subway stations were inundated, gain urgency during extreme weather but often remain background issues otherwise. Despite severe climate change impacts occurring globally, these issues feel distant to residents of first-tier cities—places where more influential people live—because extreme weather have not yet penetrated daily life in these well-known areas. P19</p> <p>Timing: Every year on World Meteorological Day, we plan thematic programs, such as producing popular science videos on climate and water. Our team of meteorologists, TV directors, and video and animation designers collaborates on creating science communication content, discussing presentation formats, and assessing dissemination effects. Climate change-related data, like decreasing freshwater resources, is sourced by consulting professional researchers. P30</p>
Section 4.2.2	Audience preference	<p>With the improvement of urban ecological environment in Nanjing, wild boars frequently appear in city areas, sometimes even venturing into residential communities. This has sparked discussion on social media and in community WeChat groups. I write related content partly out of personal curiosity, but also hope to advocate for continued environmental protection. Of course, I also capitalize on trending topics, hoping to attract more attention and clicks. P1</p>
Section 4.2.3	Professional knowledge	<p>Journalistic ideals and values: Good journalism, in my view, blends value judgment with professional technical knowledge. Value judgment focuses on public interests and social development, while technical expertise ensures the accuracy and objectivity of content. This is especially crucial for climate change reporting, which intersects with natural sciences and requires input from experts. Relying solely on value judgments can introduce bias and emotion, which can undermine the integrity of news reporting. P17</p> <p>Knowledge of climate change: I think China currently lacks journalists with a strong scientific background for climate reporting. Climate change is complex, encompassing not just political or economic aspects but also scientific and social transformations. Much of the current reporting is relatively superficial. Journalists with expertise in climate science and media literacy could explain these issues more clearly and effectively. However, I feel that many journalists involved in related reporting have limited experience, some see this topic as relatively new, some find it interesting, but if you delve deeper, it actually involves many aspects. Due to without adequate training in climate change, in-depth, long-term reporting is challenging. P19</p>
Section 4.2.4	Management mechanisms	<p>From a communication perspective, the longer a topic occupies space and the more extensive its coverage, the more it will be recommended by big data algorithms, leading to a broader audience reach. For example, in a regular newspaper, if there are only 1–2 pages dedicated to headline news, and reporters have numerous responsibilities, it is challenging to publish climate change related news daily due to the limitation of page space and reporter energy, unless there is a major event. Media outlets need to balance operational considerations with readership demands, which often limits the frequency and depth of climate change coverage. P12</p>

intuitively grasp the connection between climate change and their own lives through visual arts. In addition, participants believe that media could work with businesses to arrange visits to zero-carbon factories, which would not only spark public interest in low-carbon products but also create deep impressions. Engaging with communities through activities like rewarded knowledge competitions, interactive games, and science lectures on waste sorting could also address information gaps and engage vulnerable groups such as women, children, and the elderly more effectively. Some participants suggest that providing more reporting support for environmental NGOs' low-carbon initiatives and broadening their impact could further encourage public participation in low-carbon actions.

Participants believe media should enhance online interaction with the public to improve news content and encourage better low-carbon policies and services. They note that engaging with the public on low-carbon issues helps understand their needs and stories, allowing for timely feedback to stakeholders and fostering more inclusive policy making. Interviewees also suggest that news engagement increases exposure and diverse perspectives, enriching reporting and content production, which benefits public participation in urban governance.

Some participants also suggest that the media could host both offline and online climate change seminars or workshops, inviting the public and stakeholders to discuss low-carbon transitions. This would facilitate interdisciplinary learning, cooperation, and the generation of valuable ideas, helping to explore the opportunities and challenges of low-carbon development.

4.3.2 Improving the quality of news

Participants believe the media should enhance the quality of low-carbon news content to raise public awareness. They emphasize the need for better journalist training in climate-related knowledge, such as biodiversity, low-carbon transitions, and green lifestyles. The training would deepen journalists' understanding, improve their sensitivity to related topics, and enrich their coverage. Additionally, participants suggest making news content more specific and relevant to daily life rather than focusing on grand narratives. They propose highlighting individual climate actions and lifestyle changes to better resonate with readers. Moreover, they recommend using storytelling formats to emotionally engage readers and increase the impact of climate reporting, which requires journalists to be present at news events and skilled in identifying compelling story angles.

Participants believe that news content diversity on climate change could help audiences gain a deeper understanding. They suggest increasing the number of commentary articles to foster interactive discussions, which could offer valuable insights for developing more reasonable policies. Additionally, they propose that media should conduct more high-quality investigative reports on high carbon emission and environmental issues to support the transition to low-carbon cities.

Participants believe that adding climate change sections or columns and increasing article volume would help the public better understand low-carbon lifestyles. They argue that insufficient attention to climate change stems partly from

TABLE 4 Example quotes of participants suggestion about the way to improve public low-carbon awareness through media.

	Categories	Example of quotes
Section 4.3.1	Collaborating with stakeholders	Education and art: Displaying the content of glacier scientific expeditions and the experiences of expedition members in museums, along with simulations of glacier scenes, could offer the public a more immersive experience. P6 Interaction with public: Increasing public involvement in media production is crucial. While media outlets produce professional reports, public participation can offer valuable issues and news leads. Additionally, experts among the public, especially in natural sciences, can enrich media content, complementing the humanities-based backgrounds of most journalists. P17
Section 4.3.2	Improving news quality	Content specifics: Many media outlets lack specificity, with their coverage being quite grand. Normally, journalists' reports are from a personal perspective. P10 Storytelling: I think media coverage of climate change and low-carbon transitions lacks innovative focus and good stories. It often takes a collectivist perspective. If we instead explore angles that resonate with the public on a personal level—starting from individual interests, why people should choose a low-carbon lifestyle, and the personal benefits of doing so—the reporting might be better understood by the general public. P13 Content diversity: News exposure is an effective way for encouraging high-emission enterprises to reduce carbon emissions and protect the environment. P27
Section 4.3.3	Improving news communication	I think in China, there are few promotions about low-carbon in variety shows, movies, TV dramas, and literary works, although there are some science fiction novels, the content needs improvement. Movie 'Dune' is a good example. P31

inadequate media coverage. By adding such sections, more journalists could consistently report on related issues from diverse perspectives, such as environment, economy, health, and lifestyle. They believe this would more effectively convey the latest scientific knowledge, policy developments, and practical experiences about climate change and low-carbon transitions, encouraging proactive actions from stakeholders, such as governments, businesses, and individuals.

