

The Framing of Renewable Energy's Connection to Public Health in Global Newspapers

by

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ABSTRACT

The global reliance on fossil fuels is driving climate change and urban air pollution, both of which constitute grave threats to public health. Poor air quality has dramatically increased the incidence of respiratory illness in large cities. Climate change has brought about increased frequency and intensity of extreme weather events which directly affect public safety and lead to destruction of farmland and fresh water sources. A globally scaled transition from fossil fuel combustion to low-carbon “clean” technology for power generation is necessary for both climate change mitigation and urban air quality improvement—a feat that could be feasibly accomplished through worldwide development of renewable energy (RE) infrastructure, consequently resulting in improved public health. From the perspective of advancing technical communication research, this study performs a qualitative content and frame analysis of recent newspaper articles that draw connections between RE and public health, thereby clarifying the primary messages the public receives about these two topics which are related by climate change.

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CHAPTER 1

INTRODUCTION

It is difficult to find an aspect of modern civilization that is not contingent upon the availability of energy. Most of the world's energy systems depend on fossil fuels (Caetano et al. 2017) to generate electricity and to power transportation. To wit: the United States gets 81% of its energy from oil, coal, and natural gas (NASEM 2022). This global reliance on fossil fuels is driving climate change and urban air pollution, both of which constitute grave threats to public health.

Regional changes in climate, particularly increased temperatures, have dramatically increased the frequency and intensity of extreme weather events, flooding, drought, and destruction of farmland, fresh water sources, and wildlife (Congressional Digest Corporation 2019; Diesendorf 2013; Edenhofer et al. 2011; Moser 2010; Patz et al. 2014). While it is understood that earth has experienced other naturally-induced climate changes throughout its 4.5 billion year history, it is well-established that the climate change which is occurring presently is *unnatural*—caused by an excessive atmospheric accumulation of greenhouse gases (GHG) from combustion of fossil fuels (Edenhofer et al. 2011; Aakre and Rübhelke 2010; Björnberg et al. 2017; Cagle and Tillery 2015; Haines et al. 2009; Patz et al. 2014).

Reliance on fossil fuel combustion for energy generation diminishes public health both *directly*—poor air quality from GHG accumulation has dramatically ramped up the incidence of respiratory illness in the world's largest cities (Lin and Tsai 2021; Erickson and Jennings 2017); and *indirectly*—climate change has brought about extreme weather

events that result in immediate safety risks, and is creating longer-term problems such as damaged food and water supplies.

Reduction of GHG emissions is necessary for both climate change mitigation and urban air quality improvement, and is most feasibly accomplished by developing low-carbon energy infrastructure (Edenhofer et al. 2011; Perkins 2017). Mollification of the environmental and public health problems caused by climate change requires the phase out of fossil fuels (Perkins 2017) in favor of renewable energy (RE), i.e., power generation processes that can be derived from natural mechanisms. RE includes energy sources such as solar, wind, geothermal, tidal, biofuel, etc. and excludes fossil fuel-derived sources such as oil, coal, and natural gas (Diesendorf 2013; Elum and Momodu 2017). Implementation of RE promises to make a sizable contribution to climate change mitigation (Yang, Javanroodi, and Nik 2022) and urban air quality improvement (Erickson and Jennings 2017; Buonocore et al. 2019). If an eventual transition from fossil fuel combustion to renewable/clean technology for energy production can be accomplished, it can be expected that the worsening effects of climate change and air pollution will decelerate, consequently improving public health worldwide. The relationship is illustrated in Figure 1.

Academic scholars have attested that climate change negatively impacts public health, and that strategies for mitigating climate change can offer collateral improvements to public health (Cagle and Tillery 2015; Haines et al. 2009; Myers et al. 2012; Watts et al. 2018). Because wind and solar power, for example, can feasibly generate a large share

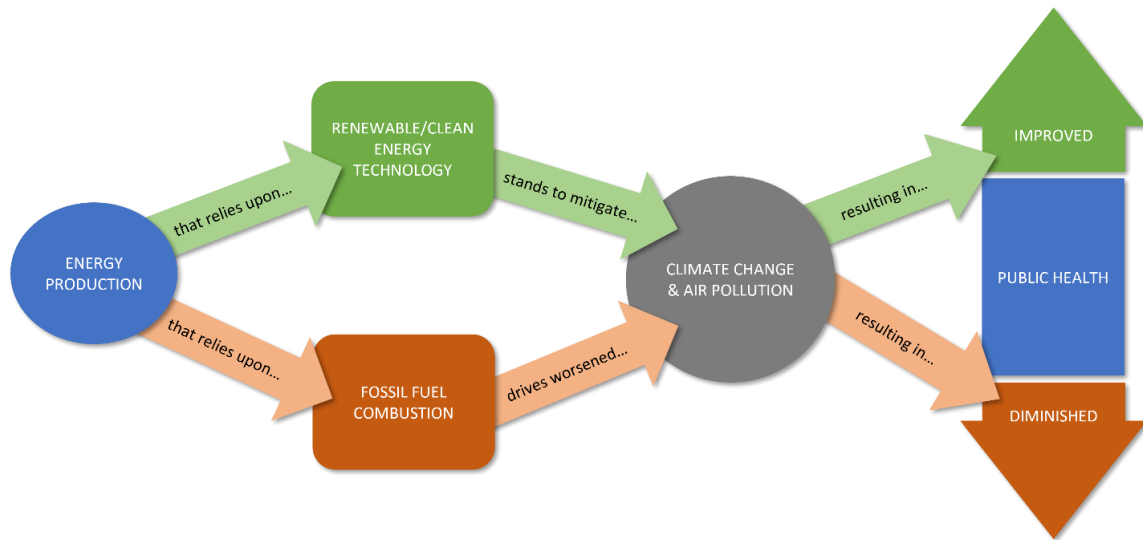


Figure 1. Energy production driven by renewable/clean technology has the potential to mitigate climate change and air pollution, which would result in improved public health. The opposite is true for energy production that continues to rely on fossil fuel combustion.

of an energy system’s demanded electricity, and in doing so provide major air-quality and climate benefits, it follows that implementation of RE constitutes climate change mitigation technology that offers significant potential for improving public health (Buonocore et al. 2019). But an expeditious fulfillment of a shift from fossil fuel power generation to RE will require a great deal of public support. Society at large must be of majority opinion that implementation of RE on a large scale is a good idea. Annual Gallup polls consistently find that at least two thirds of Americans, across all demographic groups, are concerned about climate change (Saad 2021). And a 2019 Gallup poll found that 6 in 10 Americans support the premise of shifting from fossil fuels to RE solutions as a way to address climate change (McCarthy 2019). But are the public health benefits of a large-scale shift to RE at the forefront of the public’s consciousness? In order to consider that

question from a technical communication perspective, this study examines how the connection between public health and renewable energy is depicted in news media.

Climate change connects to many important social, economic, and political issues such as public health, energy supply, social justice, and infrastructure. Despite a growing body of literature on climate change's connections to other topics, it is not easy to find interdisciplinary research on topics that are connected *because* of climate change. With only a few exceptions, the intersection of RE and public health does not receive extensive attention in scholarly research. However, this junction *does* surface in news media. Mass media performs a significant function in determining which topics are at the center of people's attention (McCombs and Valenzuela 2020) and plays an important role in conveying and creating knowledge (Weathers and Kendall 2016). Moreover, the news media is critical in shaping public opinion about who is responsible for solving social problems (Iyengar and Kinder 2010).

Climate change news stories are typically framed as environmental issues (Rademakers and Johnson-Sheehan 2014). Weathers and Kendall (2016) argue that framing climate change as an environmental problem instead of a societal issue that has public health implications likely contributes to a lack of public engagement that is necessary to develop solutions. This study, therefore, is novel in its attempt to examine two topics related by climate change (Figure 2), and how that connection is depicted in news media, thereby clarifying the primary messages the public receives about RE and public health's relationship. It is hoped that this analysis will advance future researchers' concepts for public engagement toward climate change solutions.

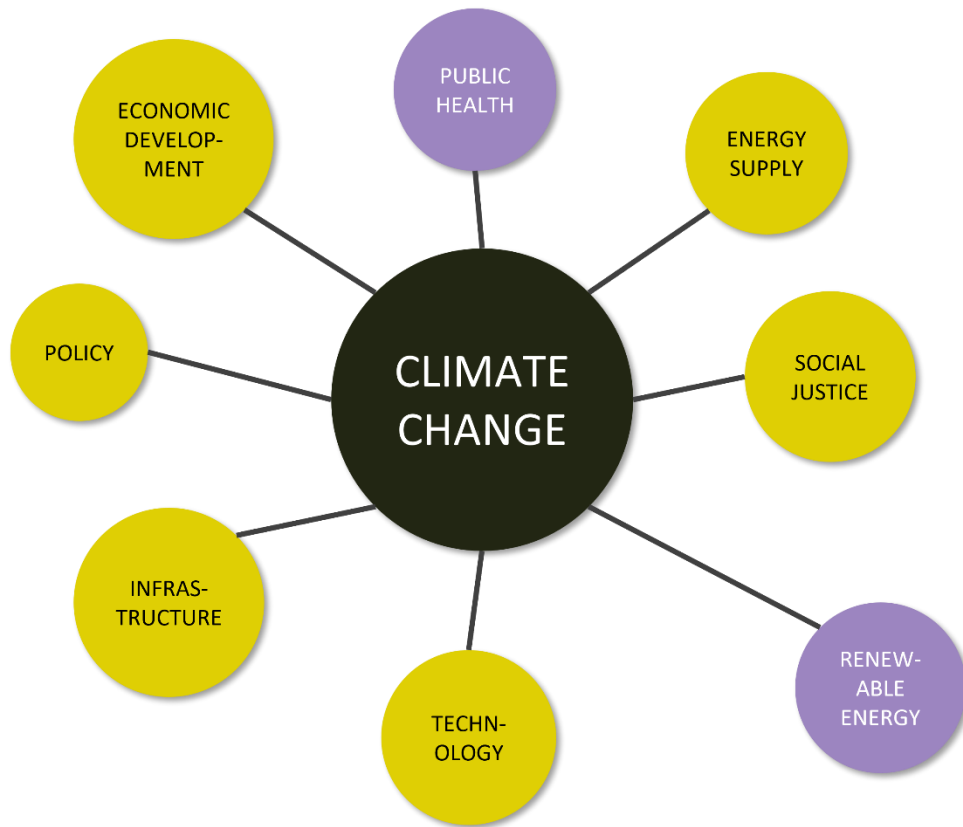


Figure 2. Like a hub with spokes, climate change has connections to many other topics. This study examines how the news media depicts two topics related by climate change.

This study performed a qualitative content and frame analysis of one recent year’s worth of newspaper articles that broached this specific interdisciplinary topic. Framing studies such as this one are concerned with how media report an event or issue. The approach to content and frame analysis employed here is a model known as emergent coding, derived from the qualitative research concept of grounded theory (Birks and Mills 2015; Chun Tie, Birks, and Francis 2019; Glaser and Strauss 1967). In this project, the emergent coding process—where coding categories are developed and revised as coding

proceeds—was used to shed light on which frames were common in news representations of RE and public health’s connection.

This thesis is divided into five main chapters. To give context to the analysis of newspaper coverage of RE and public health, CHAPTER 2 LITERATURE REVIEW summarizes selected prior scholarship on RE and public health in the news media. It concludes with an explanation of the research questions that defined the overall study.

CHAPTER 3 METHODS considers the theoretical relevance and practical importance of this study by outlining framing theory and its contributions to our understanding of how mass media shapes societal opinions and advances the public understanding of science. It reviews the approach to content analysis employed by this project as well as its relationship to framing theory. That chapter also details the steps that were taken to collect a data sample and develop a codebook from which repetitive news frames were identified.

CHAPTER 4 RESULTS delineates the eleven common frames (divided into two categories) that were identified as a result of the inductive coding methods that were applied.

For each of the eleven frames, a description and brief discussion is provided, along with selected examples of the frame’s application from the data set. Six commonly repeated contexts were also identified during the content analysis. As with each of the frames, each context is described, discussed, and exemplified. The Results chapter uses tables and discussion to detail the prevalence of the discovered frames and supporting contexts and concludes with a discussion of the relationships between those frames and contexts.

CHAPTER 5 DISCUSSION AND CONCLUSION considers the implications of this study’s findings while reflecting on the study’s contribution to technical communication

research, the utility and repeatability of its methods, and possible directions for future research.

CHAPTER 2

LITERATURE REVIEW

The news media is a cornerstone institution in the world's democracies (De Vreese 2005), with millions if not billions turning to the news media daily to learn about and to help understand the world. A baseline assumption is that its purpose is to inform people of timely issues and events. Perhaps equally important, the news media influences public opinion (Chong and Druckman 2010) by presenting events and defining issues in specific ways—a concept termed “framing.” Research suggests that news media also play a key role in the diffusion of new technologies into mainstream society (Skjølsvold 2012), such as the development and adoption of RE, an important factor in climate change mitigation (Edenhofer et al. 2011).

