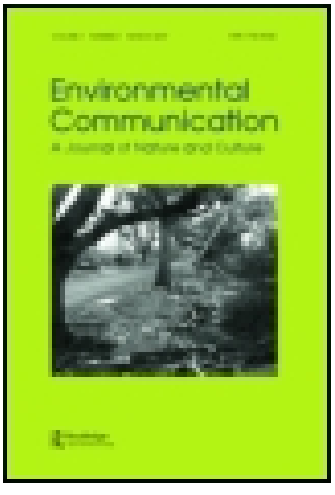

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Wind Energy in US Media: A Comparative State-Level Analysis of a Critical Climate Change Mitigation Technology

Jennie C. Stephens, Gabriel M. Rand & Leah L. Melnick

Wind power is a critically important climate change mitigation technology, and the most rapidly growing renewable energy technology in the USA. Wind energy can provide carbon-free electricity generation, so within societal discourse on how society should minimize the risks of climate change it is widely recognized and acknowledged as a valuable technology. Despite recent increases in wind turbine installation in the USA, the high-level of variation in deployment patterns of wind technology in different states cannot be explained simply by wind resource patterns. Other factors, including differences in the state-level, socio-political context, seem to be influencing wind development. This research compares these contextual differences by using media analysis to assess state-level public discourse about wind technology. Through comparative content and frame analysis of newspaper coverage of wind power in Texas, Minnesota, and Massachusetts, we explore state-level variations in the salience of wind in public discourse, the focus on wind power as a climate change mitigating technology, and the framing of wind power's risks and benefits. In addition to identifying distinct state-level variation in wind energy discourse, the results demonstrate that wind's climate change mitigation potential has been a limited but growing part of media coverage on wind power.

Keywords: Wind Power; Climate Change; Renewable Energy; Public Discourse; Newspaper

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Introduction: Climate Change and Energy Technology

Public discourse on climate change and how society should respond to the emerging challenges associated with it have changed rapidly in the USA during the past decade (Leiserowitz, 2007; Nisbet & Myers, 2007). Growing societal concern about the threats of climate change have contributed to increased acknowledgment of the need for climate change mitigation strategies designed to stabilize the accelerating anthropogenic increase in atmospheric carbon dioxide concentrations. One of the dominant climate change mitigation strategies involves a transition in society's energy technology infrastructure away from a high-carbon emitting fossil fuel dominated system (Gallagher, Holdren & Sagar, 2006; Holdren, 2006; Pacala & Socolow, 2004; Speth, 2008).

Despite a growing sense of urgency for a shift in energy technologies, diffusion of emerging energy technologies has been slow and uncertain, and there has been a high-level of variation in patterns of deployment and installation of emerging energy technologies in different states. This variation among states cannot be explained simply by resource availability and location. Many obstacles to the widespread deployment of emerging energy technologies are apparent, including reinforcing social, cultural, institutional, historical, environmental, and technological aspects of the dominant fossil fuel based socio-technical energy system (Verbong & Geels, 2007). Research exploring the challenges of energy technology diffusion has generally focused on economic and technical factors at the national level (Grubler, Nakicenovic & Nordhaus, 2002; NCEP, 2004; Nemet & Kammen, 2007). Often overlooked is the complex state-level socio-political context within which new technologies must be integrated. Without a defining national climate policy in the USA, individual states have developed a diverse patchwork of climate and energy regulations and institutions (Rabe, 2008), and geographically diverse states have drastically different energy infrastructures and carbon emission profiles (Jiusto, 2008).

In response to (a) the slow pace of technological change; (b) recognition of the critical role that socio-political influences play in technology diffusion (Jacobsson & Johnson, 2000; Wejnert, 2002); and (c) recent calls for more research into non-technical barriers to a low-carbon energy system transition (Rotmans & Kemp, 2001), an interdisciplinary framework, socio-political evaluation of energy deployment (SPEED), has been developed to facilitate the integrated analysis of social, political, economic, and cultural factors that influence energy technology deployment decisions (Stephens, Wilson & Peterson, 2008). This framework identifies how improved understanding of public discourse surrounding emerging energy technologies could assist in accelerating deployment of climate mitigating energy technologies.

Among the emerging energy technologies with potential to contribute to a low-carbon-emitting energy infrastructure, recent deployment of wind power has been particularly rapid. The USA currently has the fastest-growing wind market worldwide (Wiser & Bolinger, 2008). Innovation in wind turbine technology has improved and advanced wind power potential, however, a complex of different socio-political and

economic factors influence its development (Est, 1999), and strong opposition to some wind projects has influenced many regions (Devine-Wright, 2005; Jobert, Laborgne & Mimler, 2007; Wolsink, 2000). The widespread growth of wind power in the USA has been unevenly distributed among states (Sine & Lee, 2006). The high-level variation in wind deployment of different states cannot be explained simply by patterns of wind resource availability, so other social factors must be influencing wind development (Stephens, Wilson & Mitchell, 2007). State-level differences in factors influencing diffusion of emerging energy technologies have received some attention (Rabe, 2006; Sawin, 2003), but given that it is at the state-level that new energy technologies are sited, permitted, and built, more systematic assessment of state-level variation would be valuable. To accelerate deployment of wind turbines and other emerging low-carbon energy technologies, new insights are needed on the public discourse associated with socio-political challenges, particularly those associated with local public opposition to siting (Ellis, Barry & Robinson, 2007; Firestone & Kempton, 2007; Strachan, Lal & Malmborg, 2006; Wolsink, 2000).