4.3.3 Improvement of news communication

Participants believe that integrating innovative technology into news communication and production will enhance efficiency. They suggest that sensors could help journalists collect climate data faster, allowing for rapid analysis, visualization, and delivery to the public via mobile devices, especially during emergencies like extreme weather events. They also see potential in using artificial intelligence (AI) and virtual reality (VR) technologies to increase audience interest in news. In television production, virtual studios and scenes can make news more vivid and engaging, providing viewers a sense of immersion. Participants believe that VR's immersive experience can also help audiences better understand the impacts of climate change. However, they note that VR's current reach is limited and suggest expanding its use to engage a broader audience.

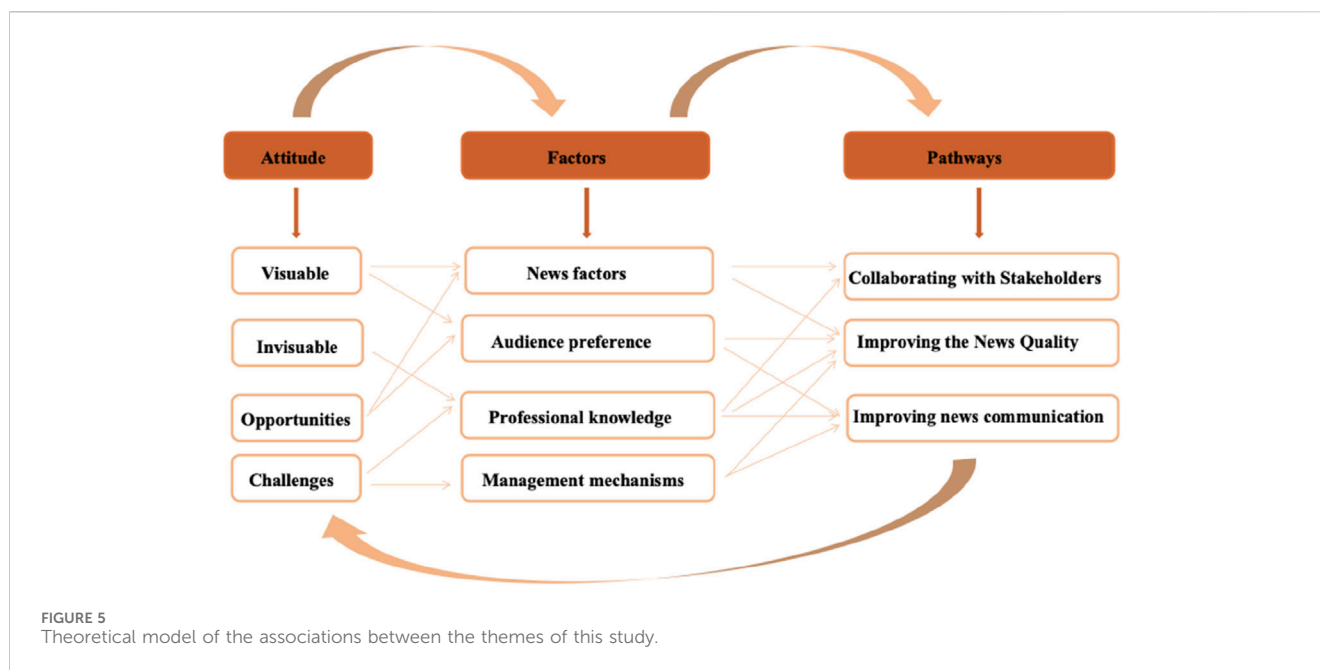
Participants believe that innovative communication channels could attract audiences to pay more attention on climate action. They suggest using formats like H5 (HTML5 interactive content), public service ads, videos, animations, audio content, variety shows, movies, games, and TV series to enhance public awareness of low-carbon concepts. These formats are particularly effective in attracting younger audiences and making climate change and low-carbon information more engaging.

Participants emphasize the importance of maintaining journalistic ethics. They believe that while new technologies and innovative channels can enhance engagement with climate change and low-carbon news, it is crucial to uphold truthfulness and fairness to preserve public trust and the integrity of news reporting. Table 4 shows participants example quotes about the way to improve public low-carbon awareness through media.

5 Discussion

News media is a crucial channel for the public to learn about climate change and low-carbon transition, with journalists' attitudes significantly influencing news reporting. This research uses semi-structured interviews within a qualitative framework to discuss journalists' perspectives of China's low-carbon urban transition. Our findings indicate that the media plays an important role in climate communication between the public and stakeholders. To realize carbon neutrality goals, it is essential for journalists to improve climate concerns. Figure 5 presents a theoretical model illustrating the relationships between the research themes. The following section elaborates on three core insights derived from our findings.

Firstly, based on our sample, we find that ordinary news audiences lack a deep understanding of low-carbon issues, focusing more on immediate, daily concerns rather than long-term climate responsibilities. Achieving low-carbon city transformation requires addressing both visible factors and invisible but crucial factors. Low-carbon city transformation brings new opportunities for urban economic development, carbon emission reduction, and technological innovation, living conditions improvement. Since 2010, China has launched 81 low-carbon city pilots, focusing on development plans and policy making, developing clean energy, and advocating low-carbon lifestyles (Li and Xing, 2024). As of 2020, China's carbon intensity has been reduced by 18% from 2015 levels, and the share of non-fossil energy has increased to 15.9% (Liu et al., 2022). However, some challenges, such as insufficient low-carbon expertise, systematic management, and limited funding could slow the transition. Information gaps due to communication limitations and misinformation can also lead to misunderstandings among vulnerable groups, impacting their engagement. Globally, similar challenges persist. In the U.S., local officials' career incentives influence green energy policies, with managerial turnover inhibiting sustainability efforts (Huang and Berry, 2022). In the UK, people with limited low-carbon knowledge or low income are less willing to upgrade their energy systems, with the most vulnerable groups often overlooked in policy making, exacerbating existing inequalities (Golubchikov and O'Sullivan,



2020). Addressing these challenges through better inclusion and clear communication is crucial for effective low-carbon transitions (Royapoor et al., 2023; Rosenburgh et al., 2023). Our findings, based on social constructionism (Holzner, 1972) and agenda-setting theory (McCombs and Shaw, 1972), indicates that news media serves as a crucial ‘mediator’ between the public and stakeholders (Crow and Boykoff, 2014). Therefore, increasing media attention to low-carbon transitions is necessary to enhance public awareness and engagement.