Content Analysis & Framing Theory

Content analysis is an extensively used communication research method that systematically examines the characteristics of texts to allow for inferences to the contexts of their use (Thayer et al. 2007). It is the process of observing categories that emerge out of text data. Scholars from a multitude of disciplines use content analysis; its most frequent application is in social science and mass communication research (Prasad 2008), as a tool for organizing themes such as news coverage of social problems, political trends, or public attitudes. Through systematic classification of text content into an efficient number of categories that represent meaning, themes emerge that help to reveal underlying meaning (Hsieh and Shannon 2005). For communication science, understanding how science journalism can be characterized requires content analysis of news media (Summ and Volpers 2016).

Three types of qualitative content analysis have been identified: summative, directed, and conventional (Hsieh and Shannon 2005). Summative content analysis involves counting the instances of words, phrases, or other content and the subsequent interpretation of that quantification. Directed content analysis applies preconceived conceptual categories to a new context; it is appropriate for use when the goal is to validate or extend a theoretical framework (Humble 2009). Conventional content analysis, applied in this project, is the process of observing categories that emerge out of the data. It is a powerful data reduction technique with the most important benefit being that it is a systematic, replicable technique for compressing lengthy text into just a few content categories based on explicit rules of coding. Other attractive features are its unobtrusiveness (eliminating the need to recruit human participants) and ability with large volumes of data (Stemler 2000).

Content analysis can provide significant insights into cultural and historical phenomena through analysis of text. The researcher's identification and quantification of themes and concepts in a data set allows for broader inferences about a subject matter than does an interview or survey (Renz, Carrington, and Badger 2018). Krippendorff (2013) describes content analysis as "indigenous" to communication research because it analyzes data captured in messages versus that from observable events. It is therefore useful and relevant to the field of technical and professional communication to practice content analyses of news media in order to examine how topics are presented to the public.

Scholars in communication, the social sciences, political science, and economics who are concerned with the effects of propaganda and persuasive messages have

recognized content analysis as an essential research tool for proposing possible explanations or relationships among concepts (Riffe et al. 2019, 5). Systematic content analysis has shown how communicators, especially journalists, shape interpretations by creating frames—central organizing ideas that supply context and suggest what the issue is (Tankard Jr 2001).

Gamson and Modigliani (1989) define frames as interpretative packages that provide a central organizing idea for making sense of an event or issue—in other words, a story line that gives meaning to an event or issue. Frames provide a way to emphasize certain elements of a topic over others, thus suggesting a way to understand an event or issue. Framing is the communicator's act of choosing to promote a particular definition, interpretation, moral evaluation, or recommendation (R. M. Entman 1993). As a macro construct, framing refers to how communicators present information in ways that resonate with their audience. As a micro construct, framing details the way individuals utilize information (Scheufele and Tewksbury 2007).

Frame analysis is the observation and assessment of how frames are constructed and applied. In communication research, framing is widely studied to understand the relationship between media and public opinion. If we think of news media frames as communication mechanisms that help define problems and shape public opinion (Iyengar and Kinder 2010), then a form of content analysis in which news media frames are studied becomes a technique for understanding how news media links concepts together (Creed, Langstraat, and Scully 2002).

Framing is concerned with the presentation of issues. However, the term is used inconsistently in academic literature, and there is no singular opinion over whether frame

analysis should focus on content or effect (De Vreese 2005). News media frames may be studied either as *dependent* variables, i.e., the outcomes of their application; or as *independent* variables, i.e., what it is that will affect audience interpretation. In either case, frame analysis of news coverage can provide useful insights into the public's perceptions of social issues, as well as creating implications for future communications research (An and Gower 2009). By identifying recurrent frames used in newspaper articles about RE and public health's relationship, this study codifies how that relationship is presented to the public and aims to spark future research inquiries into the framing of climate change-related news media.

The Global Energy Transition

The February 2022 Russian invasion of Ukraine disrupted global energy markets, generating energy price spikes not seen since the 1970s and amplifying a global energy crisis that began with the COVID-19 pandemic. Crude oil, coal, and gas prices have all reached historic highs (Guenette and Khadan 2022). Although this seemingly paves a way for scaling up RE, high commodity prices and supply chain bottlenecks have led to increased equipment costs and delivery delays across the globe (Henze 2022), undermining the pace of the clean energy transition. A joint study by the Global Solar Council and the Global Wind Energy Council found that there will be a 29% shortfall in the projected wind and solar capacity required to sustain a pathway to carbon neutrality by 2050 (Global Solar Council 2021).

By a long shot, China has the world's largest solar and wind power capacities. A third of all solar PV and half of all wind global additions in 2021 were installed in China—twice as much as the United States, which is the world's second-largest market

(Luise 2022). But China’s industries draw concerns about human and labor rights (Al Jazeera 2022), and solar panel manufacturing, which is concentrated in China, is mostly powered by coal. As world governments are seeking to mitigate climate change while abandoning risky fossil-fuel dependencies, they need to focus on ensuring the security of RE supplies and production as an integral part of clean energy transitions.

Global energy security needs to be redefined to include materials supplies and manufacturing capabilities necessary to deliver RE. More attention should be paid to countries’ high reliance on energy imports, raw materials, and manufacturing goods that are key to their supply security. To expand the global production of RE, reducing supply chain vulnerabilities is critical for a secure energy transition. Prioritizing investment in research and development, as well as in workforce training, can lead to manufacturing processes that are less reliant on critical commodities or global trade.

It is expected that RE will become the lowest-cost energy source in the immediate future (IRENA 2018). Continued reliance on fossil fuel–based energy comes at an even greater cost from direct health impacts and ecological damage. Although RE promises relief from ever-rising fossil fuel prices, it is necessary to replace the “cheapest form of power” narrative with one about RE’s unique potential to generate energy security (Luise 2022). In underserved communities, RE could be a boon that offers low-cost energy that does not involve the negative health impacts of fossil fuels (APHA 2018).

Mass Media’s Place in Communication Research

The practices of journalism—its management, personnel, impact, and effects—are central to communication research’s origin story. Traditionally, news has functioned as an avenue for people to find out what is happening in the world (Swart, Peters, and

Broersma 2018). During the World Wars, as political and social developments drew public attention to the social sciences, the news became an object of academic study for its role in making public sentiment (Glander 1999). Journalism, by and large, became squarely positioned as belonging to the mass communication subfield (as opposed to organizational communication, interpersonal communication, or technical communication), but the attributes that journalism shares with other forms of communication research provided a critical foothold for the development of communication studies (Glander 1999; Zelizer 2011).

The earliest academic investigations of journalism's role in public opinion formation were carried out by sociologists at the University of Chicago during the first four decades of the 20th century (Pooley and Katz 2008; Wahl-Jorgensen 2004; Zelizer 2011). During the World Wars, as political and social developments drew public attention to the social sciences, the news became an object of academic study for its role in making public sentiment (Glander 1999). A postwar appetite for research into how journalism influences society opened up a space for communication as an academic field grounded in problems of mass persuasion (Wahl-Jorgensen 2004).

Journalism studies helped to shape communication's disciplinary objectives by helping to define communication's boundaries, legitimate communication's authority, identify problems within the field, and influence its assumptions (Jansen 2010). Everywhere that communication research took hold during the 20th century, journalism was nearby—in writing, language, and history; and in social sciences inquiry about political, economic, and social effects (Glander 1999; Wahl-Jorgensen 2004). The interdisciplinary, behavioral science approach to communication research that marked the Chicago

school of thought shifted in the late 50s and early 60s, from qualitative social science to a more empirical approach that was sponsored by American schools of journalism (Pooley and Katz 2008). In Europe, sociology and political science scholars developed concepts based on their observations of journalism practices that would ultimately prove central to the field of communication studies (Zelizer 2011).

The tradition of journalism research that has grown up within university programs has tended to focus more on its purpose as a professional occupation and less on the overall purpose of journalism in society (Gans 2004). Early college-based journalism training was intended to turn out professional writers; but modern journalism programs are likely to be found in social science departments (Hartley 2008). Journalism was eventually incorporated into social studies as an ideological practice rather than a professional one. News texts and imagery are analyzed for their semiotic, narrative, and communication properties, in order to identify what causes the political or social impact that is observed (Hartley 2008). In the 21st century, journalism and mass media research emanates from communication, business, political science, and sociology faculties. Journalism, like other areas of practice-oriented scholarship, such as marketing or public relations, offer the field of communication a place in the real world and a reminder of why its scholarship matters. Mass media research serves to question dominant assumptions about what constitutes knowledge making and contributions to understanding society (Mellado, Georgiou, and Nah 2020).

Because the mass media constitute modern society's framework for societal self-observation (Schäfer 2012), a central concern for social scientists (including Technical and Professional Communication scholars who study science communication) is how

science is presented by mass media. Digital mass media have become the world's paramount source of information, and this is particularly true for scientific information. People in the United States cite the internet as their primary science and technology information source (National Science Board 2016). In principle, anyone with an internet connection has limited access to scientific information; in practice, however, news of scientific advancement only reaches those who seek it out. As an astute 2009 editorial in *Nature* pointed out, the average citizen is unlikely to browse the web for in-depth scientific information without first hearing or seeing something presented by mass media ("Filling the Void" 2009). For information about science and technology, the public draws primarily on the news media—particularly that which is available online (Barel-Ben David, Garty, and Baram-Tsabari 2020; Castell et al. 2014; Peters et al. 2014; Takahashi and Tandoc 2016).

Our society is structured in such a way that scientists are ill-prepared to deliver their messages to the public. Therefore, society must rely on journalists for science and technology news. Because the scientific community has historically corralled its findings within its own circles without viewing society at large as a relevant audience (Weingart 2011), science coverage in mass media remains the primary bridge between science and the public. Numerous studies have demonstrated that presentation of topics in news media plays a critical role in influencing public attitudes and in mainstream society's acceptance of new technologies (Cox and Depoe 2015; Djerf-Pierre, Cokley, and Kuchel 2016; Skjølsvold 2012). Given that most adults gain their understanding of social and environmental issues from mass media (Boykoff and Boykoff 2007; Weathers and Kendall

2016), news outlets are the primary influencers of public opinion as to how social issues are best solved and who is responsible for executing those solutions.

Democratic Roles of the Press

There is a traditional democratic role of the press as a watchdog that can make critical observations and raise ethical questions, and that manifests in journalists' choices of which topics to present and how to frame them (Barel-Ben David, Garty, and Baram-Tsabari 2020; Choi 2020; Figdor 2017). Christians's taxonomy (2010) distinguishes four normative roles of the press: monitorial, radical, facilitative, and collaborative. This organization scheme helps us understand journalism's relationship to advocacy and social progress.

A monitorial press keeps a watchful eye on those in power. Oriented toward improving transparency, the monitorial press participates in ensuring that officials cannot perpetuate wrongdoing (Ytre-Arne and Moe 2018). Research questions regarding a monitorial press revolve around the extent to which the public should be expected to study and understand complex political issues, and how reporters can facilitate distillation of those issues for faster digestion by society at large.

A radical press systematically critiques power structures and acts to condemn structures that perpetuate oppression (Christians et al. 2010; Stewart 2014; Timney 2013). Atton calls the radical press "an extremely democratic form of communication," as it is a venue for people who are normally denied access to the mainstream media (Atton 2002). A radical style of reporting prefers first-person accounts of events over more traditional, detached commentary. This was famously seen in the UK at the end of World

War II, when newspaper rationing freed journalists from the fear of alienating advertisers, allowing a stronger alignment with the working class (Thomas 2003).

A facilitative press promotes public deliberation. Rather than seeking to inform people of the activities of those in power, the facilitative press encourages public participation and public debate (Wimmer 2000), such as the “Front Porch Forum,” a late nineties partnership between the Seattle Times newspaper, KUOW-FM radio station, and the Pew Center for Civic Journalism that featured stories on issues affecting Seattle residents (Blazier and Lemert 2000).

A collaborative press is one that seeks to develop partnerships between reporters, media outlets, and the institutions in the news. The digital communication technologies of the present century enable a more inclusive public sphere (McNair et al. 2017). The internet enables citizens to overcome traditional flow of power limitations, in favor of democratic flows of information (Carson and Farhall 2018). Mass media’s commercial interests impede its public interest functions. Rather than offering a check on power, news media produce content that upholds the interests of profit making (Herman and Chomsky 2002). Thus, the internet and its social media forms create an avenue for public discussion that is not limited to the goals of a single institution.

A fifth norm, not included in Christians’s taxonomy, is constructive journalism, an emerging form of news reporting being pioneered by two Danish journalists, Catherine Gyldensted and Ulrik Haagerup, who argue that negativity bias in news leads to public frustration with societal developments (Bro 2019). Constructive journalism draws from positive psychology and its assumption is that constructive news can lead to positive emotions (Tshabangu and Salawu 2021). In desperate times, such as during a

pandemic, war, or climate crisis, the role of constructive journalism is to provide solutions and avoid elevating public fear and anxiety. In many respects, the newspaper articles collected for this research project can be said to qualify as constructive works of journalism, given their recommendations for RE as a means of addressing the climate crisis.