As society increasingly recognizes the uncertain but inevitable future impacts of climate change, a diverse set of perceptions of risks and benefits associated with potential strategies for climate change mitigation are emerging. Luhmann's theory of ecological communication (Luhmann, 1989) provides a useful structure for analyzing and categorizing the risks and benefits included in public discourse of climate change mitigation strategies and technologies. Luhmann proposes that industrialized human society comprised of functional subsystems that frame potential responses to its environment. He identifies economy, law, science, politics, religion, and education as the most crucial functions, and notes that communication between these function systems is the only means for responding to environmental perturbations such as climate change (Luhmann, 1989). Effective transmission of information requires that the message is translated into the code of the receiving subsystem. The distinctive features of the different functional subsystems provide both an explanation for society's limited capacity to respond to environmental problems and also provides a valuable structure for considering how risks and benefits of environmental issues are framed (Peterson, Peterson & Grant, 2004).

Building from Luhmann's theory of functional systems, different frames within which risks and benefits associated with climate change mitigation technologies are mentioned can be assessed and compared. Using Luhmann's theoretical framework, we analyzed media coverage of wind power as a critical climate change mitigation technology in three states by comparing the salience of wind power in state-level newspapers, the degree to which wind power is associated with climate change and presented as a climate change mitigation technology, and the frames that are used to describe the risks and benefits of wind in each state. By adapting Luhmann's theory of functional systems, we identified six discrete frames (technical, economic, environmental, health and safety, political, and aesthetic/cultural—see Table 2) within which the risks and benefits of wind technology can be assessed and compared.

Background on Media Analysis, Public Discourse, and Climate Change

Media analysis is a useful approach to probing public discourse, because the news media provides a representation of public discourse (Gamson & Modigliani, 1989), and it also has potential to influence public perception and reinforce or potentially change the direction and scope of public discourse on a particular issue (McCombs, 2004). While many factors have been identified as influencing journalistic framing of a particular issue or technology including social norms and values, organizational pressures and constraints, pressure from specific stakeholders or interest groups, journalistic routines, and the ideology or political orientation of the individual journalist (Scheufele, 1999), systematic assessment of these journalistic decisions through media analysis provides a proxy for understanding the relative contributions of these many factors.

In addition to the news media reflecting public discourse, it also plays an important role in developing the public's perceptions through several mechanisms that include providing a channel of information that may increase the political or social salience of specific issues (Culbertson & Stempel, 1985; Dunwoody & Neuwirth, 1991), and, with respect to technical issues, by linking the technical assessments of experts to the more socially recognizable assessments of laypersons (Dunwoody & Neuwirth, 1991; Gregory, 1989; Murray, Schwartz & Lichter, 2001; Singer & Endreny, 1987).

Analysis of how the news media frame stories about specific technologies provides insights on public perceptions and public discourse, because media effects research suggests that news coverage is the most uncritically accepted type of media message, i.e., audiences tend to trust and assume legitimacy of most news coverage (Gibson & Zillmann, 1994; Grabe *et al.*, 2000; Kepplinger & Daschmann, 1997; Luhmann, 2000). Although a complex, dynamic, multi-pathway set of interactions between the news media and public discourse should be assumed, systematic analysis of media coverage can help clarify how this interaction is playing out, and may suggest possibilities to enhance deployment of energy technologies to mitigate climate change.

The selection and presentation of information in a newspaper article may have strong influence on popular understanding of and opinions about any particular issue, because much of the general public's knowledge of issues is mediated rather than direct (Nelson, Oxley & Clawson, 1997). Extensive studies on the agenda setting capacity of mass media suggest that the media play an important role in prioritizing issues and in shaping public opinion (McCombs, 2004; McCombs & Ghanem, 2001). While the scale and scope of the news media's influence on any particular issue or technology is debatable, the potential of the news media to influence behavior, perceptions, and discourse is large, so consideration of the media when exploring potentially controversial issues (or technologies) is critical (Crawley, 2007).

Media frames have been defined as a "central organizing idea for making sense of relevant events, suggesting what is at issue" (Gamson & Modigliani, 1989), and frames "supply content and suggest what the issue is through the use of selection, emphasis, exclusion, and elaboration" (Crawley, 2007). Frame analysis (Snow *et al.*,

1986) of newspaper articles allows for systematic and comparative assessment of how the media presents the risks and benefits of a particular technology to the public.

Past research on news media coverage of the climate change issue has demonstrated that an apparent attempt for "balanced" reporting has led the media to downplay the severity of the climate change problem; this bias results because the viewpoints of a few contrarians have been given the same level of attention as the consensus view of thousands of scientists (Boykoff & Boykoff, 2004; Dearing, 1995; Mooney, 2004). There are many additional challenges associated with communicating about climate change including the problem's lack of immediacy, remoteness of impacts, time lags, threats to values and self-interests, uncertain science, and skepticism about potential solutions (Moser & Dilling, 2007). And the power of journalism to influence perceptions of large, long-term processes such as climate change is minimized by more concrete, near-term concerns in individuals' everyday lives (Dunwoody, 2007).

With respect to wind energy, the media clearly play a role in shaping people's understanding of the possible benefits and risks of the technology, including the potential of wind power to contribute to climate change mitigation (Thompson, 2005). Particular problem definitions occurring in the media (e.g., content emphasizing aesthetic frames) may play an important factor in strengthening either local pro-wind or anti-wind movements (Thompson, 2005).

Justification for Research Design

Through comparative content and frame analysis of newspaper coverage of wind power in Texas, Minnesota, and Massachusetts, we assessed state-level variation in the salience of wind power in the media, the focus on wind power as a climate change mitigating technology, and the frames within which risks and benefits of wind power are presented. The three states, Texas, Minnesota, and Massachusetts, were chosen for this study because not only they each have a large wind resource potential, but also very different deployment patterns and are geographically, economically, and institutionally diverse as well (Table 1). These states also have markedly different population densities, land areas, and land values, as well as different energy contexts, reliance on and production of fossil fuels, and state-level renewable energy policy. Texas is the US state with the greatest annual wind capacity and growth rate, while Minnesota is the third highest wind power producing state. Massachusetts, a state where wind projects have met with considerable siting opposition, has comparatively few installed wind projects.