Secondly, our research reveals that journalists’ attitudes towards low-carbon topics shape their reporting choices. Despite an increase in related reports, many media do not prioritize climate change or low-carbon transitions as core topics. Key factors impacting reporting choices and content include newsworthiness, audience preferences, journalists’ knowledge, and management mechanisms within media institutions. Based on the samples, we found that newsworthiness, significant events with substantial social impact, and timing plays a critical role in driving low-carbon news coverage. However, such reporting is often event-driven, with coverage typically diminishing once the event concludes, leading to reduced public engagement over time. This aligns with Anthony Downs’ Issue-attention Cycle theory, which believe that media coverage of environmental issues often follows a cyclical pattern (Downs, 1998). In addition, audience preferences also impact journalists’ low-carbon reporting. Driven by readership interests and financial pressures, media outlets focus on news that resonates with audiences’ daily lives, economic interests, or that provides novelty and unexpected angles. This type of content tends to engage emotions and attract more clicks, but as the novelty wears off, public interest may decline, leading media to shift their focus to other topics to sustain readership (McComas and Shanahan, 1999). Furthermore, journalists’ knowledge of climate change and low-carbon issues, along with their professional skills and expertise, affect the depth and quality of reporting. Journalists with specialized knowledge are better equipped to produce comprehensive and

accurate reports, but the general lack of scientific expertise among journalists poses a significant challenge, limiting the depth of low-carbon coverage. The organizational structure and management of media institutions, such as limited columns, team management, and editorial freedom also influence how prominently low-carbon topics are featured. In other countries, similar factors influence climate and low-carbon news coverage. In South Korea, media coverage of low-carbon topics often emphasizes practical activities and the economic situation due to audience preferences (Wang and You, 2024). In the UK, France, Germany, and the Netherlands, although journalists place significant importance on climate change reporting, there is a relative lack of expertise in climate science (Strauss et al., 2021). In Nepal, limited editorial independence and censorship lead some journalists to downplay or avoid covering important environmental issues, which restricts the diversity of perspectives and limits public awareness (Koirala and Sharma, 2024). Given the broad scope of climate change and low-carbon transition, which intersects with politics, economics, and society (Sovacool, 2021), this research believe that journalists’ scientific knowledge, professional skills, and reporting freedom are crucial for effective climate action, transparency, environmental justice, and public awareness (United Nations EducationalScientific and Cultural Organization, 2024).

Thirdly, this research indicates that media could enhance low-carbon communication and encourage people to join climate action by strengthening cooperation with stakeholders, increasing audience interaction, and using storytelling and innovative technology. Based on our sample, our findings highlight that media collaborating with stakeholders to organize offline activities can enhance public low-carbon awareness through first-hand experiences. Additionally, increasing online interactions with the audience can diversify news perspectives, uncover new stories, and increase public participation in urban governance. As Widener and Rowe (2018)’s research results, encouraging more stakeholders’ cooperation and more diverse voices (especially marginalized

people, youth, and women's voice), could broaden and deepen people's understandings and actions of climate change, ensuring the inclusion and equality in low-carbon city transition. Our research suggests that media can enhance the quality of low-carbon news by improving journalist training and focusing on storytelling that resonates with the public. By highlighting impact stories and diversifying news genres, media can increase the influence and credibility of their reporting, promoting low-carbon city transformation. Storytelling, based on Narrative Transportation Theory (Green and Brock, 2000), can effectively engage audiences, influencing their beliefs and actions by making complex climate issues more relatable. Narrative Policy Framework by Jones and McBeth (2010) believes that stories plays a crucial role between public opinion and the development and implementation of public policy. We also advocate for media to explore diverse news formats, such as commentary and investigative reporting, to hold high-emission industries accountable and support sustainable urban transitions. Furthermore, we recommend that media innovate news dissemination formats by integrating new technologies to enhance communication efficiency and the vividness of news, thereby attracting a wider audience and raising public low-carbon awareness. However, it is crucial for the media to keep journalistic ethics when utilizing new technologies to ensure the accuracy and fairness.

6 Conclusion

Addressing climate change and achieving a low-carbon urban transition requires public participation. News media serve as the primary channel for the public to access relevant information, and journalists' attitudes influence the content of related news reports. This study focuses on journalists' attitudes toward low-carbon city transformation in China, employing semi-structured interviews in qualitative analysis with 31 journalists from Chinese mainstream media. We discussed journalists' attitudes towards low-carbon city transformation, factors influencing journalists' low-carbon news reporting, and how to further enhance public awareness through media.

Our research highlights that media plays an important role in climate communication between the public and stakeholders, it is necessary for media to improve climate concern to support the achievement of carbon neutrality goals in China. Based on our samples, our findings indicate that, firstly, low-carbon city transformation brings some new opportunities, such as urban economic development and environmental improvement, but there are also some potential challenges that need to consider, such as a lack of professional knowledge and systematic management, and information gaps. Secondly, journalists choose to report low-carbon related topics primarily considering the newsworthiness, social impact, and audience preferences, but these news exhibit a life cycle. Despite an increase in coverage of low-carbon topics due to policy influences, it has not become a core topic in most media organizations, we highlight that journalists' scientific knowledge, professional skills, and reporting freedom are crucial for effective climate action and achieving carbon neutrality. Thirdly, we suggest that media strengthen collaboration with stakeholders, increase audience interaction to learn diverse voices,

use storytelling and technological innovations to improve low-carbon communication in order to promote inclusive low-carbon urban transition.