Nelkin's classic book (1995) claims that science journalism should provide three things to non-scientists: it should keep people apprised of scientific advancements, it should assess the appropriateness of scientific research, and it should make choices related to perceived personal risks. Scholars citing Nelkin argue that a public informed by science journalism should be better equipped to make decisions when faced with competing arguments related to their safety, health, and environment (Secko, Amend, and Friday 2013). News media are critical intermediaries for translating science information into forms easily understood by the public (Viswanath 2008). Nelkin (2001) suggested that the news media act as brokers between science and the public, shaping public consciousness about science-related events. Recent explorations of health and medical journalism has begun to examine how health reporters may influence factors that act as antecedents to media agenda setting and framing in health and medical science news (Wallington et al. 2010). This study seeks to contribute to illumination of that line of thought through its collection and analysis of newspaper articles that explore how RE, public health, and their connection to climate change are framed by the media.

Public Understanding of Science

Public understanding of science (PUS), also termed public awareness of science or public engagement with science and technology, refers to a research discipline that

examines the relationship between the general public and scientific knowledge. Early work in the PUS discipline fell in line with the deficit model of science communication (Simis et al. 2016), which imputes that public skepticism toward science is due to lack of understanding. According to the deficit model, scientists possess crucial knowledge that non-scientists lack, and the purpose of science communication is to fill the knowledge gaps by creating a flow of information from expert to layperson (Reincke, Bredenoord, and van Mil 2020; Sinatra, Kienhues, and Hofer 2014).

The deficit model has been heavily criticized for its implicit assumption that scientific expertise dominates other forms of knowledge (Jasanoff 2011; Reincke, Bredenoord, and van Mil 2020; Lauer 2020). Questions have been raised regarding science experts' ability to participate in public interactions such as one-way flow of information from expert to layperson (Reincke, Bredenoord, and van Mil 2020). The deficit model also assumes that more scientific knowledge induces a positive attitude with respect to science, for example, feelings of trust (Nisbet and Scheufele 2009; Sinatra, Kienhues, and Hofer 2014).

Today, most communication experts consider the deficit model obsolete (Dudo and Besley 2016; Nisbet and Scheufele 2009; Simis et al. 2016). PUS research has shifted toward two other models: the dialogue model, which promotes communication between scientists and the public; and the participation model, which facilitates inclusion of non-scientists in scientific processes (Hetland 2016; Kahlor and Stout 2010; Osseweijer 2006). In the dialogue model, non-scientific forms of knowledge, such as cultural or experiential knowledge, are considered equal in value to scientific knowledge. Science may offer insights into possible risks and benefits of scientific advancements but cannot

regard the individual or social meaning that is implied (Reincke, Bredenoord, and van Mil 2020). For example, how we regard health or climate change is influenced by our beliefs, socioeconomic status, and personal experience (Simis et al. 2016; Sivertsen and Meijer 2020). In the dialog model, members of the non-scientific public are encouraged to share their perspectives; a two-way flow of information between scientist and layperson engenders mutual learning (Besley and Nisbet 2013; Grand et al. 2015; Nisbet and Scheufele 2009).

While the dialogue model concerns itself with PUS, the participation model stresses the methods used to produce new knowledge; the two models are interrelated, as they both focus on dialogic approaches to public engagement rather than one-way information dissemination (Bucchi 2008; Hetland 2016). The central concept behind the participation model is to create communication initiatives in which experts and audiences are reconfigured as collaborative groups where knowledge is co-produced through mutual learning; individuals who possess expertise in non-scientific arenas are encouraged to act as agents of change through the collaborative production of knowledge (Bonney et al. 2016; Phillips, Carvalho, and Doyle 2012).

Scholarly critiques of science journalism consistently point to problems with uncritical reporting and failure to present a range of expert opinions (Elmer, Badenschier, and Wormer 2008; Lewis, Orrock, and Myers 2010; Sumner et al. 2014). The repetitive criticisms of science journalism, however, fail to produce recommendations on how to improve (Secko, Amend, and Friday 2013). This is due to lack of clarity on the role of science journalism and lack of agreement on what constitutes improving the public understanding of science (Bauer 2009; Bonney et al. 2016; Retzbach and Maier 2015). An

uptick of attention to scientists as public communicators has marked the beginning of the 21st century. Such research is helping to clarify the characteristics of scientists' communication efforts toward the public (Besley and Nisbet 2013; Peters et al. 2014). Much of this attention stems from encouragement by scientific community leaders to build rapport between science and the public, to ensure that their views contribute to policy making (Dudo and Besley 2016).

Rae Goodell-Simpson's 1977 book *The Visible Scientists* is considered a landmark work in PUS. One of the reasons the book has deeply influenced research in science communication is its discussion of the impact of scientists who are well-known to the public. *The Visible Scientists* argued that scientists of public prominence in the United States—such as astronomer Carl Sagan, anthropologist Margaret Mead, and chemist Linus Pauling—were distinct because they were uniquely attuned to the needs of the mass media (Bucchi 2008; Fahy 2017).

These so-called visible scientists used their prominence gained from interaction with mass media to draw public attention to science policy issues. They turned to the mass media, Goodell-Simpson argued, because the traditional mechanisms through which scientists impacted policy no longer functioned properly (Goodell 1977). They saw science communication as a form of influencing policy formation (Fahy 2017; Joubert and Guenther 2017). Addressing research questions over how the scientific community approaches public engagement has contributed to some improved best practices (Dudo and Besley 2016). For example, the American Association for the Advancement of Science (AAAS) ratified an updated set of organizational goals in 2007 that include enhancing communication among scientists and the public (Lohwater and Storksdieck 2017). And

many articles have reported on the benefits of two-way communication between scientists and the public, which include improved attitudes about the legitimacy of science to inform decision-making (Stylinski et al. 2018). However, communication research regarding PUS has also brought to light new questions that necessitate more granular research.

Leading scientists have frequently commented on the communication shortcomings that create problems with PUS (Cicerone 2006). The countless activities aiming to improve the science–media relationship prove the widespread perception of an unsatisfactory relationship between the two entities (Peters et al. 2014). Not only do the 21st century’s digital media platforms create avenues for people to inform themselves about what is happening, they also create a medium for public connection, through commenting, liking, or sharing. Online media provide shared frames of reference that enable people to engage and participate within their societies (Loosen and Schmidt 2012).

Because the scientific community has historically corralled its findings within its own circles without viewing society at large as a relevant audience (Weingart 2011), science coverage in the news media remains the primary bridge between science and the public. Media coverage strongly contributes to the public image of science and influences its public support and funding. As a result, it has become a norm that scientists are expected to communicate with the mass media. Many scientific institutions have established formal interfaces for responding to media demands (Peters et al. 2008; 2014).

To build public trust through participation, Hagendijk (2004) argues that society requires a better understanding of the new media-culture in relation to issues of science and technology. Research should focus, Hagendijk continues, on the ways in which

narratives and attitudes toward science emerge and change under the influence of media coverage. For example, climate researchers are in near unanimous agreement over the scientific facts surrounding climate change, but how well the mass media convey this to the public requires more inquiry (Nelkin 1995; Painter and Gavin 2016). In the specific area of climate change, there is some doubt about whether the press is able to communicate its complexities accurately (Boykoff and Boykoff 2007). As this study will show, there are many everyday examples of news media content in which the complexities of climate change's connected, ancillary topics—such as RE and public health—are being discussed.

If public understanding of climate change influences societal acceptance of climate policy, then empirical studies of factors that influence public interpretation of science may assist in developing effective communication strategies (Wolf and Moser 2011). Effective communication strategies may, in turn, influence the development of effective climate change mitigation policies (Patz et al. 2014; Zia and Todd 2010).

News Media's Role in Climate Change

In May 2019, UK's The Guardian newspaper explicitly instructed its reporters to begin referring to climate change with more urgent terminology like “climate crisis” or “climate emergency” (Feldman and Hart 2021). Beyond journalism, other actors are also increasing their use of “emergency” and “crisis” to describe climate change (Ripple et al. 2020; Colitt and Parkin 2020). Oxford Dictionaries declared “climate emergency” its word of the year for 2019, citing a 10,789 percent surge in the term's usage (Chow 2019). Existing research has shown that small changes to terminology or framing can have

significant effects on the public's perceptions of climate change (Schuldt, Enns, and Cavaliere 2017).

Following The Guardian's logic, stronger terminology may stimulate news readers' attention, encouraging them to see climate change as a more serious problem that requires immediate action. But there's also research showing that climate news stories can be overwhelming and disempowering (Moser 2010; O'Neill and Nicholson-Cole 2009; Stanley et al. 2021). Feldman and Hart (2021) examined whether the interaction of climate change terminology and political ideology ("liberal" versus "conservative") variables influenced public perceptions of climate change news. Their results showed that engagement with climate change news is unrelated to terminology, but consistently affected by whether the news stories focus on impacts versus actions.

A large portion of the body of literature over public understanding and engagement with climate change use qualitative methodologies such as surveys, interviews, and focus groups to examine people's perceptions (Besley, O'Hara, and Dudo 2019; Dudo and Besley 2016). However, research insights into the effectiveness of different communication strategies and into the factors that underlie public opinions are generally not obtained through opinion surveys (Dobbins, Gibson, and Lamm 2021; Wolf and Moser 2011). Moreover, there is often great variation, and even contradiction, between qualitative research reports. This points to a need for further refinement in our knowledge of public understanding and action regarding climate change.

It has been asserted that public understanding of climate change is critical to public interest and bringing action into fruition requires public knowledge (Zia and Todd 2010). Public knowledge of climate change is regularly cited as being critical to

development of public health policy (Fox et al. 2019) and economic analysis (Aakre and Rübhelke 2010). Furthermore, climate change mitigation policies require public acceptance in order to induce high levels of public participation. The arguments for improving public understanding of climate change rely on the premise that the public will make policy decisions that mesh with the scientific normative view (Zia and Todd 2010).

News Media's Role in Public Health

Broadly speaking, the discipline of public health has two central goals: to monitor the health of a population (which includes the identification of health problems), and to craft policies that address the identified health problems (Paul and Dredze 2017). The public health model is a theoretical framework which maintains that injury and many causes of death are preventable (Australian Institute of Family Studies 2014). This model seeks to define risk factors, then develop methods to prevent the problems that threaten public health (Callaway, Connor, and Foley 2018; Surez et al. 2017; Warren and Smalley 2014).

To support its goals, public health depends on data surveillance that includes monitoring for existing identified health concerns as well as discovering new issues. Traditionally, public health draws data from two main sources: surveys and clinical encounters (Paul and Dredze 2017). Increasingly, researchers are using social media monitoring to measure public reaction to disease epidemics (M. C. Smith et al. 2016; So et al. 2016). Compared to traditional public health monitoring, media-based monitoring is fast, cheap, covers a large population, and provides data on topics with little coverage from traditional sources (Paul and Dredze 2017; M. C. Smith et al. 2016).

Mass media play a decisive role in transmitting public health information. The framing of health information by the news media, and the ways in which audiences interpret it, has complex impacts on health-related behaviors (Grilli et al. 2002; Sharma et al. 2003; Sumner et al. 2014). These impacts are often beneficial, such as in disseminating education and promoting disease prevention (Odone and Signorelli 2016), but cumulative misreporting can delude individuals and erode public trust in medicine and science (Leveson 2012; Schwitzer 2008; Sumner et al. 2014).

For public health issues, it is critical for communicators to understand online misinformation. Public health experts who express dissatisfaction with the way health information is delivered by mass media say that anecdotes at the expense of context creates a distorted view of public health (Coleman, Thorson, and Wilkins 2011). Dredze et al. (2016) note, “public health officials must get out in front of the conspiracy theorists to educate and influence the population”. Unfortunately, little is known, regarding public health, about whether public opinion is being monitored, or what communicators are doing to counter misinformation (Avery 2017).

Despite research showing that the media are crucial contributors to the factors that guide health behaviors (Odone and Signorelli 2016; Schwitzer 2008), there is surprisingly little known about how certain public health topics are covered in the news (Yates et al. 2015), likely due to the substantial barriers to content analysis of news media (Ayers et al. 2018). These barriers include difficulty identifying and narrowing relevant content, and the sheer amount of time and effort required to read and code hundreds of articles. Yet, news media monitoring is a key tool for public health communication research (Althouse et al. 2015; Ayers, Althouse, and Dredze 2014; Schwitzer 2008).

Given news is a conduit for how information (and misinformation) spreads, news media monitoring is essential to the cultivation of public health communication research (Avery 2017; Emery et al. 2014; Odone and Signorelli 2016). Communication and journalism scholars ask: Where are specific topics garnering coverage? What issues are emerging? What interventions are being prioritized? (Althouse et al. 2015). By looking at journalists as data collectors and their reports as qualitative accounts of the public health landscape, researchers stand to glean valuable insights (Althouse et al. 2015; Ayers, Althouse, and Dredze 2014; Coleman, Thorson, and Wilkins 2011; Odone and Signorelli 2016).

Renewable Energy Framing

Media coverage of RE is shaped by political, scientific, economic, environmental, institutional, and societal aspects (Edenhofer et al. 2011). Journalists contextualize global issues such as RE to provide meaning and relevance for their readership (Clausen, 2004). Because sustained mitigation of climate change is reliant on broad adoption of RE, it is of value to understand how RE is framed in news media that influence public opinion and set political agendas, and what factors limit and enable this framing (Djerf-Pierre, Cokley, and Kuchel 2016).