Methods

Using the Lexus Nexus Academic database, a search was conducted for newspaper articles about wind energy technology in the highest circulating regional newspapers in the three study states (*Boston Globe* in Massachusetts, *Houston Chronicle* in Texas,

Table 1. Key state-level indicators and statistics.

	MA	MN	TX
Economic and demographic indicators			
Population, 2006 (in millions)[a]	6.4	5.1	23.5
Population growth, 2000–2006[a]	1.4%	5%	12.7%
Land area (square miles)[a]	7840	79,610	261,797
Person per squ. mile, 2000[a]	810	62	80
Per capita income, 2006 (US$)[b]	46,255	36,629	35,058
Economic growth, 2005[b]	5.5%	2.9%	4.3%
Electricity sector data			
Installed wind capacity, June, 2008 (MW)[c]	5	1,366	5,605
Electricity consumption per capita, 2005 (MWh)[d]	6.8	13.7	14.3

Sources: [a]US Census Bureau 2008, [b]BEA 2008, [c]AWEA 2008, [d]EIA 2008.

and *Minneapolis Star Tribune* in Minnesota). The search included articles within the date range from January 1, 1990 to December 31, 2007; these dates coincide with the publishing of the first 1990 Intergovernmental Panel on Climate Change (IPCC) Assessment Report and of the most recent 2007 fourth IPCC Assessment report. The article search included all article types (news, business, editorials, etc.) and identified articles where six inclusion terms (wind energy, wind power, wind turbine, wind and renewables, windfarm, and windmill) were mentioned in the heading or the lead paragraph. To exclude non-relevant articles, the search also excluded two terms (rain and storm). Retrieved articles were manually reviewed to identify and remove any articles that were not explicitly about wind power.

Using NVIVO 7.0 text analysis software, attributes for each article were recorded and the text was analyzed. The analysis focused on three aspects: (1) the salience of wind technology in the newspaper reporting; (2) whether or not the article made an explicit connection with climate change framing wind technology as a climate change mitigation technology; and (3) the frequency and type of frames used to describe wind power's risk and benefits. To assess salience, the frequency and distribution over time of relevant articles were quantified, as was the placement and categorization of each article, i.e., front page, business, or op-ed. To quantify the number of articles that made an explicit connection between wind power and climate change mitigation, a query was conducted for all the articles within the sample that also included the terms "climate change," "global warming," "climate," and "carbon." All articles that were identified in this query were manually reviewed to confirm whether or not the article made an explicit connection with climate change, and those that did not were removed from the subsample. To assess the frequency of frames used to describe risk and benefits of wind, articles were analyzed and coded by considering risks and benefits within six frames. These six frames—technical, economic, environmental, health and safety, political, and aesthetic/cultural (see Table 2)—were identified by the researchers to include the social functions suggested by Luhmann (1989) to be critical to late modern society.

To facilitate intercoder reliability a codebook was developed through an iterative process (Riffe, Lacy & Fico, 1998), and consistency between the coders was assessed both before and after the coding (Lombard, Snyder-Duch & Bracken, 2002). The codebook containing a detailed coding protocol was developed based on previous conceptual state-level energy diffusion work done by the researchers (Stephens *et al.*, 2008). The codebook provided operational definitions of the six frames and explicit guidelines for assigning content to particular frames. All coding was performed by two of the authors who divided the full set of articles into two roughly equal, mutually exclusive, and exhaustive subsets. Intercoder reliability assessment ensured consistency between the two coders (Lombard *et al.*, 2002). After completion of coding of the full sample of articles, the level of intercoder reliability was measured on a randomly selected subsample of 136 articles, corresponding to 20% of the population. The indices used to measure intercoder reliability were simple agreement and the numerical Scott's pi index. The minimum simple agreement for the category variables with 95% confidence ranged from 66.2 to 92.6%, and the minimum Scott's pi values ranged from 0.35 to 0.88 (Table 3). Prior to initial coding it was decided that we would include only category variables with reliability greater than or equal to 80% simple agreement and 0.45 Scott's pi value. The Scott's pi acceptability value is lower because it is considered a much more conservative index (Riffe *et al.*, 1998). Of the six frames, only one—the political frame—was excluded from our results because of low-intercoder reliability. In addition, the benefit categories within the economic and technical frames were also excluded because the results did not meet the aforementioned intercoder reliability requirements. This inconsistency in coding

Table 2. Descriptions of the risk and benefit frames. These categories were developed by the researchers by adapting and building from the functional subsystems within Luhmann's social theory of ecological communication (Luhmann, 1989).

Frames	Risks	Benefits
Technical	Technological limitations and uncertainty	Technological reliability, sophistication, and advancements
Economic	Expensive, destabilizes local economy, i.e., reduces tourism	Low cost, strengthen economy (jobs, tourism, etc.), free resource
Environmental	Negative environmental consequences (bird-kills, habitat loss)	Positive environmental consequences (reduce carbon emission, reduce air pollution)
Health and safety	Health or safety concerns (glare, navigation, radar, worker safety)	Health and safety improvements (i.e., reduce respiratory problems)
Political	Negative political ramifications, image, reputation of state, or political leaders. Threat to military or political security	Positive political ramifications, i.e., being a leader, closer to political goals, energy independence, and energy security
Aesthetic and cultural	Negative visual impacts. Negative impacts on cultural, historical, or recreational sites, negative community impact	Positive visual impacts, i.e., positive community impact, enhance local culture, bring community together

Table 3. Intercoder reliability results.