This study makes several contributions. Regarding theoretical contributions, first, it provides a comprehensive review of the history of media coverage on climate change, previous studies on the role of the media, and the background of Chinese media coverage on low-carbon city transformation. This offers valuable insights for scholars studying media coverage of climate change. Second, by using in-depth interviews within a qualitative framework, this study explores Chinese journalists' attitudes toward low-carbon transition, addressing a gap in the existing literature and research methods. Third, we employ a combination of purposive sampling and snowball sampling to recruit representative participants and ensure diversity. Most of our participants are influential journalists from mainstream Chinese media institutions, with 5–24 years of experience and master's degrees in journalism and communication. Through in-depth discussions, we explore the factors influencing journalists' reporting on low-carbon issues and strategies for the media to improve public awareness of low-carbon topics, providing a foundation for future research on climate communication. As for practical contributions, this study discusses the opportunities and challenges associated with low-carbon city transformation, offering valuable insights for policymakers to improve related policies. It also provides practical guidance for journalists on how to report low-carbon issues effectively and proposes ways to enhance public awareness and engagement in climate action, thereby improving the quality of future low-carbon news reporting.

However, this research has some limitations. Our study focuses exclusively on Chinese journalists' attitudes toward low-carbon city transformation and the factors influencing their reporting, which may limit the applicability of the findings to low-carbon news reporting in other countries. In addition, this study may be criticized due to the limited sample size of qualitative research. We chose the semi-structured interview approach for its depth and flexibility, and the lack of existing research about journalists' attitudes toward low-carbon city transitions in China. Although our research offers rich and detailed data based on the perspective of journalists working in mainstream Chinese media, it may not fully capture the different views among all journalists in the country. It is also important to note that our findings only represent the participants' views and observations, not necessarily those of their organizations.

We recommend that future research examine journalists' perspectives in different countries, comparing them to those in China, while considering diverse cultural, policy, and climate contexts. Additionally, future studies could combine other methods, such as textual analysis of published news reports, to understand the focus and narrative style of Chinese media on climate change and low-carbon transition, and compare the differences between central and local media reporting. Furthermore, it would be valuable to explore the attitudes of content creators on social media platforms, analyzing how their narratives differ from those of mainstream media journalists, and investigating their influence on public perceptions of the low-carbon cities transition. Lastly, we encourage further discussion on the

journalistic ethics involved in utilizing new technologies for climate communication.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by The Faculty Niet-WMO Verplicht Research Ethics Committee, Maastricht University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

YW: Conceptualization, Data curation, Investigation, Methodology, Writing—original draft. PM: Conceptualization, Methodology, Supervision, Writing—review and editing. TK: Conceptualization, Methodology, Supervision, Writing—review and editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. YW is

funded by the China Scholarship Council (CSC) with grant No. 202008320395. The funder had no role in research design, data collection and analysis, decision to publish, or preparation of the manuscript.

Acknowledgments

We want to thank all participants for joining the interviews.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Amu, C. J., and Agwu, A. E. (2012). Attitude and knowledge of print media journalists towards reporting of climate change news in Nigeria. *J. Agric. Ext.* 16 (2), 52–67. doi:10.4314/jae.v16i2.5
- Antilla, L. (2005). Climate of scepticism: US newspaper coverage of the science of climate change. *Glob. Environ. Change* 15 (4), 338–352. doi:10.1016/j.gloenvcha.2005.08.003
- Appelgren, E., and Jönsson, A. M. (2021). Engaging citizens for climate change—challenges for journalism. *Digit. Journal.* 9 (6), 755–772. doi:10.1080/21670811.2020.1827965
- Boykoff, M., and Lueddecke, G. (2016). “Elite news coverage of climate change,” in *Oxford research encyclopedia of climate science*. doi:10.1093/acrefore/9780190228620.013.357
- Boykoff, M. T., and Boykoff, J. M. (2007). Climate change and journalistic norms: a case-study of US mass-media coverage. *Geoforum* 38 (6), 1190–1204. doi:10.1016/j.geoforum.2007.01.008
- Boykoff, M. T., and Rajan, S. R. (2007). Signals and noise: mass-media coverage of climate change in the USA and the UK. *EMBO Rep.* 8 (3), 207–211. doi:10.1038/sj.embor.7400924
- Boykoff, M. T., and Roberts, J. T. (2007). Media coverage of climate change: current trends, strengths, weaknesses. *Hum. Dev. Rep.* 2008 (3), 1–53.
- Brown, J. D., Bybee, C. R., Wearnden, S. T., and Straughan, D. M. (1987). Invisible power: newspaper news sources and the limits of diversity. *Journal. Q.* 64 (1), 45–54. doi:10.1177/107769908706400106
- Brüggemann, M., and Engesser, S. (2017). Beyond false balance: how interpretive journalism shapes media coverage of climate change. *Glob. Environ. Change* 42, 58–67. doi:10.1016/j.gloenvcha.2016.11.004
- Bulle, R. J., Carmichael, J., and Jenkins, J. C. (2012). Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the US, 2002–2010. *Clim. Change* 114 (2), 169–188. doi:10.1007/s10584-012-0403-y
- Burr, V., and Dick, P. (2017). “Social constructionism,” in *The palgrave handbook of critical social psychology*. Editor B. Gough (London: Palgrave Macmillan). doi:10.1057/978-1-137-51018-1_4
- Carvalho, A. (2010). Media (ted) discourses and climate change: a focus on political subjectivity and (dis) engagement. *Wiley Interdiscip. Rev. Clim. Change* 1 (2), 172–179. doi:10.1002/wcc.13
- Carvalho, A., and Pereira, E. (2008). Communicating climate change in Portugal: a critical analysis of journalism and beyond. *Commun. Clim. Change Discourses, Mediat. perceptions*, 126–156.
- Cheng, J., Yi, J., Dai, S., and Xiong, Y. (2019). Can low-carbon city construction facilitate green growth? Evidence from China's pilot low-carbon city initiative. *J. Clean. Prod.* 231, 1158–1170. doi:10.1016/j.jclepro.2019.05.327
- Cheng, X., Long, R., Wu, F., Geng, J., and Yang, J. (2023). How social interaction shapes habitual and occasional low-carbon consumption behaviors: evidence from ten cities in China. *Renew. Sustain. Energy Rev.* 182, 113387. doi:10.1016/j.rser.2023.113387
- Cherry, C., Hopfe, C., MacGillivray, B., and Pidgeon, N. (2015). Media discourses of low carbon housing: the marginalisation of social and behavioural dimensions within the British broadsheet press. *Public Underst. Sci.* 24 (3), 302–310. doi:10.1177/096362513512442
- Cho, J. Y., and Lee, E. H. (2014). Reducing confusion about grounded theory and qualitative content analysis: similarities and differences. *Qual. Rep.* 19 (32).