Research on RE framing has yielded mixed results in terms of the effect on public support. Past work has not fully examined how different RE frames are received by in various contexts. Overall, general public opinion on RE is good; however, political support for RE policy is variable (Rabe and Mills 2017; Rogge and Reichardt 2016; Leiserowitz et al. 2020). Political attempts to advance a federal RE standard in the United States have gone back and forth through the past decade. Former President Obama

implemented a Clean Power Plan (CPP) in 2015, but the EPA under former President Trump called CPP “overreaching” and repealed it in 2019, replaced by the Affordable Clean Energy (ACE) rule. Then in 2021, the District of Columbia District Circuit Court vacated ACE (EPA 2022b).

Renewable portfolio requirements and incentives at state and local levels, as well as in some international regions, have proliferated (Komor and Bazilian 2005; Rogge and Reichardt 2016; Köhler et al. 2019). The majority of U.S. states have enacted policies that expand RE capacity (Rabe and Mills 2017), although the policy structures and the rationale vary considerably from state to state (Hazboun et al. 2019). For example, 100% RE targets exist in 11 states plus the District of Columbia and Puerto Rico. But states where fossil fuel mining underlies local economies and cultural identities, such as Pennsylvania and Montana, have been resistant to large-scale RE standards (Olson-Hazboun 2018).

The urgent need for climate change mitigation is a commonly used rationale for generating public support to expand the use of RE, although the climate change lens may not be the most effective strategy for broad audiences, given its tendency to activate political derision (Feldman and Hart 2018; Hamilton et al. 2018; Kahan et al. 2012; Miltenberger et al. 2017). However, it is notable that public support for RE is strong in a few states that are politically conservative and closely tied to fossil fuel industries, such as Texas, Wyoming, and Alaska (Jepson, Brannstrom, and Persons 2012; Holdmann et al. 2022; Moffit 2021). There are a variety of reasons why states like Texas or Wyoming might support RE development, and some scholars have suggested the use of other, less-

polarizing frames to encourage broader public support (Hazboun et al. 2019; Stokes and Warshaw 2017).

Some studies have found that individuals' support for RE is not closely related to their views on climate change (Hamilton et al. 2018), but other research has found the opposite to be true (Olson-Hazboun, Howe, and Leiserowitz 2018). Recent experimental studies in the U.S. found political orientation to be a strong predictor of RE frame effects. For example, Stokes and Warshaw (2017) demonstrated that positively-worded frames (such as: RE lowers air pollution and creates jobs) were effective with both Republicans and Democrats for encouraging RE support. Feldman and Hart (2018) found that Republicans' support for RE was lower when the climate change frame was used. RE message framing effects are also likely to vary geographically based on factors such as local culture and economic identity (Bell and York 2010; Stokes and Warshaw 2017; Miltenberger et al. 2017). To examine how RE framing is perceived in different geographic and political contexts, Hazboun et al. (2019) tested acceptance of several positively worded RE frames and concluded that political ideology, level of concern over climate change, and state of residence were important predictors of an individual's reaction to RE framing. A great number of RE frame effects studies have suggested that non-environmental justifications for RE may resonate with greater effect, given the political polarization of environmentalism in the United States (Hazboun et al. 2019; Miltenberger et al. 2017; Stokes and Warshaw 2017; Feldman and Hart 2018; Jepson, Brannstrom, and Persons 2012; Djerf-Pierre, Cokley, and Kuchel 2016).

Research Questions

Tracing interdisciplinary connections by communicators is a technique for addressing “wicked problems” in science whose solutions are multi- and sometimes trans-disciplinary (Cagle and Tillery 2015). Using the intersection of RE and public health as a case in point, this study examined how newspapers framed a particular interdisciplinarity for public consumption by posing the following research questions:

RQ1: How is the intersection of RE and public health being framed in the news media around the world?

RQ2: What contexts are common in news stories from around the world about RE and public health?

Answering these questions will help shed light on news media’s role in the public discourse about the nexus of RE, public health, and climate change. Findings will deepen understanding of climate change and interdisciplinary framing. This study also hopes to contribute to derived lessons on how academic scholars might improve at framing and communicating their interdisciplinary expertise for the non-scientific public. Analysis of news media content and framing at the intersection of two scientific topics (RE and public health) comprises a transdisciplinary communications research opportunity that could contribute to a larger topic in TPC: disconnection between scholars and journalists over matters of scientific communication.

CHAPTER 3

METHODOLOGY

This study concerns the intersection of public health and RE communication as conveyed in newspaper articles from 2021. The primary aim was to conduct a qualitative content analysis that identified recurrent frames found in newspaper articles that discussed both public health and RE. A data set of 93 newspaper articles from 24 countries were collected (the sample collection method is described in detail in a following section) then examined numerous times to inductively develop a codebook that focused on locating the way(s) each article related RE and public health, and how the article substantiated the relationship through further detail, evidence, or argument. The study's secondary aim was to identify contexts that prompt news content about the intersection of RE and public health. In this respect, I wish to understand what circumstances accompany publication of such stories, such as an extreme weather event or political news.

Identification of frames involves interpretive work on the part of the researcher. There are two primary methodological approaches to frame identification: **inductive**, where the identification of frames is the outcome; and **deductive**, where the presence of previously-defined frames is measured (Djerf-Pierre, Cokley, and Kuchel 2016; Jungblut 2021). In this study, a deductive approach was unavailable, due to the novel combination of topics, and thus lack of previously-defined frames. Therefore, my work involved inductive identification of frames and contexts common to news content about the intersection of RE and public health. Induction is important to interdisciplinary research because it allows for constructive alignment of topics that have not been previously compared.

Sample Collection

The main inquiry for this study is to investigate how the connection between RE and public health is represented in the quality press. Newspaper content was used for both theoretical and practical reasons. From a theoretical standpoint: it is widely acknowledged that, for as long as they have existed, newspapers have played a key function in opinion formation and public knowledge (Baum and Groeling 2008; Baum and Potter 2008; Gerber, Karlan, and Bergan 2009; Mutz and Soss 1997). From a practical standpoint, newspaper content is easy to discover using search engines, and easy to manage using Computer-Assisted Qualitative Data Analysis Software (CAQDAS).

To create the data set for analysis, the search strategy employed Riffe's (2019) convenience sampling concept, in which a data set is built with content that is conveniently available. Convenience sampling is an appropriate data collection strategy when "resources limit the ability to generate a random sample of the population... [and] when a researcher is exploring some under-researched but important area" (Riffe et al. 2019, 75). To limit the results to a manageable dataset for close reading by a single researcher with limited time and resources, the search was restricted to a single calendar year. The calendar year 2021 is the most recent one and was also a non-election year in the United States, which presumably helped to avoid rhetorical distractions in American news.

I searched the LexisNexis® database for English-language newspaper articles, dated January 1 through December 31, 2021, that contained the terms "public health" AND ("renewable energy" OR "clean energy"). The unit of analysis was the individual news story. The initial search yielded $n = 906$. Figure 3 illustrates how the initial results were systematically carved down to achieve the final data set. Articles were excluded if

their content was not germane to the study's research questions. For example, if an article's discussion of public health was limited to COVID-19 news, rather than public health's association to renewable energy, that article was discarded. However, some articles leveraged the pandemic to argue that COVID-19 has laid many public health issues bare, thus reinforcing the urgency of climate change mitigation; those articles were included in the final data set.

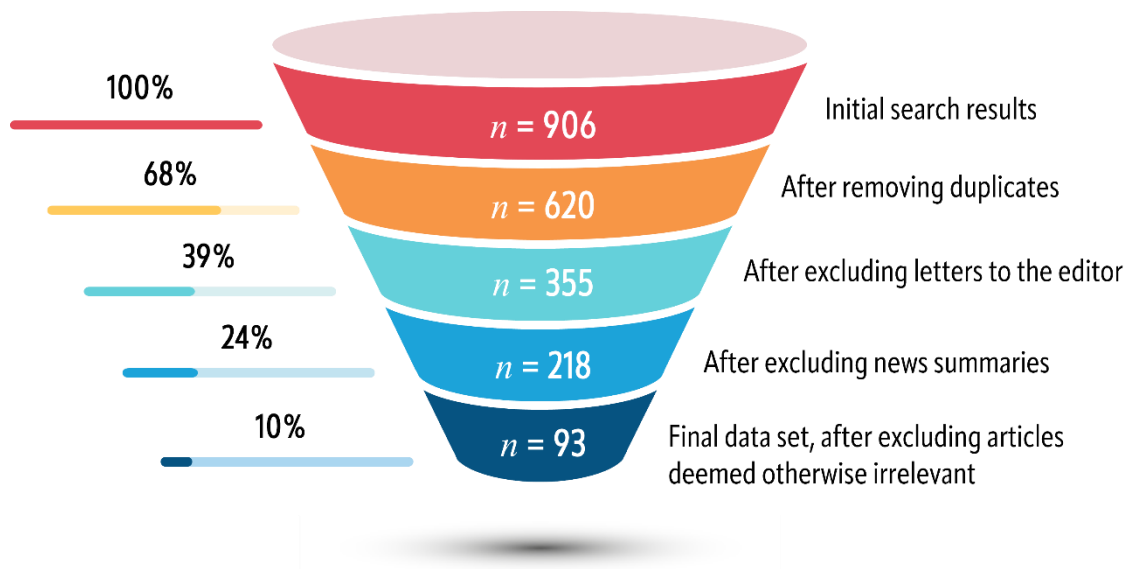


Figure 3. The initial search results were systematically pared down to achieve the final data set of $n = 93$.

I also discarded duplicates and non-articles, such as letters to the editor and news summaries. As per Nisbet & Huges's (2006) methodology, opinion/editorial articles were included. Previous researchers have defined the academic value of observing editorials as a space in which the media's agenda is captured (Golan 2010; Guazina, Prior, and Araújo 2019). Editorial work plays strategic roles in the framing process (R. Entman 2007) that shapes information coverage and public debate; therefore, editorials can be understood as

attempts by the media to engage in political-economic dialogue. The final sample size was $n = 93$. A complete list of the articles included in the data set is provided in the Appendix.

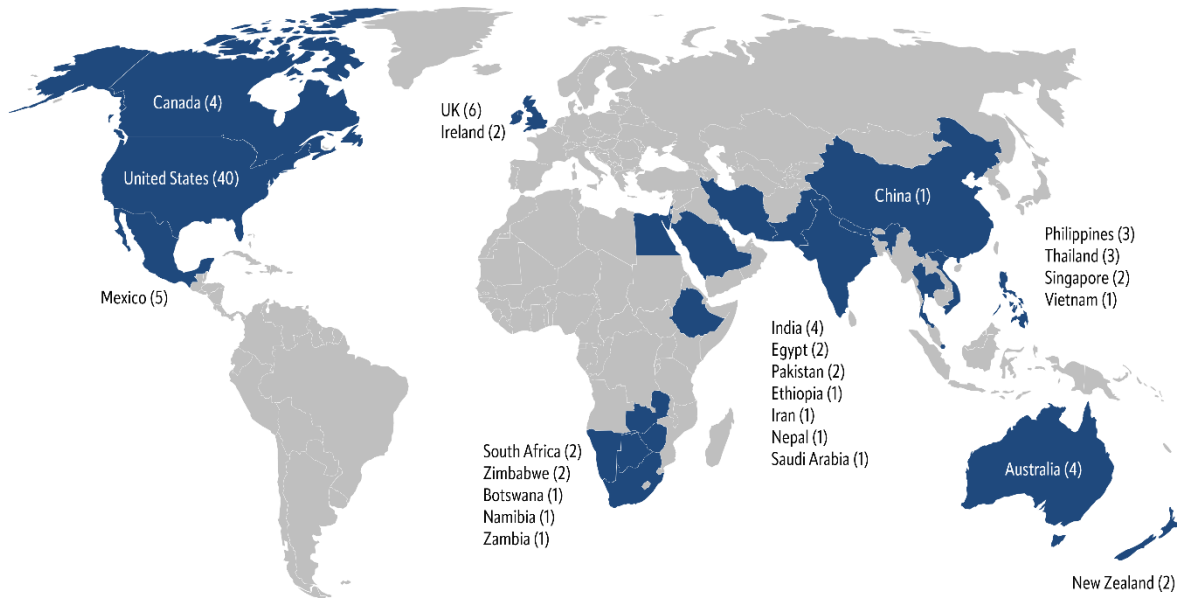


Figure 4. The U.S. was the largest contributor of articles to the data set, but the corpus included articles from 24 countries.

Of the 93 articles that comprised the final data set, 40 were from newspapers published in the U.S. The U.S. was the largest contributor of articles, but the total data set was made up of articles from 24 countries, as illustrated in Figure 4. The second-largest contributing North American country was Mexico, due to five articles from *CE Noticias Financieras*, which is an international news aggregator based in Mexico City, but focusing on news from all of the Western Hemisphere. Three articles from Thailand were published by *Asia News Monitor*, which reports on world news; the three Thai articles, consequently, were not reporting news from Thailand *per se*. Those articles were about

Canada, Hungary, and the U.S., rather. Among the 40 articles from the U.S., Figure 5 illustrates a state-by-state breakdown.