	Minimum simple agreement of population with 95% confidence	Scott's Pi index
Technical risk	85.9%	0.69
Technical benefit[a]	72.1%	0.53
Economic risk	82.0%	0.71
Economic benefit[a]	73.3%	0.58
Environmental risk	91.3%	0.86
Environmental benefit	82.0%	0.74
Health and safety risk	91.3%	0.64
Health and safety benefit	95.7%	0.49
Political risk[a]	78.2%	0.35
Political benefit[a]	66.2%	0.38
Aesthetic risk	83.3%	0.71
Aesthetic benefit	85.9%	0.67

[a]The four categories of frames that were excluded because they were below 80% minimum simple agreement or below 0.45 Scott's Pi.

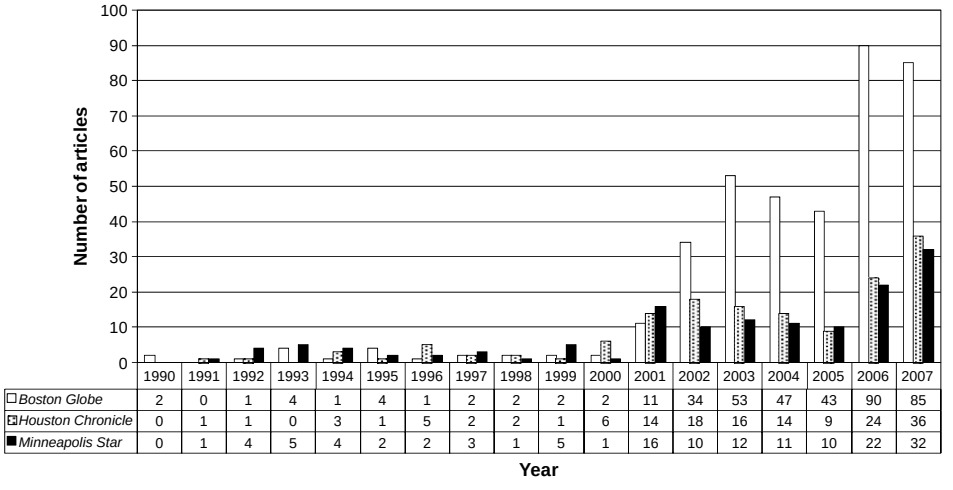
resulted from variation between the two coders in interpreting these frames in the article text.

An acknowledged limitation of this study is the undoubtedly different relationship between public discourse and the largest circulating newspaper in each of these three states. In addition, each of these states has several other prominent and important newspapers with different audiences and potentially different angles and perspectives. Recognizing these limitations, this analysis does provide a valuable and consistent approach to considering comparative state-level discourse on wind power.

Results

The search process retrieved 153 articles from the *Houston Chronicle*, 384 from the *Boston Globe*, and 141 from the *Minneapolis Star Tribune* for a total sample size of 678 articles about wind technology from 1990 to 2007. In all three newspapers, the frequency of articles relating to wind power increased considerably starting in 2001, and the years 2006 and 2007 had the highest number of articles (Figure 1). The biggest increases can be seen between the years 2000 and 2001 and between 2005 and 2006. From 2002 onwards, the *Boston Globe* surpasses the rest of the newspapers in number of articles by almost double, and very few articles related to wind power were found in any of the newspapers throughout the 1990s.

With respect to the placement and type of wind technology articles in the three newspapers, the Minneapolis newspaper had many more articles that were published on the front page than did either the *Boston Globe* or the *Houston Chronicle* (Figure 2). Houston had a much higher percentage of articles in the business section, and Boston had a higher percentage of wind articles that were classified as opinion pieces (Figure 2).



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Boston Globe	2	0	1	4	1	4	1	2	2	2	2	11	34	53	47	43	90	85
Houston Chronicle	0	1	1	0	3	1	5	2	2	1	6	14	18	16	14	9	24	36
Minneapolis Star	0	1	4	5	4	2	2	3	1	5	1	16	10	12	11	10	22	32

Figure 1. Frequency over time. The number of wind-power-related articles published in each of the three newspapers from 1990 to 2007.

Of the total sample of 678 articles, only 129 of them relate wind power directly to climate change by including at least one of the following words or phrases: "climate change," "global warming," "climate," or "carbon." There was a similar pattern over time among the three newspapers in the proportion of articles that make this explicit connection with climate change (Figure 3), and the overall percent of articles making this explicit connection was similar; in Minnesota 18% of all the wind articles included at least one of these phrases, in Texas 15%, and in Massachusetts 21%. In each of the newspapers, this explicit climate change connection was greatest in the most recent year, 2007 (Figure 3).

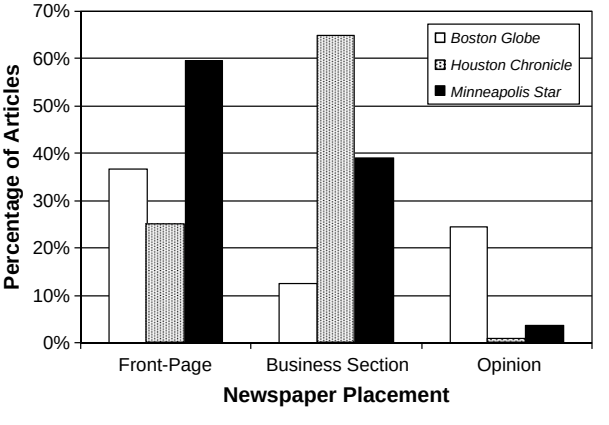


Figure 2. Placement. Percent of wind-related articles published on the front page, in the business section, or as an opinion piece in each of the three newspapers.