- Comfort, S. E., and Park, Y. E. (2018). On the field of environmental communication: a systematic review of the peer-reviewed literature. *Environ. Commun.* 12 (7), 862–875. doi:10.1080/17524032.2018.1514315
- Corbin, J., and Strauss, A. (2015) *Basics of qualitative research*, 14. United Kingdom: Sage.
- Crawley, S., Coffé, H., and Chapman, R. (2022). Climate belief and issue salience: comparing two dimensions of public opinion on climate change in the EU. *Soc. Indic. Res.* 162 (1), 307–325. doi:10.1007/s11205-021-02842-0
- Crouch, M., and McKenzie, H. (2006). The logic of small samples in interview-based qualitative research. *Soc. Sci. Inf.* 45 (4), 483–499. doi:10.1177/0539018406069584
- Crow, D., and Boykoff, M. (2014). *Culture, politics and climate change: how information shapes our common future*. New York: Routledge.
- DiCicco-Bloom, B., and Crabtree, B. F. (2006). The qualitative research interview. *Med. Educ.* 40 (4), 314–321. doi:10.1111/j.1365-2929.2006.02418.x
- Downs, A. (1998). “Up and down with ecology—the issue-attention cycle,” in *Political theory and public choice* (Edward Elgar Publishing), 100–112. doi:10.4337/9781035335336.00011
- Eker, S., Garcia, D., Valin, H., and Van Ruijven, B. (2021). Using social media audience data to analyse the drivers of low-carbon diets. *Environ. Res. Lett.* 16 (7), 074001. doi:10.1088/1748-9326/abf770
- Elia, E. F. (2021). Journalists’ awareness and understanding of climate change in Tanzania. *Int. J. Commun.* 15, 19.
- Elo, S., and Kyngäs, H. (2008). The qualitative content analysis process. *J. Adv. Nurs.* 62 (1), 107–115. doi:10.1111/j.1365-2648.2007.04569.x
- Faugier, J., and Sargeant, M. (1997). Sampling hard to reach populations. *J. Adv. Nurs.* 26 (4), 790–797. doi:10.1046/j.1365-2648.1997.00371.x
- Francis, J. J., Johnston, M., Robertson, C., Glidewell, L., Entwistle, V., Eccles, M. P., et al. (2010). What is an adequate sample size? Operationalising data saturation for theory-based interview studies. *Psychol. health* 25 (10), 1229–1245. doi:10.1080/08870440903194015
- Galbin, A. (2014). An introduction to social constructionism. *Soc. Res. Rep.* 6 (26), 82–92.
- Geall, S., and Ely, A. (2018). Narratives and pathways towards an ecological civilization in contemporary China. *China Q.* 236, 1175–1196. doi:10.1017/S0305741018001315
- Gillings, M., and Dayrell, C. (2024). Climate change in the UK press: examining discourse fluctuation over time. *Appl. Linguist.* 45 (1), 111–133. doi:10.1093/applin/amad007
- Glaser, B., and Strauss, A. (2017). *Discovery of grounded theory: strategies for qualitative research*. New York, USA: Routledge.
- Golubchikov, O., and O’Sullivan, K. (2020). Energy periphery: uneven development and the precarious geographies of low-carbon transition. *Energy Build.* 211, 109818. doi:10.1016/j.enbuild.2020.109818
- Green, M. C., and Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *J. personality Soc. Psychol.* 79 (5), 701–721. doi:10.1037/0022-3514.79.5.701
- Guest, G., Namey, E. E., and Mitchell, M. L. (2013). *Collecting qualitative data: a field manual for applied research*. London, UK: Sage.
- Ha, Y. Q., and Huang, D. H. (2012). *An analysis of agenda setting in environmental reporting under ecological crisis*. Beijing, China: People.cn. Available at: <http://media.people.com.cn/n/2012/1129/c352242-19742900.html> (access 10/June/2024)
- Happer, C., and Philo, G. (2013). The role of the media in the construction of public belief and social change. *J. Soc. political Psychol.* 1 (1), 321–336. doi:10.5964/jspp.v1i1.96
- He, F., Guo, X., and Yue, P. (2024). Media coverage and corporate ESG performance: evidence from China. *Int. Rev. Financial Analysis* 91, 103003. doi:10.1016/j.irfa.2023.103003
- Hennink, M., and Kaiser, B. N. (2022). Sample sizes for saturation in qualitative research: a systematic review of empirical tests. *Soc. Sci. and Med.* 292, 114523. doi:10.1016/j.socscimed.2021.114523
- Hielscher, S., and Sovacool, B. K. (2018). Contested smart and low-carbon energy futures: media discourses of smart meters in the United Kingdom. *J. Clean. Prod.* 195, 978–990. doi:10.1016/j.jclepro.2018.05.227
- Hindman, D. B. (2009). Mass media flow and differential distribution of politically disputed beliefs: the belief gap hypothesis. *Journalism and Mass Commun.* Q. 86 (4), 790–808. doi:10.1177/107769900908600405
- Holzner, B. (1972). *Reality construction in society*. Cambridge, Mass: General Learning Press.
- Huang, C. S., and Berry, F. (2022). Intergovernmental influence, managerial turnover, and city energy policy adoption. *Publius J. Fed.* 52 (2), 254–282. doi:10.1093/publius/pjab036
- Huang, Z. Y. (1998). Overview of weather and climate characteristics in China in 1997. *China Meteorol. News.* 26.01 Available at: https://www.cma.gov.cn/kppd/kppdqxsj/kppdtqqh/201212/t20121218_198230.html (access 10/June/2024)
- Huo, D., Zhang, X., Hu, C., Tang, A., Chen, Y., Chen, F., et al. (2023). Spatial externality of journalism on carbon efficiency: a quasi-natural experiment based on interplay of journalism-based professionally generated content and digital economy. *Econ. Analysis Policy* 80, 1326–1336. doi:10.1016/j.eap.2023.10.009