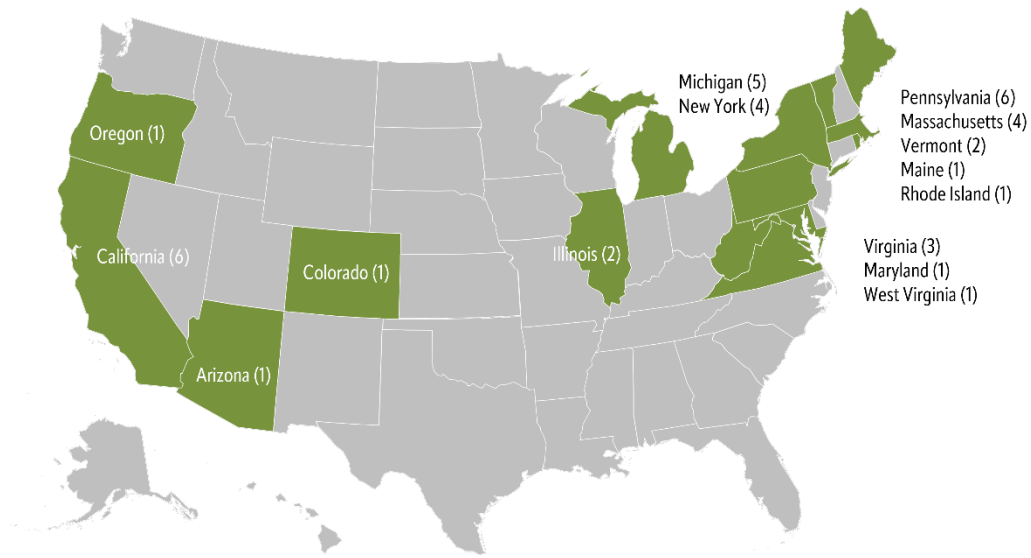


Figure 5. Over a third of the analyzed data set was composed of articles from U.S. newspapers; this figure illustrates the state-by-state breakdown.

Codebook Development & Coding Procedure

Despite the prevalence of framing studies in mass communications research, best practices for codebook development vary, and are chosen to fit their project (Chong and Druckman 2010; Scheufele and Tewksbury 2007). Techniques range from deductive approaches that measure the presence of pre-defined frames (e.g., Chong & Druckman, 2010), to statistical methods such as cluster analysis (e.g., Semetko & Valkenburg, 2000), to inductive approaches that identify frames (Kojola 2017). As Chong and Druckman (2010) noted, the scholarly literature does not prescribe a preferred approach.

Table 1. The first cluster of codes established a set of frames that describe *threats to public health*.

Code	Description
1. Pollution	Pollution from fossil fuel emissions, extraction, or refinement causes illness.
2. Climate change	Climate change/global warming threatens public health.
3. Socioeconomic	Socioeconomically disadvantaged communities are more vulnerable to public health threats, especially those exacerbated by climate change/global warming.
4. Extreme weather	Extreme weather (especially heat waves) threatens public health.
5. Power outages	Power outages or reduced availability of electricity threatens public health.

To address the study’s research questions, I read all the units of analysis at least three times each to achieve a holistic sense of the data. Prior research on media framing informed the analysis, but coding was not limited to a set of predetermined frames. Instead, an inductive, open coding approach was used. In initial and secondary readings, recurring themes were noted. I used analytic memos to capture themes, patterns, and events described in the data set. In tertiary and quaternary readings, those concepts were grouped and boiled down into a codebook of 11 axial codes that clustered into two groups that comprise the dominant frames—*threats to public health* (Table 1) and *benefits of RE* (Table 2). A third cluster of codes (Table 3) accounted for the contexts described in the data set. The data set was then reanalyzed to apply the codes.

Table 2. The second cluster of codes established a set of frames that describe *benefits of RE*.

Code	Description
1. Public health benefits	Public health benefits of RE/decarbonization/emissions reduction are mentioned; or RE/decarbonization/emissions reduction is described as a pathway to improved public health.
2. Addressing climate change	RE/decarbonization/emissions reduction will help to combat the effects of climate change, or aid in developing “climate resilience.”
3. Economic development	RE/decarbonization/emissions reduction is described as a way to drive economic development, such as job creation.
4. Social equity	RE/decarbonization/emissions reduction is a component of improved equity and social justice.
5. Financial benefits	Economic/financial benefits of RE/decarbonization/emissions reduction, such as reduced expenses or added income, are mentioned.
6. Energy supply	RE is mentioned as a solution for energy grid failures, or as a way to make electricity more widely available.

The codes were not mutually exclusive, and all articles had multiple codes, but individual codes counted only once per article. In other words, the study quantified the number of articles that used each code but did not tabulate the number of times a code recurred in a single article. As the following chapter will discuss, nearly every article used a combination of the two code clusters or frame sets: *threats to public health* and *benefits of RE*. In this way, the application of codes from Tables 2 and 3 addressed RQ1; the application of codes from Table 3 addressed RQ2.

Table 3. A third cluster of codes accounted for supporting contexts.

Code	Description
1. COVID-19 pandemic	Relevance of the COVID-19 pandemic is discussed.
2. Energy transition	The energy sector’s transition from fossil fuels to clean/renewable energy is mentioned.
3. Fossil fuel dependence	Reliance on fossil fuels is mentioned.
4. Government & policy makers	Government/policymakers are urged to take action.
5. Green economy	A “green economy” or “clean energy economy” is discussed.
6. Infrastructure & transportation	Improvement, expansion, or development of public infrastructure is mentioned; or vehicles and/or transit is discussed.

Reliability

Only one human coder participated in this analysis. Reliability was accomplished by repeating the coding process upon a data sample four weeks after the initial effort, then performing an intercoder reliability calculation within MAXQDA. To create the intercoder reliability sample, fifty articles were randomly selected from the data set. This study followed Neuendorf’s (2017) recommendation that intercoder reliability samples “should be at least 10% of the full sample, probably never smaller than 50” (p. 187). In this case, a 50-article sample represented 53.8% of the data set. MAXQDA reported an intercoder reliability coefficient of 84.6%, indicating a high level of reliability. However, as Saldaña (2021) points out, there is questionable utility to intercoding agreement measurements, given that qualitative data analysis is an interpretive exercise.

CHAPTER 4

RESULTS

The first research question asked how the intersection of RE and public health is being framed in the news media. The content analysis of 93 international newspaper articles found that the intersection of the two topics was usually made in two steps: (1) framing energy-related circumstances that threaten public health; and (2) framing the benefits afforded by RE deployment. Of the 93 newspaper articles analyzed, 71 of them (76.3%) applied at least one frame from both categories: those that portray threats to public health *and* those that portray benefits of RE.

Frames that Portray Threats to Public Health

Of the 93 data units, 76 (81.7%) were classified as containing frames that portray threats to public health. Content analysis established five recurrent frames used to portray major threats to public health (ranked in order of their frequencies):

1. Air pollution caused by fossil fuel-based power generation (primarily transportation) is extreme enough to be life threatening in many cities.
2. Climate change causes a wide range of public health problems.
3. Socioeconomically disadvantaged communities are more vulnerable to public health threats such as those amplified by climate change.
4. Extreme weather, especially heat waves, is exacerbated by climate change.
5. Lack of electricity prohibits provision of healthcare; or power outages due to extreme weather create dangerous conditions.

The proportions of the data set in which each of the threats to public health frames were found are detailed in Table 4 and illustrated in Figure 6.

Table 4. Five frames portraying threats to public health

Frames portraying threats to public health	Number of articles	Percentage (n=93)
7. Air pollution	49	52.7%
8. Climate change/global warming	47	50.5%
9. Socioeconomic disadvantage	37	39.8%
10. Extreme weather	34	36.6%
11. Lack of electricity	9	9.7%
Articles containing one or more of the <i>threats to public health</i> frames	76	81.7%

Incidence of Threat Frames

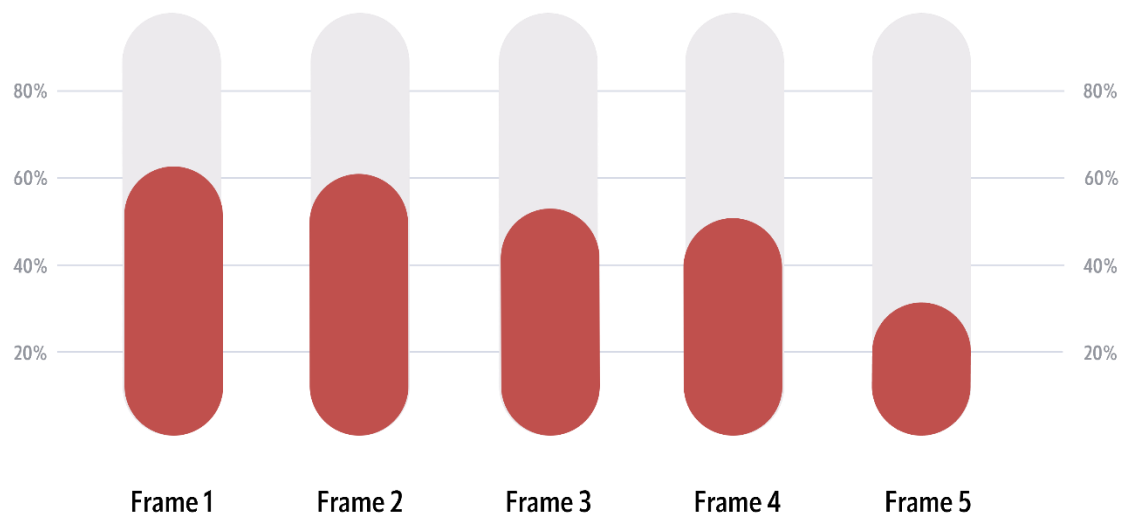


Figure 6. A visualization of the incidence of *threats to public health* frames.

Threat Frame 1: Air Pollution

Air pollution caused by fossil fuel emissions was the most frequent frame used to portray energy-related threats to public health. The World Health Organization (WHO) states that at least 7 million deaths annually are caused by air pollution from fossil fuel combustion (National Post 2021). An argument that the invisible particulate matter and nitrogen dioxide from vehicle exhaust is the most important environmental risk factor for deaths globally, was found in 52.7% of the analyzed articles. For example, in one of the articles by Brody (2021b):

Toxic substances like fine particulate matter, nitrogen dioxide and ozone form primarily when fossil fuels are burned and enter the atmosphere in the exhaust from motor vehicles, heating units and smoke from wildfires. Inhaling such pollutants can cause bodily damage that lasts for years, if not for life, and may even lead to death.

The issue of fossil fuel-linked air pollution is a noteworthy topic in Asian cities, where respiratory illness from poor air quality is common. One article from The Financial Times (Delhi, India)—which has a dedicated section titled “Pollution”—boiled down the collateral damage that is caused by air pollution: “Polluted air increases likelihood of deaths due to cancer and stroke, spikes in asthma attacks and worsens severity of Covid-19 symptoms” (Kumar 2021). The air pollution frame was most prominent in articles from Asia. In data units from the U.S. and Australia, the public health threat from air pollution was often associated with smoke from wildfires, which have become more frequent and severe because of climate change.

Threat Frame 2: Climate Change

The climate change that is occurring during the present century is due to excessive build-up of atmospheric greenhouse gases from fossil fuel-based power generation. The rising temperature averages, changed weather patterns, and altered ecosystems caused by climate change can have serious effects on public health—an issue that was mentioned in 50.5% of the data units. The climate change public health threat code was applied whenever a passage outrightly connected climate change to diminished human health, such as in another article by Brody (2021a):

[People] who already have allergies can expect them to get worse... Infectious diseases carried by ticks, mosquitoes and other vectors also rise with a warming climate... Climate change endangers the safety of foods and water supplies by fostering organisms that cause food poisoning and microbial contamination of drinking water. Extreme flooding and hurricanes can spawn epidemics of leptospirosis.

Nearly a third (28%) of the data set used both air pollution and climate change frames in concert, to illustrate that carbon emissions are to blame for both deadly air pollution and climate change, which in turn worsens the effects of air pollution.

Threat Frame 3: Socioeconomic Disadvantage

As Huang et al. (2011) explain, all people will be exposed to the impacts of climate change, but some populations are more vulnerable than others because of heightened exposure (e.g., living in a city or neighborhood with extreme pollution) or population sensitivity (e.g., elderly people may be less able to cope with extreme heat). The adverse public health effects of climate change vary between communities, countries, and socioeconomic development patterns (Sellers and Ebi 2018). Rothstein (2021) illustrated the commonalities between the pandemic and climate change: “The parallels between the

COVID-19 pandemic and the climate crisis are striking: Both present dangers to our lives, threaten to disrupt our economy, and disproportionately impact low-income communities and communities of color.” An important variable when measuring the public health impact of any circumstance is the set of socioeconomic factors that influence a population’s levels of exposure, the quality of healthcare it receives, and its ability to secure legal recourse and political advocacy. Thus, in this project’s data set, which was composed of newspaper articles that discussed the interconnectedness of climate change, energy, and public health, it was inevitable that a frame related to the socioeconomic variables of public health would be identified. Indeed, 37 (39.8%) articles from the data set remarked on the relevance of socioeconomic patterns.