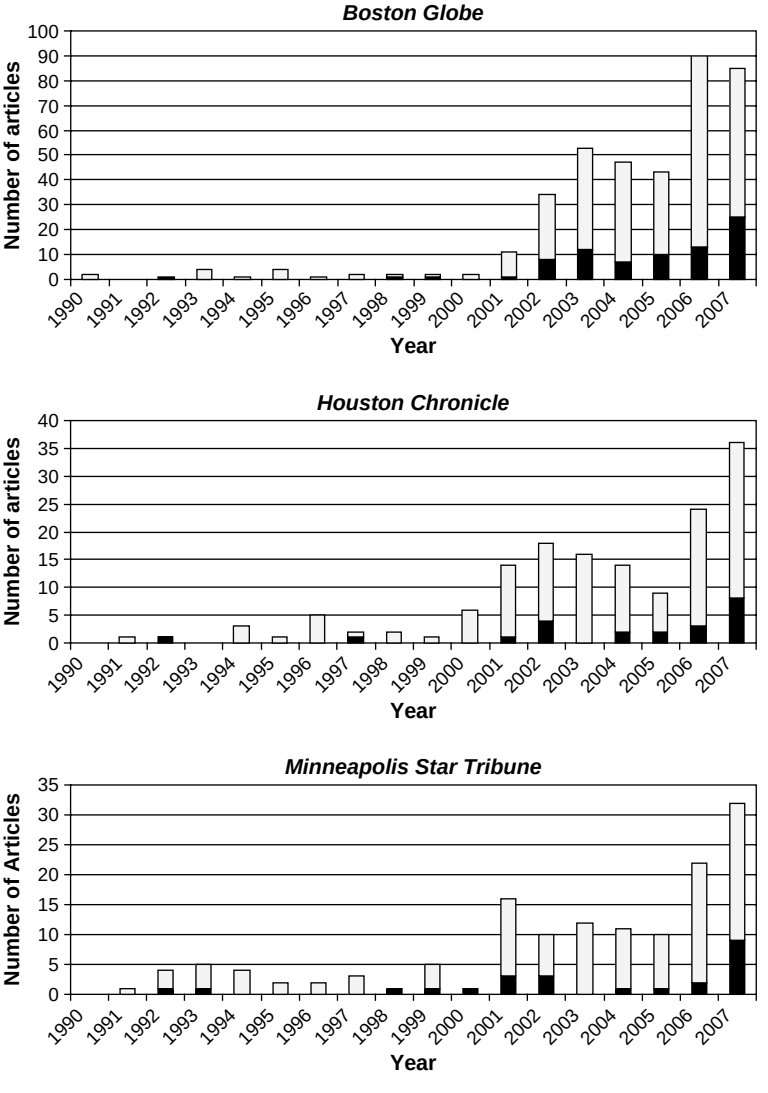


Figure 3. Association with climate change. This set of graphs demonstrate the number of articles (dark portion of each bar graph) that explicitly mention "climate change," "global warming," "climate," or "carbon".

Analysis of frames within which risks and benefits of wind are mentioned demonstrate some distinct differences in the wind technology framing among the three states (Figure 4(a),(b)). Variation in risks mentioned within the aesthetic/cultural, environmental, technical, and health and safety frames among the three newspapers was identified (Figure 4(a)). In the *Boston Globe*, 44% of articles included mention of risks within the aesthetic/cultural frame, while there was minimal mention of aesthetic/cultural risks in either the *Houston Chronicle* (14%), or the *Minneapolis Star Tribune* (6%). In the *Boston Globe*, 31% of the articles mentioned

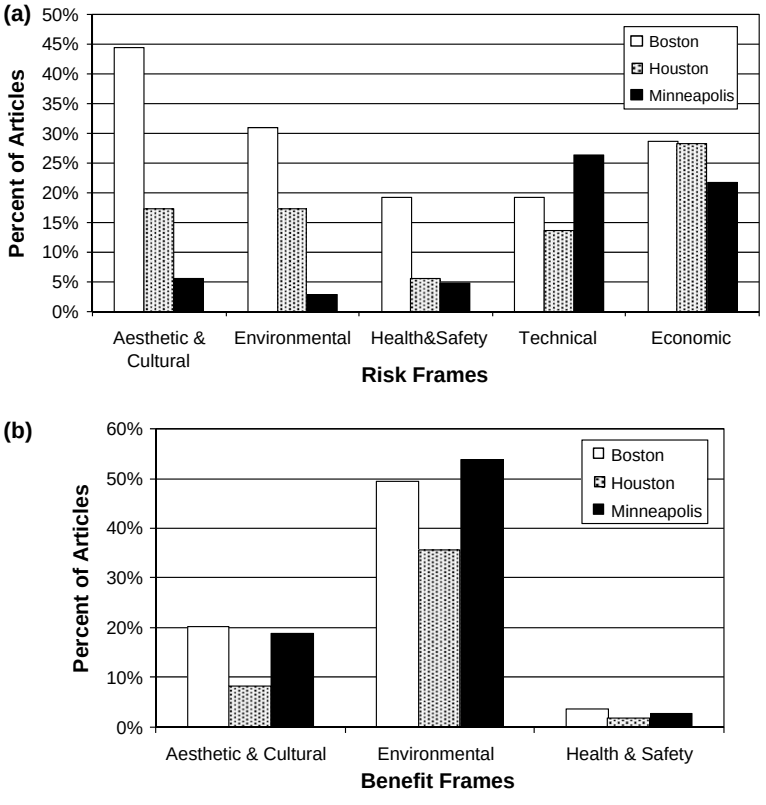


Figure 4. Comparative breakdown of specific (a) risk frames and (b) benefit frames. Percent of articles in each newspaper that includes each category of risk and benefit frames.

risks within the environmental frame, in Houston 17%, and in Minneapolis 3%. Risks within the health and safety frame were included in *Boston Globe* articles 19% of the time while these were only mentioned in the other two newspapers in 5% of the articles. Risks within the technical frame were more prevalent in Minneapolis articles than in Houston, or Boston articles. No significant differences among the three newspapers in the prevalence of risk within the economic frame were identified.