- Imuetinyan, I. C. H., Okocha, D. O., and Wang, S. (2024). Climate journalism in Nigeria: implications and contributions to the sustainability of the climate debate. *JALINGO J. Soc. Manag. Sci.* 5 (3), 1–15.
- Jiang, X., Ding, Z., and Liu, R. (2019). Can Chinese residential low-carbon consumption behavior intention be better explained? The role of cultural values. *Nat. Hazards* 95, 155–171. doi:10.1007/s11069-018-3461-2
- Johnson, J. L., Adkins, D., and Chauvin, S. (2020). A review of the quality indicators of rigor in qualitative research. *Am. J. Pharm. Educ.* 84 (1), 7120. doi:10.5688/ajpe7120
- Jones, M. D., and McBeth, M. K. (2010). A narrative policy framework: clear enough to be wrong? *Policy Stud. J.* 38 (2), 329–353. doi:10.1111/j.1541-0072.2010.00364.x
- Koirala, S., and Sharma, S. (2024). Increasing challenges and shrinking roles of environmental journalists in Nepal. *Environ. Commun.* 18, 1110–1123. doi:10.1080/17524032.2024.2353079
- Lei, S. M., (2017) Interview diary of the great daxing’ anling forest fire 30 Years ago. *Bolanqunshu*. Available at: https://epaper.gmw.cn/blqs/html/2017-05/01/nw.D110000blqs_20170501_1-03.htm (access 10/June/2024)
- Li, J., Li, J., and Zhang, J. (2024). Can digitalization facilitate low carbon lifestyle? Evidence from households’ embedded emissions in China. *Technol. Soc.* 76, 102455. doi:10.1016/j.techsoc.2024.102455
- Li, X., and Xing, H. (2024). Better cities better lives: how low-carbon city pilots can lower residents’ carbon emissions. *J. Environ. Manag.* 351, 119889. doi:10.1016/j.jenvman.2023.119889
- Li, X., and Zhao, C. (2024). Did innovative city constructions reduce carbon emissions? A quasi-natural experiment in China. *Environ. Dev. Sustain.* 26 (3), 6315–6340. doi:10.1007/s10668-023-02964-0
- Lim, W. M. (2024). What is qualitative research? An overview and guidelines. *Australas. Mark. J.* 0 (0). doi:10.1177/14413582241264619
- Liu, J., Li, M., and Ding, Y. (2021). Econometric analysis of the impact of the urban population size on carbon dioxide (CO₂) emissions in China. *Environ. Dev. Sustain.* 23 (12), 18186–18203. doi:10.1007/s10668-021-01433-w
- Liu, Y., Liu, R., and Jiang, X. (2019). What drives low-carbon consumption behavior of Chinese college students? The regulation of situational factors. *Nat. Hazards* 95, 173–191. doi:10.1007/s11069-018-3497-3
- Liu, Z., Deng, Z., He, G., Wang, H., Zhang, X., Lin, J., et al. (2022). Challenges and opportunities for carbon neutrality in China. *Nat. Rev. Earth and Environ.* 3 (2), 141–155. doi:10.1038/s43017-021-00244-x
- Liu, Z. L., and Zheng, B. W. (2013). *Comprehensive training textbook for news editing and reporting*. Beijing, China: Xinhua Publishing House.
- Lyytimäki, J. (2011). Mainstreaming climate policy: the role of media coverage in Finland. *Mittig. Adapt. Strategies Glob. Change* 16, 649–661. doi:10.1007/s11027-011-9286-x
- Major, A. M., and Atwood, L. E. (2004). Environmental risks in the news: issues, sources, problems, and values. *Public Underst. Sci.* 13 (3), 295–308. doi:10.1177/0963662504044557
- Mason, M. (2010). Sample size and saturation in PhD studies using qualitative interviews. *Forum Qual. Sozialforschung Forum Qual. Soc. Res.* 11 (3). doi:10.17169/fqs-11.3.1428
- McComas, K., and Shanahan, J. (1999). Telling stories about global climate change: measuring the impact of narratives on issue cycles. *Commun. Res.* 26 (1), 30–57. doi:10.1177/009365099026001003
- McCombs, M. (2005). A look at agenda-setting: past, present and future. *Journal. Stud.* 6 (4), 543–557. doi:10.1080/14616700500250438
- McCombs, M. E., and Shaw, D. L. (1972). The agenda-setting function of mass media. *Public Opin. Q.* 36 (2), 176–187. doi:10.1086/267990
- Mi, Z., Zheng, J., Meng, J., Zheng, H., Li, X., Coffman, D. M., et al. (2019). Carbon emissions of cities from a consumption-based perspective. *Appl. Energy* 235, 509–518. doi:10.1016/j.apenergy.2018.10.137
- Moser, S. C. (2010). Communicating climate change: history, challenges, process and future directions. *Wiley Interdiscip. Rev. Clim. Change* 1 (1), 31–53. doi:10.1002/wcc.11
- Naveena, N. (2015). Importance of mass media in communicating health messages: an analysis. *IOSR J. Humanit. Soc. Sci.* 20 (2), 36–41. doi:10.9790/0837-20253641
- Neergaard, M. A., Olesen, F., Andersen, R. S., and Sondergaard, J. (2009). Qualitative description—the poor cousin of health research? *BMC Med. Res. Methodol.* 9, 52–55. doi:10.1186/1471-2288-9-52
- Nerlich, B., Koteyko, N., and Brown, B. (2010). Theory and language of climate change communication. *Wiley Interdiscip. Rev. Clim. Change* 1 (1), 97–110. doi:10.1002/wcc.2
- New York Times (1895) *Prospects of another glacial period*, 24. New York, USA: Geologists Think the World May Be Frozen Up Again. February, 1895. Available at: <https://www.nytimes.com/1895/02/24/archives/prospects-of-another-glacial-period-geologists-think-the-world-may.html> (accessed on February 05, 2024).
- Nguyen, T. T., Grote, U., Neubacher, F., Do, M. H., and Paudel, G. P. (2023). Security risks from climate change and environmental degradation: implications for sustainable land use transformation in the Global South. *Curr. Opin. Environ. Sustain.* 63, 101322. doi:10.1016/j.cosust.2023.101322