A common refrain in articles from the U.S. that were coded for the socioeconomic disadvantage frame was low-income communities’ exposure to pollution: “Noise and air pollution from diesel vehicles can harm neighborhoods near bus yards and heavily traveled roads. Those neighborhoods are disproportionately low-income and communities of color” (Trofatter 2021). In one of the data units, Murphy (2021) mentioned my former home (and a subject of some of my earlier public health research), Richmond, California:

For disadvantaged communities like the Bay Area’s Richmond and Los Angeles’ Wilmington neighborhoods, wildfire smoke and other climate impacts are further compounded by decades of exposure to air pollution from fossil fuels and some of the highest asthma rates in the state.

Socioeconomic status (SES) is the social standing of a person or group, and is usually measured as a combination of income, education, and occupation (APA, 2022). Inequities in access to resources are associated with SES. Sociologists and epidemiologists have established that SES underlies three major determinants of public health:

access to healthcare, environmental exposure, and health behavior. Additionally, lower SES is linked to increased incidence of cardiovascular disease, diabetes, and cancer (Adler & Newman, 2002). It is logical that socioeconomic disadvantage was a prominent frame in this study's data set, given that SES is such a crucial factor in discussions of the energy transition's relationship to public health.

Threat Frame 4: Extreme Weather

Increasing incidence of extreme weather events and severe heat waves is attributed to climate change. Although extreme weather is frequently included in lists of the effects of climate change, I identified within the data enough specific, substantiated references to extreme weather events to warrant codification of a separate frame—one that was distinct from more generic assertions about climate change's threat to public health. For example, in an op-ed discussion of an infrastructure plan that should prioritize RE, McElfish (2021) specifically called out the problem of extreme weather:

Virginia has approximately 10,000 miles of coastline threatened by sea level rise with subsequent flooding and food insecurity. By modernizing our electric grid and expanding 100% renewable, pollution-free energy resources, we will see far fewer deadly climate disasters and extreme weather events such as floods and fires.

In an article from West Chester, Pennsylvania's Daily Local News, I coded this passage as one that clearly framed a connection between extreme weather and public health: "Global warming is making severe flooding, dangerous wildfires, extreme heat, and other dangerous weather events the norm. It's a threat to public health, our environmental health, and our economic future" (Comitta 2021).

The data set included 34 articles (36.6%) that contained the extreme weather frame. Included in the list of extreme weather events that are attributed to climate change are heat waves, hurricanes, drought, wildfires, and torrential rainstorms that cause severe flooding. These events, which increase in intensity and frequency with each year, threaten public health when they destroy communities, disrupt delivery of drinking water and electricity, and create otherwise uninhabitable conditions. The extreme weather frame sets the stage for arguments that climate change must be urgently addressed, and innovations that will make communities more resilient to extreme weather are warranted.

Threat Frame 5: Lack of Electricity

A small proportion of the data set brought up lack of electricity as a threat to public health. Nine articles (9.7%) were coded for their discussions of either power outages creating dangerous conditions, or how lack of electricity due to geographic circumstances prohibits provision of healthcare.

For example, the series of severe winter storms and record-breaking cold snap that gripped Texas during February 2021 was the foundational cause of days-long black-outs that created an avalanche of public health problems, including widespread lack of heat, unavailability of municipal water, and shuttered grocery stores. Writing about that particular crisis in Texas, Cunningham (2021) said:

The harsh reality is that without electricity, very few things that are critical to public health and safety will function, and life as we know it grinds to a halt. From transportation to health care and emergency services, grocery stores and water supplies, cell phones, the internet and banking, nearly everything we consider essential relies on electricity.

Energy use is related to population growth and economic output (Global Energy Assessment Writing Team 2012). The amount and quality of energy used drives economic productivity; more efficient and flexible electricity sources are associated with higher economic development (Toman and Jemelkova 2003; Hosier 2004). As with economic development, more energy use is associated with better public health (K. R. Smith et al. 2013). Availability of energy is also associated with “energy security,” which refers to a family’s probability of having enough energy to cook food and to regulate a home’s temperature—matters of availability and affordability (Pachauri 2011). In contrast, “energy poverty” refers to financial hardship in affording energy for these basic uses. Energy poverty is associated with economic poverty and thus correlates with poor health and adverse social outcomes (Cook et al. 2008; Howden-Chapman et al. 2012). One article (*Business Line* 2021) spoke about lack of electricity as a serious threat to public health:

Access to electricity is critical to development, especially in the context of mitigating the impact of Covid-19 and supporting human and economic recovery... About 759 million people still live without electricity, half of them in fragile and conflict-torn countries.

While this frame appeared less frequently than other threats frames, it provides a strong justification for the usefulness, practicality, and human benefits of RE.

Frames that Portray the Benefits of RE

Of the 93 units of analysis, 88 (94.6%) were coded with frames that portray the benefits of RE. I codified six frames that were repeatedly found in the data set (ranked in order of their frequencies):

1. RE and decarbonization efforts create a pathway to improved public health.

2. RE is a critical aspect of addressing climate change, or to aid in development of “climate resilience.”
3. RE infrastructure projects will drive economic development (such as job creation).
4. The energy transition is associated with improved environmental justice and social equity.
5. Implementation of RE creates immediate financial benefits, such as reduced healthcare costs or lower energy prices.
6. RE is a way to improve energy supply and increase the availability of electricity, including as a solution for energy grid failures.

The proportions of the data set in which each of the benefits of RE frames were found are detailed in Table 5 and illustrated in Figure 7. Whenever two or three of the top three benefits frames appeared together in a single article (which occurred 66.7% of the time), my subjective observation was that no one frame carried more weight than another. The tendency of the journalists/editorialists was to equate the multiple benefits by listing them in a series. For example, Strother (2021) writes, “Across the political spectrum, Arizonans say investments in non-combustion power will yield significant benefits to air quality, health, climate, and the economy.”

Table 5. Six repetitive themes portraying the benefits of RE were identified and coded.

Frames portraying the benefits of RE	Number of articles	Percentage (n=93)
1. Pathway to improved public health	74	79.6%
2. Addressing climate change	58	64.2%

3. Economic development	45	48.4%
4. Environmental justice and social equity	36	38.8%
5. Financial benefits	30	32.3%
6. Energy supply	29	31.2%
Articles containing one or more of the <i>benefits of RE</i> codes	88	94.6%

Incidence of Benefit Frames

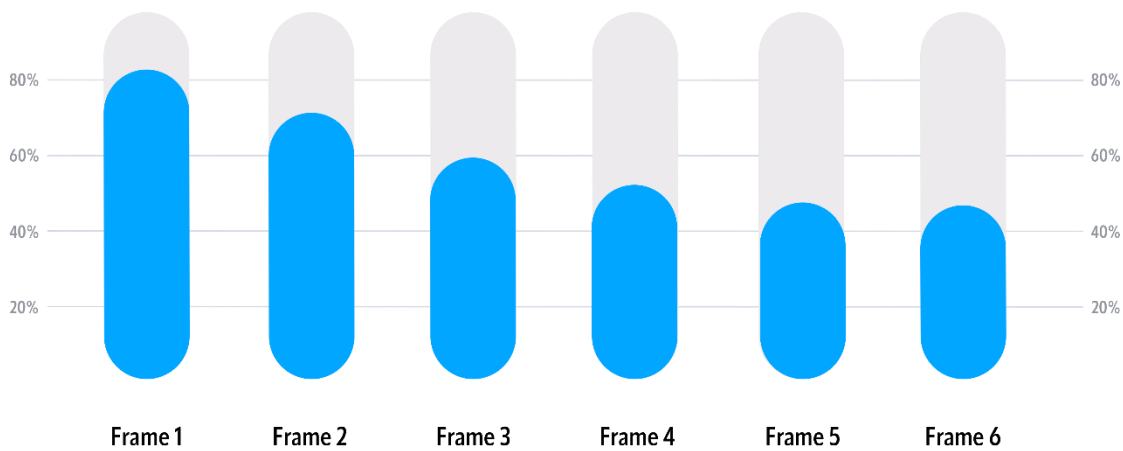


Figure 7. A visualization of the incidence of *benefits of RE* frames.

Benefit Frame 1: Pathway to Improved Public Health

Given the essential characteristics of the data set—newspaper articles that discuss both RE and public health—it is unsurprising that the frame encountered most frequently throughout the entire content analysis was the portrayal of RE as a technology pathway to improved public health. This frame was identified in 79.6% of the data units. The improved public health code was applied whenever a sentence directly stated a public health

benefit of RE or decarbonization/emissions reduction technology. For example, Milman (2021) writes:

A Biden administration plan to force the rapid uptake of renewable energy would swiftly cut planet-heating emissions and save hundreds of thousands of lives from deadly air pollution, a new report has found amid growing pressure on the White House to deliver a major blow against the climate crisis.

By far, this was the most frequently encountered *benefits of RE* frame. Given the data set's characteristics, this result is not surprising. The structural formula for most of the analyzed newspaper articles was to first call attention to energy-related threats to public health, followed by a testament to the benefits of RE. In the majority of analyzed data units, improved public health was cited as a moral argument in favor of RE.

Benefit Frame 2: Addressing Climate Change

Response to climate change has two fronts: mitigation and adaptation (NASA.gov 2022). Mitigation refers to stabilizing the build-up of atmospheric greenhouse gas levels in a short-enough time frame that catastrophic environmental degradation is limited, and in ways that enable sustainable economic development. Climate change adaptation (which is sometimes termed, "climate resiliency") is the act of adjusting to harmful changes in climate and weather. Throughout history, climate changes (drought in particular) have been at least partly responsible for the rise and fall of civilizations. Preservation of our modern civilization will hinge on our ability to cope with and survive the public health threats of climate change.

This was the second-most frequently encountered benefits frame. I coded 58 articles (64.2%) within the data set for the presence of a frame where either mitigation or

adaptation was discussed. Deklinski's (2021) piece contains a typical example of the use of this frame:

The task force reviewed DEP's 2018 Pennsylvania Climate Action Plan and incorporated some of the strategies and actions into the city's environmental resiliency plan, which is focused primarily on reducing greenhouse gas emissions, but attempts to include mitigation efforts and concerns of environmental justice. The aim is to increase overall resiliency in the community.

Many of the articles containing this frame used it in the context of a local government or public agency's justification of a climate change mitigation initiative. Pacts to slow climate change are global, international efforts; meanwhile, smaller entities such as U.S. cities and states, along with small countries such as Vietnam and Costa Rica, have been adopting and implementing policies aimed at responding to the problems created by climate change. Most of these policies are packaged as "climate resiliency plans" and almost always include initiatives to increase the use of RE. Efforts to increase climate resilience facilitate expansion of RE by enabling more electrification solutions and accelerating the energy transition (see Supporting Context 2, page 57).

Benefit Frame 3: Economic Development

Whenever an article in the data set described RE (or, more generally, climate change mitigation) as a way to drive economic development, such as the promise of job creation, I coded the presence of the economic development frame. Forty-five (48.4%) of the data units contained this frame. An example comes from Rothstein (2021):

By targeting emissions reductions through energy efficiency and tapping renewable energy resources, we can reduce pollution, gain independence from outside sources of fuel, and turn our states into economic engines by creating thousands of local jobs.

This frame underscores RE as an *investment*, thereby justifying public and governmental expenditures to expand RE. In some cases, such as in the opinion piece, “Biden’s American Jobs Plan builds back better for Michigan” (Bieber and Wozniak 2021), an article’s central message was a general argument for expanded public investment. In those cases, RE was listed as one of several possibilities for ways to drive economic growth. Job growth was the primary example cited whenever this frame was employed.

Articles were also coded for the presence of this frame when they discussed how RE-related infrastructure improvements would expand commerce, such as in “The Bipartisan Infrastructure Law Advances Environmental Justice” (Asia News Monitor 2021), which was also coded for four out of five of the threats to public health frames and five out of six of the benefits of RE frames, such as:

Modern, resilient, and sustainable port, airport, and freight infrastructure will reduce unhealthy environmental impacts on neighboring communities while also supporting U.S. competitiveness by removing bottlenecks and expediting commerce. Deploying a nationwide network of EV chargers with a focus on the communities that need them most will make clean electric vehicles affordable and convenient options and improve local air quality.

This article, although placed in the “General News” section by its publisher, appeared to be a reprint of a White House press release, which explains its deliberate use of so many frames to construct its rhetoric. In articles that contained this frame, whether the angle was *new forms of public investment to expand the economy*, or *climate change mitigation will have the added benefit of economic development*, RE’s potential for job creation was a central justification.

Benefit Frame 4: Environmental Justice and Social Equity

The United States Environmental Protection Agency defines environmental justice as: “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (EPA 2022a). Fair treatment means that no group bears a disproportionate share of negative environmental consequences resulting from industrial or municipal operations or from the enforcement of regulations or policies. Under the notion of environmental justice, it is expected that all citizens have access to decision makers and the ability to make informed decisions and take positive actions with respect to environmental issues.