A notable difference in benefit frames is that the *Houston Chronicle* had a lower level of environmental framing of benefits than either of the other two newspapers (Figure 4(b)). About half of all articles in both Boston (54%) and Minneapolis (49%) mentioned benefits within the environmental frame, but in Houston only 35% of articles mentioned environmental benefits. A similar pattern emerged for benefits within the aesthetic/cultural frame (Figure 4(b)).

In the aggregate, when all risk and benefits within all the frames that met our intercoder reliability conditions are compiled, we see that the *Boston Globe* has a considerably higher percentage of articles that include explicit risk frames (Figure 5).

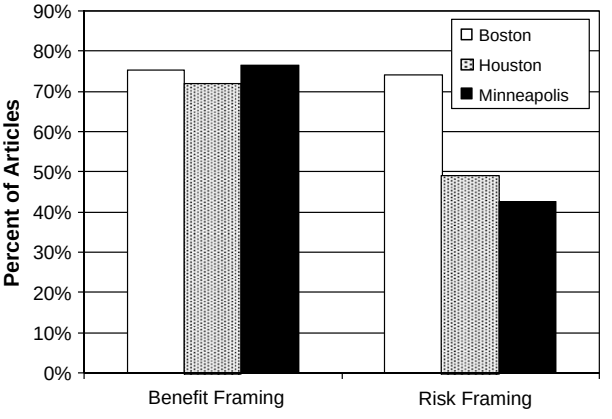


Figure 5. Risk and benefit framing. Percent of articles from each newspaper that includes some type of benefit framing and risk framing.

Discussion

The results of this analysis demonstrate several comparative aspects of the salience of wind power, its association with climate change, and the risk and benefit framings associated with wind power in the discourse within the highest-circulation newspapers of these three states. In addition to identifying distinct state-level variation in both the salience and risk and benefit framings in wind energy discourse, the results demonstrate that the technology's potential for climate change mitigation has been a limited but growing part of media coverage on wind power.

Salience of Wind Technology in the Media

The steady increase after 2000 in the frequency of newspaper articles about wind power in all three newspapers reflects the increasing relevance and interest in renewable energy technologies during this time. The increasing interest in wind power during this time parallels an increase in national awareness of climate change (Leiserowitz, 2007). In the case of Texas and Minnesota, the timing of the increase in newspaper articles mirrors, to some degree, the timing of the increase in installed wind capacity (AWEA, 2008). This does not hold true for Massachusetts, a state that has had comparatively little wind deployment. The comparatively large number of articles, and the pace of increase in the number of articles published in the *Boston Globe*, is more likely related to and potentially mirrors developments in the controversial Cape Wind project that was first proposed in 2001. In each year between 2001 and 2006, at least 50% of newspaper articles in the *Boston Globe* included some mention of the Cape Wind Project.

The higher absolute number of articles in the *Boston Globe* demonstrates a more intense public discourse surrounding wind power in Massachusetts. First proposed in 2001 as 170 (later decreased to 130) wind turbines in the Nantucket Sound, the Cape Wind project immediately met with both strong supporters who praised the project

for its potential to reduce greenhouse gas emissions and help the country diverge from foreign oil, and by staunch opponents who claimed the project would be an aesthetic and environmental disaster, would destroy the natural beauty of Cape Cod, reduce tourism, disturb the marine ecosystem, and threaten birds. Since the initial project was proposed, a number of politicians have gotten involved including former Massachusetts Governor Mitt Romney, who argued in 2004 for a change in the federal-state costal boundary to allow for state jurisdiction over the project, jurisdiction to the state, and Senator Edward Kennedy who in 2006 failed in an attempt to pass a law that gave the Governor veto power over the project (Williams & Whitcomb, 2007). As the project currently continues through a complex permitting process, so does the controversy, along with news media coverage related to the project.

The placement of articles within a newspaper provides some additional insights on the salience, extent, and type of discourse. Articles selected to be on the front page of a newspaper are generally considered by the editor to have an appealing quality; these are articles that editors hope will draw readers in, attract them to pick up and read the newspaper. The high percentage of wind articles in Minneapolis that made the front page (60%) suggests that wind power is an intriguing, hot topic in Minnesota with potential for wide appeal. This is in contrast to Texas, a state with a long history and close state-level identification and association with the energy industry and energy technologies, where developments in wind power are less likely to be new and exciting front-page news. The high percentage of the *Houston Chronicle* newspaper articles about wind power published in the business section (65%) is consistent with the economic focus on energy and energy technologies in the state of Texas.

Opinion pieces reflect issues that are currently on the political agenda and have some degree of controversy. Also, the editorial page is the third most-read section of the newspaper (general news is the most-read section and sports is the second most-read section) (Newspaper Association of America, 2003). The contrast in the percentage of articles that were opinion pieces in the *Boston Globe* compared to the other two newspapers reflects the higher degree of politicization of wind power in Massachusetts. Of the 94 total opinion pieces published in the *Boston Globe*, 66 of them (70%) mentioned the controversial Cape Wind project.

Explicit Association with Climate Change

The similar pattern over time among the three newspapers in the proportion of articles that make an explicit association with climate change (Figure 3) suggests that there may not be a distinct difference among the states in how often wind power discourse relates explicitly to climate change mitigation. The percent of articles in each state that included the climate-related search terms was similar; in Minnesota 18% of all the wind articles included at least one of the explicit words or phrases used in the query, in Texas 15%, and in Massachusetts 21%. It is possible that other words or phrases that were not used in this query could less explicitly allude to the climate change problem and the climate mitigation potential of wind power. The low overall

percent of the articles that make this explicit connection represents the dominance of wind-related articles in all three newspapers that tend to focus on specific operational or procedural details related to individual projects, and often do not explicitly mention the climate change mitigation potential of the technology.