- Nollet, J. (2020) "Field theory and the foundations of agenda setting and social constructionism models: explaining media influence on French mad cow disease policy," in *Globalizing issues: how claims, frames, and problems cross borders*, 95–114. doi:10.1007/978-3-030-52044-1_5
- Painter, J., Kangas, J., Kunelius, R., and Russell, A. (2024). The journalism in climate change websites: their distinct forms of specialism, content, and role perceptions. *Journal. Pract.* 18 (4), 954–973. doi:10.1080/17512786.2022.2065338
- Parker, C., Scott, S., and Geddes, A. (2019). *Snowball sampling*. SAGE research methods foundations. doi:10.4135/9781526421036831710
- Patton, M. Q. (2014). *Qualitative research and evaluation methods: integrating theory and practice*. California, USA: Sage publications.
- Peng, S., Wang, X., Du, Q., Wu, K., Lv, T., Tang, Z., et al. (2023). Evolution of household carbon emissions and their drivers from both income and consumption perspectives in China during 2010–2017. *J. Environ. Manag.* 326, 116624. doi:10.1016/j.jenvman.2022.116624
- Polkinghorne, D. E. (2005). Language and meaning: data collection in qualitative research. *J. Couns. Psychol.* 52 (2), 137–145. doi:10.1037/0022-0167.52.2.137
- Protest, D., and McCombs, M. E. (2016). *Agenda setting: readings on media, public opinion, and policymaking*. New York, USA: Routledge. doi:10.4324/9781315538389
- Ren, X., Xiao, Y., Xiao, S., Jin, Y., and Taghizadeh-Hesary, F. (2024). The effect of climate vulnerability on global carbon emissions: evidence from a spatial convergence perspective. *Resour. Policy* 90, 104817. doi:10.1016/j.resourpol.2024.104817
- Rhaman, M. (2018). Climate change journalism in Bangladesh. *Prof. Norms Atten. Newsp. Cover. Clim. Change*. doi:10.1177/2f0262728016638717
- Rivas, C. (2012). Coding and analysing qualitative data. *Res. Soc. Cult.* 3 (2012), 367–392.
- Robinson, O. C. (2014). Sampling in interview-based qualitative research: a theoretical and practical guide. *Qual. Res. Psychol.* 11 (1), 25–41. doi:10.1080/14780887.2013.801543
- Rosenburgh, J. L., Butler, D., and Storey, N. (2023). Customers in vulnerable situations and community resilience: a cross-utility study. Available at: <https://www.nea.org.uk/wp-content/uploads/2024/01/CSV-and-Community-Resilience-FINAL.pdf> (access on 08 June 2024)
- Royapoor, M., Allahham, A., Hosseini, S. H. R., Rufa'i, N. A., and Walker, S. L. (2023). Towards 2050 net zero carbon infrastructure: a critical review of key decarbonization challenges in the domestic heating sector in the UK. *Energy Sources, Part B Econ. Plan. Policy* 18 (1), 2272264. doi:10.1080/15567249.2023.2272264
- Sampei, Y., and Aoyagi-Usui, M. (2009). Mass-media coverage, its influence on public awareness of climate-change issues, and implications for Japan's national campaign to reduce greenhouse gas emissions. *Glob. Environ. change* 19 (2), 203–212. doi:10.1016/j.gloenvcha.2008.10.005
- Schreier, M. (2018) "Sampling and generalization," in *The SAGE handbook of qualitative data collection*. London: SAGE Publications, 84–97.
- Shoemaker, P. J., and Reese, S. D. (2013). *Mediating the message in the 21st century: a media sociology perspective*. London, UK: Routledge.
- Sovacool, B. K. (2021). Who are the victims of low-carbon transitions? Towards a political ecology of climate change mitigation. *Energy Res. and Soc. Sci.* 73, 101916. doi:10.1016/j.erss.2021.101916
- Steven, J. (2024). Allen. Running hot and cold: climate doomsdays across three centuries. Available at: <https://www.climatedollars.org/full-study/running-hot-and-cold-climate-doomsdays-across-three-centuries/> (accessed on February 05, 2024).
- Strauss, N., Painter, J., Ettinger, J., Doutreix, M. N., Wonneberger, A., and Walton, P. (2021). Reporting on the 2019 European heatwaves and climate change: journalists' attitudes, motivations and role perceptions. *Journal. Pract.* 16 (2–3), 462–485. doi:10.1080/17512786.2021.1969988
- Su, M. (2002). El Niño set to make a comeback this spring. China youth daily. Available at: https://zqb.cyol.com/content/2002-01/31/content_384243.htm (access on 06 March 2024)
- Sun, Q., Xiao, Q., Jiang, J., and Huang, X. (2024). The loss of political connections and the fluctuation of corporate stock prices: moderating effect based on media attention. *Heliyon* 10 (6), e27902. doi:10.1016/j.heliyon.2024.e27902
- Thomas, D. R. (2003). A general inductive approach for qualitative data analysis.
- Torrance, H. (2012). Triangulation, respondent validation, and democratic participation in mixed methods research. *J. Mix. methods Res.* 6 (2), 111–123. doi:10.1177/1558689812437185
- Tufte, T. (2017). *Communication and social change: a citizen perspective*. John Wiley and Sons.
- United Nations (1992). Rio declaration on environment and development. Available at: https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_CONF.151_26_VolI_Declaration.pdf (accessed on January 30, 2024).
- United Nations (2024). Causes and effects of climate change. Available at: <https://www.un.org/en/climatechange/science/causes-effects-climate-change> (accessed on January 29, 2024).
- United Nations Educational, Scientific and Cultural Organization (2024). Special rapporteurs issue joint declaration on environmental transparency and media freedom. Available at: <https://www.unesco.org/en/articles/special-rapporteurs-issue-joint-declaration-environmental-transparency-and-media-freedom> (accessed on January 29, 2024).
- Urry, J. (2015). "Climate change and society," in *Why the social sciences matter* (London: Palgrave Macmillan UK), 45–59.
- Van Eck, C. W., Mulder, B. C., and Dewulf, A. (2019). "The truth is not in the middle": journalistic norms of climate change bloggers. *Glob. Environ. Change* 59, 101989. doi:10.1016/j.gloenvcha.2019.101989
- Wang, J., and Zhang, D. (2002). Air conditioner inventory reaches 7.2 million units, down jackets inventory at 32 million pieces—unpredictable weather puts companies in a dire situation. *China Youth Dly*. Available at: https://zqb.cyol.com/content/2002-03/18/content_410289.htm (access on 05 May 2024)
- Wang, Y., Fang, X., Yin, S., and Chen, W. (2021). Low-carbon development quality of cities in China: evaluation and obstacle analysis. *Sustain. Cities Soc.* 64, 102553. doi:10.1016/j.scs.2020.102553
- Wang, Y., and You, K. H. (2024). News media coverage of carbon neutrality in Korea and China: a big data analysis. *J. Internet Comput. Serv.* 25 (3), 55–70. doi:10.7472/jksii.2024.25.3.55
- Wang, Z., Fu, H., Ren, X., and Gozgor, G. (2024). Exploring the carbon emission reduction effects of corporate climate risk disclosure: empirical evidence based on Chinese A-share listed enterprises. *Int. Rev. Financ. Anal.* 92, 103072. doi:10.1016/j.irfa.2024.103072
- Widener, P., and Rowe, C. (2018). Climate discourse: eluding literacy, justice and inclusion, by evading causation, privilege and diversity. *Environ. Sociol.* 4 (1), 162–174. doi:10.1080/23251042.2018.1434035
- Williams, J. (2016). Can low carbon city experiments transform the development regime? *Futures* 77, 80–96. doi:10.1016/j.futures.2016.02.003
- Wilson, K. M. (2000). Drought, debate, and uncertainty: measuring reporters' knowledge and ignorance about climate change. *Public Underst. Sci.* 9 (1), 1–13. doi:10.1088/0963-6625/9/1/301
- Wonneberger, A., Meijers, M. H., and Schuck, A. R. (2020). Shifting public engagement: how media coverage of climate change conferences affects climate change audience segments. *Public Underst. Sci.* 29 (2), 176–193. doi:10.1177/0963662519886474
- World Meteorology Organization (2024). WMO confirms that 2023 smashes global temperature record. Available at: <https://wmo.int/news/media-centre/wmo-confirms-2023-smashes-global-temperature-record> (accessed on January 29, 2024).
- Wu, Z., Duan, C., Cui, Y., and Qin, R. (2023). Consumers' attitudes toward low-carbon consumption based on a computational model: evidence from China. *Technol. Forecast. Soc. Change* 186, 122119. doi:10.1016/j.techfore.2022.122119
- Xue, J., He, Y., Gao, P., Tang, Y., and Xu, H. (2022). Multi-agent evolutionary game model: corporate low-carbon manufacturing, Chinese government supervision, and public media investigation. *Sustainability* 14 (9), 5587. doi:10.3390/su14095587
- Yang, G., and Calhoun, C. (2007). "Media, civil society, and the rise of a green public sphere in China," in *China's embedded activism* (New York, USA: Routledge), 87–106.
- Yang, G., and Wang, J. (2018). *The development and characteristics of early environmental news reporting in China*. Beijing, China: News Frontline. 08. Available at: http://paper.people.com.cn/xwzx/html/2018-08/01/content_1888313.htm (access 10/June/2024)
- Yang, X., and Chen, Q. (2023). Mining violations, rent-seeking, and resource governance in China: evidence from central environmental protection inspection. *Extr. Industries Soc.* 13, 101218. doi:10.1016/j.exis.2023.101218
- Zeng, S., Jin, G., Tan, K., and Liu, X. (2023). Can low-carbon city construction reduce carbon intensity? Empirical evidence from low-carbon city pilot policy in China. *J. Environ. Manag.* 332, 117363. doi:10.1016/j.jenvman.2023.117363
- Zhang, D. (2002) Recent widespread abnormal rainfall linked to El Niño—el Niño shows a different temperament this year. *China Youth Dly*. Available at: https://zqb.cyol.com/content/2002-07/09/content_489038.htm (access on 06 March 2024)
- Zhang, H., and Su, L. (2020). "Chinese media and journalists in transition," in *The global journalist in the 21st century* (New York, USA: Routledge), 9–21.
- Zhao, F., Wang, J., and Xiao, H. (2024). Climate change disclosure and stock price informativeness, evidence from China. *Appl. Econ. Lett.*, 1–10. doi:10.1080/13504851.2024.2334438
- Zhao, Z. Y., Gao, L., and Zuo, J. (2019). How national policies facilitate low carbon city development: a China study. *J. Clean. Prod.* 234, 743–754. doi:10.1016/j.jclepro.2019.06.116
- Zhou, E., and Wang, W. (2020). *Xinhua Headlines: illegal mining threatens China national nature reserve, Xinhua investigation finds*. Beijing, China: Xinhuanet. Available at: http://www.xinhuanet.com/english/2020-08/12/c_139285788.htm. (access 10 June 2024)
- Zong, X., Tian, X., Yao, Q., and Brown, P. M. (2022). An analysis of fatalities from forest fires in China, 1951–2018. *Int. J. Wildland fire* 31 (5), 507–517. doi:10.1071/WF21137