Social equity refers to management of public institutions and creation of public policies that acknowledge and attempt to repair inequalities in society, so that everyone in a community has access to the same opportunities and outcomes (United Way 2021). Planning for social equity means recognizing social policy practices that have had an unfair impact on certain groups and working to correct those policies so that every community member is given the opportunity to thrive.

Frame identification and coding activities found that 36 (38.8%) of the data set’s articles contained arguments that the energy sector’s transition to RE promises improved social equity and/or environmental justice, such as in the article, “Biden’s clean energy plan would cut emissions and save 317,000 lives,” where Milman (2021) writes, “...air quality improvements [would be] most acutely felt by black people who currently face disproportionate harm from living near highways and power plants.” The environmental justice and social equity frame conveys a facet of a larger social justice movement to

counteract historic, institutionalized racism that has notably afflicted wealthy nations such as the United States. Poor and marginalized communities have been (and are still being) unfairly exposed to environmental and public health burdens associated with resource extraction, industrial activity, hazardous waste, and climate change. Speaking about environmental justice in California, S. Kumar (2021) writes: “Thoughtful policies and increased funding can bridge gaps between environmental policies and affordable housing, and counteract the inequities inflicted upon Black and Brown people by historic racism in America’s housing planning and finance systems.” The appearance of this frame in newspaper articles shows how the energy transition (see Supporting Context 2, page 57) is closely related to aspects of social justice movements and provides an added moral dimension to RE’s capacity for improving public health.

Benefit Frame 5: Financial Benefits of RE

Claims that RE deployment would lead to immediate and near-future financial benefits were found in 30 (32.3%) of the data units. The financial benefits frame is differentiated from the economic development frame in its specificity of increasing income or saving money, whereas the economic development frame captured more abstract notions of economic growth, such as job creation and improved commerce. Use of this frame most often highlighted how RE placement will help individual households stand to save money through lowered energy bills, such as the Philadelphia-area article, “Chester County Commissioners adopt new Climate Action Plan,” (MediaNews Group 2021), which wrapped multiple benefits frames into a single statement:

The Climate Action Plan’s primary goal is the reduction of greenhouse gas emissions, which in turn yields additional benefits, including improved public health due to cleaner air, saving money through more energy-

efficient vehicles and homes, reducing damage to our natural resources, and creating jobs.

In addition to promoting the potential for lowered household energy bills, seven of the 30 articles using this frame also mentioned reduced healthcare costs that could be expected from improved public health with RE deployment, as in Milman (2021): “A total of \$1.13 trillion in health savings due to cleaner air would be achieved between now and 2050.” Article authors who use this frame may be attempting to expand RE’s appeal to pragmatic audience members who are more interested in financial benefits than in public health benefits or climate change mitigation.

Benefit Frame 6: Energy Supply

The challenge of mitigating climate change is closely linked to the development of secure, sustainable, and efficient energy systems (Potrč et al. 2021). A wide range of technologies is needed to reduce climate change-causing carbon emissions, and RE is the most widely cited of those technologies (IEA 2020). The Energy supply frame was identified in 29 (31.2%) of the data units. This frame described discussions of RE either as a solution for energy grid failures, or as a way to make electricity more widely available or affordable. For example, the article, “EEA Sees New Oil and Gas Projects for Carbon Neutrality in 2050” (CE Noticias Financieras 2021b), describes projected improvements to energy efficiency that simultaneously lower demand and raise global GDP:

Investments in renewable energy could raise global GDP by 4% by 2050 from current forecasts. By this time, energy efficiency could lead to an 8% drop in global demand compared to today, despite the fact that there would be about 2 billion more people with access to electricity.

Apart from mitigating climate change, several forms of RE are also useful to society in their ability to produce electricity without being connected to a wide-area utility grid. This aspect of RE was prominent in mass media content during 2021 because of two other phenomena: the widespread power outages that affected millions of Texans in February 2021; and the COVID-19 pandemic, which intensified public health issues attributed to lack of electricity in rural, underdeveloped parts of the world.

Supporting Contexts

The second research question asked: What contexts are common in news stories about RE and public health? To answer this question, I identified six topics that appeared frequently in the data set—not as frames but as supporting concepts that reinforced the arguments made by the frames. The extent to which these supporting contexts were encountered is described in Table 6.

Table 6. Six topics that reinforced news frames

Supporting Context	Number of articles	Percentage (n=93)
Infrastructure and transportation	55	59.1%
Energy transition	40	43.0%
Government and policy makers urged to act	39	%
COVID-19 pandemic	28	30.1%
Fossil fuel dependence	12	12.9%
Green economy	12	12.9%

Supporting Context 1: Infrastructure and Transportation

Naturally, a collection of newspaper articles that discussed the interrelatedness of public health, climate change, and RE would include many mentions of infrastructure improvements and transportation (as it relates both to air pollution caused by fossil fuel emissions and to electric vehicles as an important form of RE technology). This study coded mentions of infrastructure and/or transportation in 55 (59.1%) of its newspaper articles. Infrastructure is germane to the study in its relationship to several factors: provision of healthcare and public health services, availability of electricity, contribution to greenhouse gas emissions, and especially all things having to do with transportation such as roads, bridges, public transit, and EV-charging stations.

Perhaps the most major aspect of the energy transition (see Supporting Context 2) is the gradual replacement of gasoline-powered vehicles with electric ones (EVs), and the gravity of this was exemplified in Price's (2021) article about a symposium of governors from midwestern U.S. states: "On Thursday, governors from Illinois, Indiana, Michigan, Minnesota and Wisconsin announced the establishment of a partnership to collaborate on electric vehicle charging infrastructure across the Midwest." The U.S. Department of Energy urges that EV charging infrastructure at public destinations may help bolster market acceptance; its Energy Efficiency & Renewable Energy Bureau offers an online tool to estimate the quantity and type of charging infrastructure necessary to support regional adoption of EVs and to determine how EV charging will impact electricity demand. Clearly, both federal and state leaders are taking RE seriously with regard to infrastructure and transportation.

The infrastructure/transportation context appeared most frequently alongside Benefit Frame 1: Pathway to Improved Public Health (page 48), which may reflect the connections between public works and health science. Quoting a study that argues the American transportation system threatens public health, Rodgers (2021) demonstrates that connection:

What's needed now in order to achieve the sweeping changes necessary to protect our health, well-being and environment is a fundamental shift in thinking at the policy level regarding transportation infrastructure, land use, clean energy, pricing and more, as part of a new approach to transportation that puts public health and the environment first.

With transportation as the largest source of GHG emissions in the U.S. (EPA 2022c), it cannot be denied that cars, trucks, and buses are contributing to negative public health impacts. In the U.S., due to a long history of racist policies that have resulted in elevated pollution exposure, the worst of the transportation system's air quality impacts occur in underserved communities, near highways and transportation depots, among people of color (C-CHANGE 2021). President Biden's Infrastructure Investment and Jobs Act, signed into law in August 2022, is a landmark federal investment intended to improve transportation infrastructure, expand access to clean drinking water, advance environmental justice, and amplify RE implementation toward climate crisis mitigation.

Supporting Context 2: Energy Transition

An energy transition is a set of structural and economic changes to the way civilization generates and consumes power. For example, a century ago, the widespread adoption of automobiles replaced the use of animals for "horsepower." A century before that, the world shifted from wood burning to coal, which burned longer and hotter, and was

more readily available. Today, an energy transition away from fossil fuels has begun. As with previous energy transitions, technological advances are what afford the shift. The present energy transition, however, is different in that it is also driven by a recognition that fossil fuel consumption is to blame for the current climate crisis, and the practice must be abandoned before earth becomes uninhabitable.

This study found mention of the energy transition in 40 (43.0%) of the data units. The use of the concept was generally in proximity to discussions about embracing technological advancement, such as in the article by Wolfe (2021), who writes about RE innovation in Canada: “At the same time, we are witnessing a rapid shift away from carbon-based forms of energy to renewable forms, including wind, solar, battery electric, fuel cells and hydro power. What do these trends mean for innovation policy in Canada?” On another continent, Mann (2021) chastises Australia for its unwillingness to espouse the energy transition:

To an outside observer like myself, Australia’s approach is reminiscent of what we saw several years ago with other intransigent countries—hesitant, stubbornly clinging to outmoded energy systems and unwilling to embrace the necessary and inevitable transition away from fossil fuels.

Public health professionals have a role to play in evaluating, supporting, and monitoring the energy transition. If it is thoughtfully accomplished, the energy transition provides opportunities for promoting health equity by ensuring energy production and consumption are more equitably distributed, affordable power is more widely available, and historically disenfranchised communities experience the health benefits of improved environmental conditions.

Supporting Context 3: Government and Policy Makers Urged to Act

Because of society's traditional democratic role of the press as a watchdog that can make critical observations and raise ethical questions (discussed in CHAPTER 3 LITERATURE REVIEW), I considered it worthwhile to code instances in the data set when government actors and/or policy makers were urged to respond to issues that surround the intersection of public health and RE. Content analysis activities found 39 (41.9%) of the articles contained pleas urging governments and policy makers to act. Of those, 29 also contained Benefit Frame 1: Pathway to Improved Public Health (page 48); 21 articles also contained Benefit Frame 2: Addressing Climate Change (page 49). Associations between this and other frames were constructed as the need for policy change that would help to accelerate the energy transition, as Duval's (2021) opinion piece argued: "What we need most is a policy and regulatory framework that requires pollution reductions from our transportation and heating sectors, with responsibilities for the entities that import and sell those fossil fuels."

The United States does not have a unified national energy strategy. Instead, energy policy and legislation is patchwork, involving different governmental levels (APHA 2018). As such, lawmakers and regulators at the local, state, and federal levels have a responsibility to ensure that energy policies adequately address the health challenges related to the nation's varied energy strategy. While Anderson (2009) suggests that media corporations' dependency on advertising revenue from fossil fuel industries may discourage criticism of government's inaction over climate change, Boykoff and Boykoff (2007) observe that the trajectory of climate crisis news coverage is strongly connected to policy developments.

Changes in energy policy could have disproportionate economic impacts on socioeconomically disadvantaged communities. It is the role of policymakers and regulators at all levels of government to be arbiters of a just transition for vulnerable communities, and it is the role of mass media to inform the public about changes in energy policy.

Supporting Context 4: COVID-19 Pandemic

Of the 93 data units, 28 (30.1%) related the COVID-19 pandemic to the discovered frames. The pandemic was relevant to all of the threats to public health frames—not because it stands on its own as an epic public health crisis, but because it has laid bare the weaknesses of global healthcare systems, and it has directly caused several setbacks in UN-backed development goals. For example, for the first time in a decade, the number of people in Africa without access to electricity rose in 2020, due to a combination of economic and infrastructure problems triggered by the pandemic.

The pandemic’s amplification of Threat Frame 1: Air Pollution (page 41) is demonstrated in the article “Exposure to air pollution increases COVID-19 deaths by 15%,” it is reported that exposure to air pollution increases the risk of death from COVID-19 by 15 percent *on average globally*. In East Asian countries, where air pollution is an extreme threat to public health, that risk increases to 27 percent (CE Noticias Financieras 2021a).

The article, “5 steps to create stronger, greener Rhode Island,” exemplifies COVID-19’s relationship to Threat Frame 2: Climate Change (page 42) as well as Threat Frame 3: Socioeconomic Disadvantage (page 42) by drawing parallels between the pandemic and the climate crisis: “Both present dangers to our lives, threaten to disrupt our

economy, and disproportionately impact low-income communities and communities of color” (Rothstein 2021).

In the *New York Times* article, “More Than 40 Nations Pledge to Cut Emissions from Their Health Industries” (Choi-Shagrin 2021), the COVID-19 pandemic is related to Threat Frame 4: Extreme Weather (page 44):

“In the midst of the pandemic, we had to recover from extreme weather events and manage the resulting health impacts,” said Ifereimi Waqainabete, Fiji’s Minister for Health and Medical Services, in a statement. It “has shown us that health systems and facilities are the main line of defense in protecting populations from emerging threats.

An association between the pandemic and Threat Frame 5: Lack of Electricity (page 45) appears in the title of the article, “Covid-19 crisis makes electricity too costly for millions in Africa, Asia.” That article describes how the economic toll of the pandemic deepened socioeconomic disparities in already-fragile countries, putting the UN’s goal of ensuring everyone has electricity by 2030 in jeopardy (*Business Line* 2021).

All of the threats to public health frames were problems amplified by the pandemic. But the pandemic’s effects were not only associated with discussions of public health. The COVID-19 adjacent theme also appeared in relation to RE. For example, in the article, “Advancements in electric buses making green transit more accessible,” the director of transportation for a Kalamazoo Public Schools lamented that benefits of the district’s recently-purchased electric school bus weren’t able to be quantified because of the non-traditional school year (Trofatter 2021).