The *Boston Globe* clearly had quite a few more articles that make the connection between wind and climate change mitigation than the other two newspapers, but the number of articles is approximately proportional to the total number of wind-related articles in each newspaper. As awareness of climate change has risen (Leiserowitz, 2005), the connection between wind power and its potential to contribute to mitigating climate change by reducing carbon dioxide emissions is being made more often. These results are consistent with general increases in climate change reporting that they have been well documented (Liu & Vedlitz, 2004; Takahashi, 2008).

Examples from each state demonstrate the variety in how the connection between wind power and climate change is made in the articles. Consistent with the dominance within Massachusetts discourse of the Cape Wind project, the following excerpt illustrates an inconsistency in Massachusetts environmental politics regarding climate change policy and actual deployment of wind power:

> Senator Edward M. Kennedy's longstanding vocal opposition to Cape Wind defies his lengthy track record as a supporter of sound energy policies. His unwillingness to look beyond local aesthetics to a broader view of sustainable energy solutions is deeply disappointing. Ironically, the very coastline whose vistas he seeks to preserve is on the front line of the battle against climate change—a battle we will lose if we dare not advance projects like Cape Wind. (Warburg, 2006, p. A11)

This excerpt provides an example of both the frequent reference in Massachusetts to the Cape Wind project and also of a direct connection between wind power and climate mitigation. In this article, the journalist is suggesting that wind power is a requirement for sufficient climate change mitigation. This piece also provides an example of the prominent aesthetic frame in Massachusetts wind power discourse.

The following example from Texas highlights the connection between wind power and climate change by relating the greenhouse gas emission reductions associated with wind displacing coal to the Kyoto Protocol emissions reduction targets:

> To help meet current U.S. energy demand, the authors propose building 225,000 turbines that would cost the U.S. government an initial $338 billion. The United States could eliminate almost two-thirds of its coal-generated electricity under this plan and thereby reduce greenhouse gas emissions to below 1990 levels, say the authors. That goal is already envisioned by the 1997 U.N. Kyoto Protocol on climate change. (Furlon, 2001, Business p. 9)

This example from the *Houston Chronicle* illustrates a direct and explicit connection between wind power and climate change, while also demonstrating the economic emphasis that dominates the Texas coverage.

The example below from Minnesota makes the connection between wind power and climate change by illustrating the recent emergence of a competitive approach to climate change mitigation:

> Legislators and other observers argue that Minnesota has in some ways gone further than California by requiring that utilities produce 25 percent of their energy with renewable sources by 2025, and begin reducing their production by 1.5 percent annually put the state in the forefront of climate change mitigation. (McAuliffe, 2007)

The emergence of the competitiveness associated with climate change mitigation strategy and stringency demonstrated in this excerpt can be viewed as consistent with the increased public awareness about climate change and the dramatic increase in number of articles about wind power. As climate change awareness grows, the political pressure to take action toward mitigating climate change increases, and supporting wind power and other renewable energy technology is a tangible way to respond to that political pressure.

Frames Presenting Wind Technology Risks and Benefits

The comparison of frames used to describe risks and benefits of wind power included in the newspaper articles provides more details on the varied type of discourse in the three states. The overall higher attention to risk (Figure 5), specifically the higher percentage of articles that mention risks within the aesthetic/cultural, health and safety, and environmental frames in the *Boston Globe* articles (Figure 4), confirms the controversial nature of wind power in that state. This higher level of sensitivity to potential negative implications of wind power may be partially explained by considering the higher population density and the higher percentage of imported electricity in Massachusetts. Unlike residents in Texas, Massachusetts citizens are not accustomed to having large-scale energy technology projects in their region. More positive framing of wind technology in Texas and Minnesota (lower percentage of articles including risks) may also reflect a greater degree of perceived local gains from wind power development. Many residents of Cape Cod appear to feel they have little or nothing to gain and quite a bit to lose by allowing an offshore wind farm to be built in Nantucket Sound. In contrast, for struggling Minnesota farmers who receive payments for renting parts of their land for wind turbines in an apparent "win–win" situation, wind power is likely to be viewed as a net positive development. Economically favorable projects that have had grass roots interest and support of farmer cooperatives who own many of the new projects have been critical to the recent growth of wind power in Minnesota.

The most drastic differences among the three newspapers was the degree to which risks were identified within the aesthetic/cultural frame that occurred in 44% of *Boston Globe* articles but only 14 and 6% of articles in Houston and Minneapolis, respectively. The following 2006 *Boston Globe* excerpt highlights the aesthetic/cultural frame used to describe risk associated with the Cape Wind project: "(T)he energy project will be an industrial eyesore when seen from the pristine shores of Cape Cod" (Daley, 2006, p. B1). Risk within this aesthetic/cultural frame surfaced frequently in the Massachusetts articles emphasizing the potential for wind turbines to disrupt the previously undisturbed natural landscape or seascape. The comparative lack of risks

mentioned within the aesthetic/cultural frame in Texas and Minnesota is indicative of a substantially different emphasis in state-level discourse.

The health and safety frame was minimal in both the Minneapolis and Houston newspapers, while 20% of the Boston articles contained mention of risks within the health and safety frame. The following quote from the *Boston Globe* illustrates health and safety risks of residents who may live close to a wind turbine. "She [a Dover, MA resident] said she's worried it [the wind turbine] might topple in a storm, or shoot off icicles, or prove distracting to drivers trying to navigate the curving road" (Moscowitz, 2002, p. B1). The prominence of this fear of negative health and safety implications of wind power only in the *Boston Globe* articles may be understood by considering differences in the demographic context. In Massachusetts, land is more expensive and competition among land-use is greater, so wind turbine proposals have competition with other conflicting residential and commercial land-use. In addition, for Massachusetts residents who are not accustomed to living close to energy technology, the prospect of new energy infrastructure in proximity to where they live may invoke fear about the unknown that may be associated with apprehension and concern about their personal safety. The health and safety frame is also prominent in the Cape Wind discourse where health and safety risks relating to navigation challenges of airplanes and boats were mentioned as serious arguments against development.