Appendix 1

Interview Invitation Letter

Dear who it may concern,

This is to invite you to be our interview participants in the research titled: Public Awareness of low-carbon urban transition in China.

I'm Yan Wu, a PhD researcher from Maastricht University, focusing on climate change, sustainability, and low-carbon city transition, under the supervision of Prof. Dr. Pim Martens and Prof. Dr. Thomas Krafft. I am supported by the China Scholarship Council (CSC) under grant No. 202008320395.

Addressing global climate change necessitates collective action. To work towards a low-carbon future, we aim to investigate public awareness and behaviors related to low-carbon practices. This interview will be used for research purposes only and will not be used for commercial activities. Your responses reflect your personal views and will remain anonymous.

Many thanks for your participation.

Interview Questions

1. Current position in your institution. Please describe any previous experience working on environmental issues.
2. What is your understanding of low-carbon lifestyles and climate change
3. How did you learn about these?
4. How do you see the switch to low-carbon lifestyles and low-carbon urban transition?
5. How you think about the gap between low-carbon awareness and people's real-life actions?
6. What do you think are the main factors that affect people's low-carbon awareness?
7. How select the low-carbon/ climate change news topics, interact with sources?
8. Factors influencing media attention and reporting on climate change?
9. What's your opinion about the role of technology in climate communication.?
10. How to improve public's low-carbon awareness and Interactivity (online and offline), encourage people to participate in climate action through media