Supporting Context 5: Fossil Fuel Dependence

The world depends on oil, coal, and natural gas to generate electricity and power transportation. Most countries' energy systems are based on fossil fuels (Caetano et al. 2017). The United States gets 81% of its energy from fossil fuels (NASEM 2022). The burdens and problems created by fossil fuel dependence, such as market instability, environmental impacts, and threats to public health, are an argument for expanding use of RE. Of the 93 data units, 12 (12.9%) mentioned civilization's dependence/reliance on fossil fuels to maintain world order. Fossil fuel dependence was most often associated with the Threat Frames 1 and 2 (Air Pollution and Climate Change, respectively) and the Benefit Frames 1 and 2 (Pathway to Improved Public Health and Addressing Climate Change, respectively). For example, the article, "Mexico must move to clean energy and take advantage of solar energy: WHO" (CE Noticias Financieras 2021c), all four of those frames are connected to fossil fuel dependence:

Those fossil fuels are literally killing us, that dependence on fossil fuels is having devastating effects on people's health... We understand that there has to be a transition, but we understand that there are many benefits for health, for the economy, for society and of course for a much healthier development of all countries... Meanwhile, air pollution, primarily resulting from the burning of fossil fuels, which also drives climate change, causes 13 deaths per minute worldwide... Reducing air pollution to WHO guideline levels, for example, would reduce the total number of global deaths from air pollution by 80% while drastically reducing greenhouse gas emissions that fuel climate change.

One empirical cross-national analysis found that the influence of fossil fuel dependence on climate change shapes public understanding and risk perception of climate change via economic interests and efforts to defend them (Knight 2018). Fossil fuel dependence can also shape media coverage of climate change. Schmidt et al. (2013) found

that the carbon intensity of a nation's economy (carbon emissions per unit of GDP) and net fossil fuel exports are positively associated with media attention.

Supporting Context 6: Green Economy

The “green economy” (also called the “clean” economy), according to the Brookings Institution, is the sector of the economy that produces goods and services with an environmental benefit. It includes manufacturing jobs such as RE equipment and public services such as wastewater and mass transit. The green economy is a widely-celebrated concept—albeit foggy—for its forecasts of job creation, economic renewal, and climate change mitigation. However, “green” activities and jobs exist in all sectors of the economy, making it difficult to isolate and analyze an actual “green” economic sector (Muro, Rothwell, and Saha 2011).

This study found 12 (12.9%) articles in its data set included the either the term “green economy” or “clean economy.” For example: “The transition to a green economy with clean, renewable energy sources will benefit both the environment and public health, locally improving air quality and globally limiting climate change” (CE Noticias Financieras 2021a).

At the United Nations Conference on Sustainable Development, also known as Rio+20, held in Rio de Janeiro, Brazil in 2012, the UN formally adopted the concept of “green economy” (Barbier 2012)—an economy driven by sustainable investments that reduce carbon pollution, enhance energy efficiency, and prevent the loss of biodiversity (Loiseau et al. 2016). Despite the popularity of the idea among policy institutions, its actual usefulness toward achieving the sustainable energy transition has been questioned (Le Blanc 2011).

The green economy context was seldom associated with any of the threats to public health frames; but in 11 of the 12 articles that contained either the “green economy” or “clean economy” term, the Benefit Frame 1: Pathway to Improved Public Health (page 48) was also present. Sommerfeldt (2021) quotes New York Governor Kathy Hochul relating the concept of a clean economy to four other frames in a single statement:

“With this expansion, we are demonstrating New York State’s commitment to increasing the amount of renewable energy flowing to the electric grid as well as creating more jobs in the solar industry in support of our growing clean energy economy... Climate change is a public health issue—we need to fight with everything we’ve got in order to ensure generations to come will be able to thrive.”

A difficulty lies in variable definitions and uses of the term “green (or clean) economy”. A quick web search returns a spectrum of philosophies over its meaning. To some, a green economy is a general term for economic activity, of any kind, that doesn’t contribute to (or helps to mitigate) the climate crisis. To others, the green economy is the vision of job growth that would come from greatly expanded RE implementation. And still others use the term to describe the economic aspects of the energy transition.

CHAPTER 5

DISCUSSION & CONCLUSION

This study examined media framing of international newspaper articles that discussed both public health and RE during the calendar year 2021. Eleven prominent frames were identified and grouped into two categories: five frames that are about energy-related threats to public health, and six frames that are about the benefits of RE. In total, the eleven frames appear to perform the framing functions suggested by Entman (1993). That is, the threats to public health frames define the problem, provide interpretations, and sometimes offer a moral evaluation; the benefits of RE frames offer solutions or recommendations for future action.

In the majority of data units, one or more threats to public health frames were combined with one or more benefits of RE frames to establish a problem and solution structure. In all but eight of the data units, climate change formed the backdrop for the relationship between public health and RE. That is, climate change (or human activity that contributes to climate change) was presented as either a factor that exacerbates the threats to public health or as a justification for expansion of RE (or both). I observed that the messaging tones were consistent regardless of a newspaper article's country of origin. The content analysis also identified six supporting contexts that were oft repeated. The most common of these was the relevance of infrastructure and transportation to considerations of the public health-climate change-RE nexus. These classifications serve as evidence that this study accomplishes its objective of illuminating how news media presents and links these concepts together.

While the connections between public health and problems caused by fossil fuel dependence may seem obvious to researchers concerned with these issues, this study suggests that there are significant geographic differences in how those connections are presented in news content. For example, the data set's most frequently-employed threat frame (air pollution) was usually related to wildfire smoke in articles about the U.S. and Australia but was related to the more persistent problem of smog in stories about Asia. In another example, the incidence of Threat Frame 5 (lack of electricity) appeared in stories about power outages due to weather events in the U.S. but was associated with infrastructure needs in African news. Triangulating the geography of climate and energy news against whether news content is event-driven (such as wildfires or extreme weather) or a discussion of a persistent problem (such as urban smog or lack of infrastructure) represents an assortment of future research opportunities.

It has been said that, while the political elite is mostly ineffective at constructing new frames, they are proficient at appropriating existing ones. It is my contention, then, that public health and RE advocates would be well-served by fostering increased use of threat-benefit frame combinations in news media, to strengthen the penetrance of their message. This contention, however, circles back to consideration of geographic differences in news presentation: do frame combinations that motivate and persuade members of an American audience work just as well with an audience from a different continent? How should communication researchers attempt to answer such a question? Moreover, should the point of such research be to improve how communication researchers understand international differences in how frames are received? Or should it be in service of

helping individuals better engage with difficult concepts such as climate change mitigation?

Conclusion

What light, then, does this study shed on news media's treatment of a contemporary issue? As an additional case to the roster of climate change framing studies, it presents a variation on a theme: how interrelated effects and solutions surrounding climate change are contextualized for the public. This study, which adds to the body of scholarship on frame analysis, also points to new directions for future research on the public's response and reaction to climate change. Any of the frames identified in this content analysis is worthy of deeper inspection—in both the qualitative media/communications realm and through empirical analysis.

However, the study's limitations should be acknowledged. First, compared to other framing studies that examined newspaper articles (van Dooremalen and Uitermark 2021; Clemente and Gabbioneta 2017; Ireri et al. 2019), the sample size is small. Some might argue that a smaller sample size increases the risk of missing some frames, or of overemphasizing certain frames. Due to the time intensity of this study's inductive approach—which requires reading and studying each data unit several times—it was necessary to restrict the size of the data set. I would argue that the qualitative, purposive approach of an inductive study allows deeper and more nuanced data analysis, leading to richer results. As an unassisted, solitary researcher, the results of this study are subjective and no doubt affected by my personal biases. Nevertheless, the results of this qualitative study, informed by my personal interest in RE and my previous graduate studies in public health, are a unique addition to existing literature on frame analysis.

The ways in which climate change-related news topics are framed for mass audiences are a matter of significant scholarly interest. This study has uniquely shown that substantive frames are employed in news stories relating two seemingly disparate topics related by climate change. Not only does mass media play a critical role in formation of public opinion, its content can be said to represent the general public's level of awareness and understanding of certain topics. Therefore, the relationship between the scientific community and mass media can also be characterized as the relationship between science and the public.

In the Introduction, I posed the question: to what extent is it understood that a large-scale shift to RE will benefit public health? It was meant as a thought-provoking philosophical question rather than a research question, given that an inductive framing content analysis cannot answer such a broad question as to what extent something is understood by the public. What the study's results do show is that the news media is actively engaged in delivering this critical interdisciplinary concept to the public: fossil fuel dependence is harming public health, and there are many ways RE expansion stands to resolve that. The research presented by this study is a starting point for examining and critically assessing how two topics related by climate change are narrated to mass audiences—a concept that deserves further attention from scholars in technical communication, journalism, environmental policy, and public health.

Relating public health and RE has the potential to provide an understandable, effective, and motivating frame for news about the risks and effects of climate change. By defining the relevance of climate change in ways that connect to the needs and values of the public, news media can foster enhanced public engagement and influence research

funding. Given the global public's disposition toward RE and the public health implications of climate change, there is much the media can continue to do to increase the salience of satellite issues associated with climate change, such as RE for the sake of improved public health.

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APPENDIX A

LIST OF ARTICLES COMPRISING DATA SET

Article Title	Publication Title	Place of Publication
Farmers welcome renewable energy zone boost	<i>Newcastle Herald</i>	Australia
Green line: Sydney's trains go renewable	<i>Sydney Morning Herald</i>	Australia
Why Ballarat should adopt a zero target	<i>The Courier</i>	Australia
The deadly devastation of global warming	<i>The Age</i>	Australia
Official urges tapping of abundant solar energy	<i>Botswana Daily News</i>	Botswana
Digitization and decarbonization are picking up; the innovation imperative	<i>National Post</i>	Canada
Health systems urged to develop green cure for fast-rising emissions	<i>National Post</i>	Canada
New WHO air-quality guidelines aim to cut deaths linked to fossil fuels	<i>National Post</i>	Canada
U.S. cities hire specialists to counter climate change as impacts worsen	<i>National Post</i>	Canada
Climate change 'biggest human public health crisis': Lancet Countdown report	<i>Global Times</i>	China
Unlocking sustainable investment with Africa is key priority for EU: Portuguese PM	<i>Daily News Egypt</i>	Egypt
Egypt's Ministry reviews mechanisms supporting private sector transformation to green economy	<i>Daily News Egypt</i>	Egypt
Global leaders confer on clean, healthy future for all	<i>New Business Ethiopia</i>	Ethiopia
Bad air killed 1.2 lakh across 6 Indian cities, cost \$17.7B: study	<i>The Economic Times</i>	India
Covid-19 crisis makes electricity too costly for millions in Africa, Asia	<i>Business Line</i>	India
India's health sector presents an opportunity to transition to clean energy	<i>Hindustan Times</i>	India

PM 2.5 air pollution claimed 54,000 lives in Delhi last year: study	<i>The Hindu</i>	India
Air Pollution May Affect Severity and Hospitalization in COVID-19 Patients	<i>Iran News</i>	Iran
Progress in cutting emissions needs to rise tenfold to meet Paris Agreement; 'Clear need for far greater ambition,' say climate experts after global study	<i>The Irish Times</i>	Ireland
Reduced air pollution improves public health	<i>The Irish Times</i>	Ireland
Israel Explores How to Battle Climate Change as Its Population Increases	<i>Haaretz (English)</i>	Israel
EEA sees new oil and gas projects for carbon neutrality in 2050	<i>CE Noticias Financieras</i>	Mexico
Electric, hybrid, diesel or petrol, which car pollutes more?	<i>CE Noticias Financieras</i>	Mexico
Exposure to air pollution increases COVID-19 deaths by 15%	<i>CE Noticias Financieras</i>	Mexico
Mexico must move to clean energy and take advantage of solar energy: WHO	<i>CE Noticias Financieras</i>	Mexico
Twenty countries to stop financing fossil fuels abroad by 2022	<i>CE Noticias Financieras</i>	Mexico
MPs Engage in Climate Change Mitigation Efforts	<i>New Era</i>	Namibia
Nepal's roadmap for green recovery from Covid-19	<i>My Republica</i>	Nepal
Waste-to-energy plant slammed	<i>Timaru Courier</i>	New Zealand
Climate change: Future of gas	<i>Kapi-Mana News</i>	New Zealand
Thar to become pollution hotspot in South Asia as country boasts Clean Green Pakistan drive	<i>Daily Times</i>	Pakistan
Smog: no end in sight	<i>Dawn</i>	Pakistan
PHL to harness wind energy resources	<i>Business Mirror</i>	Philippines
MPIC, Meralco intensify sustainability programs	<i>The Philippine Star</i>	Philippines
ASEAN needs \$172 billion for green recovery ADB	<i>The Philippine Star</i>	Philippines

Crown Prince calls Jordan's king, Abu Dhabi's crown prince to discuss 'green initiatives'	<i>The Saudi Gazette</i>	Saudi Arabia
The future of finance is sustainable; Amid the public health crisis, we must ask ourselves how we should incorporate sustainability into our investment decision-making.	<i>The Business Times</i>	Singapore
India's opposition to phasing out coal supported at home	<i>The Straits Times</i>	Singapore
Work harder to stop climate change, health body tells government	<i>The Herald</i>	South Africa
Global citizens are using tech to overcome power challenges	<i>Insider Sunday</i>	South Africa
Canada: Disastrous Impact of Extreme Heat	<i>Asia News Monitor</i>	Thailand
Hungary: EIB signs its first green loan to unlock 300 million for improved energy efficiency of homes	<i>Asia News Monitor</i>	Thailand
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