Within the technical frame, risks include mention of unreliability of the technology and difficulty in integrating wind into the grid. Challenges of intermittency and the need for improved transmission line infrastructure were frequently mentioned risks within the technical frame. The higher percentage of articles in Minnesota that mention technical risks could reflect a greater challenge for ensuring transmission lines for distributed power in Minnesota, as reflected in the following quote from the *Minneapolis Star Tribune*:

> The utility guarantees payments to wind farm owners whenever their machines produce electricity, but it doesn't have enough transmission lines to deliver all of that power to consumers. As a result, wind machines have been routinely disconnected, sometimes on the windiest days, when the most power could be generated. (Meersman, 2006, p. 1A)

This example demonstrates a juxtaposition of and inconsistency between potential economic benefits to Minnesota farmers and technical risks associated with insufficient transmission line infrastructure. This integration of considering risks and benefits associated with different frames captures a complexity that is apparent in much of the media discourse related to wind power. Technical risks are also prevalent in the *Boston Globe* articles. The Cape Wind proposed wind farm in Massachusetts is a first-of-its-kind off-shore project, so risks associated with transmission capacity and uncertainty about technological reliability were both recurring mentions within the technical frame in Massachusetts.

The high percentage of risks included in the environmental frame in the *Boston Globe* articles represents the widespread concern often cited by opponents of the

off-shore Cape Wind project for aquatic ecosystems. The following *Boston Globe* 2005 excerpt illustrates the concern for both migrating birds and marine life:

> Herzfelder called on Cape Wind to do additional studies of potential environmental impacts, such as an additional year of radar data on spring and fall migration patterns of birds. She also called on Cape Wind to develop better maps of fish habitat in the project area and more analysis of how the wind farm could affect marine life. (Allen & Daley, 2005, p. A1)

This example also demonstrates how the uncertainty of risks within the environmental frame can be used to justify additional research or analysis and has contributed to controversy. Risks within the environmental frame are often mentioned in conjunction with risks associated with other frames, as demonstrated in this 2005 *Boston Globe* article: "Still, the proposal is sure to raise the ire of some Cape Cod residents who have voiced concern over the previous wind farm proposal. They are worried about harm to marine life, birds, aesthetics, and navigation" (Daley, 2005, p. B1). This excerpt demonstrates how in a single sentence a journalist can integrate mention of risks within three different frames, the environmental, aesthetic/cultural, and health/safety frames.

The comparatively lower frequency of benefits mentioned within either the aesthetic/cultural frame or the environmental frame in the Houston articles reflects the highly economic, competitive, business orientation, and focus of wind technology discourse in Texas, as seen in this example: "Texas accounted for about one-third of all new wind generation installed in 2006 and overtook California as the top wind-energy-producing state in the U.S., with 2768 megawatts of capacity" (Fowler, 2007, p. 1). The competitive pride illustrated here is typical of the competitive, economic, industry-oriented energy technology discourse in Texas. The positive mentions within the economic frame also include discussion of the economic growth potential of wind power as illustrated in this 2006 excerpt from the *Houston Chronicle*:

> The U.S. Department of Energy predicts wind power will be an $80 billion global business by 2020. "We want the blade-testing facility here in Texas because it fits in with what we're doing in being the leader in wind power," said Patterson, a promoter of wind power whose office has leased state land offshore for turbines. (Elliott, 2006, p. 1)

These examples reflect the dominant economic frame of Texas discourse, and also provide context for understanding the comparative minimal focus on either the environmental or the aesthetic/cultural frame in Texas.

Within the aesthetic/cultural frame, benefits include words and phrases that evoke picturesque or even romantic visions of wind turbines turning in the wind or a proud community brought together strengthening its cultural identity through a wind project. This aesthetic/cultural framing was less frequently included in the Houston reporting than in either Boston or Minneapolis (Figure 4(b)), but was included to some degree in all three newspapers, as can be seen with the following example from Texas: "Virtually every flat-topped mesa visible from the center of town bristles with tall, graceful, state-of-the-art wind turbines" (Freemantle, 2002, p. A1). This

description of the wind turbines is clearly positive, suggesting a proud and beneficial community perspective on wind technology.

Benefits within the environmental frame were important in all three newspapers, but to a lesser extent in the Texas newspaper. About 50% of articles in both the *Boston Globe* and the *Minneapolis Star Tribune* included benefits within the environmental frame, while only 35% of *Houston Chronicle* articles did. One environmental benefit of wind power is its capacity to mitigate climate change by producing electricity without generating greenhouse gases, but other benefits within the environmental frame include more general positive aspects including the mention of "pollution-free" and "clean" energy. The results from the analysis of environmental frames can be assessed in conjunction with the analysis of whether or not the articles presented wind power as a climate change mitigation technology. As discussed above, a similar temporal pattern was identified among the three states in the proportion of wind-related articles that make an explicit connection with climate change, and the percent of articles that made this connection was similar: in Minnestoa 18%, in Texas 15%, and in Massachusetts 21%. When these numbers are compared to the percentage of articles that mention benefits within an environmental frame, it is clear that other non-climate specific, and/or more general environmental benefits comprise a large portion of the environmental benefits mentioned in these articles.

Conclusions

A distinctly different media discourse surrounding wind power technology in these three states has emerged from this analysis. First, since 1990 the salience of wind energy in state discourse has been distinctly greater in Massachusetts than in Texas or Minnesota. The primary reason for this relates to the highly controversial proposed Cape Wind project; the higher frequency of media coverage related to wind in Massachusetts can be correlated with a higher degree of controversy in the state. Texas and Minnesota have far more developed wind energy than Massachusetts, but clearly the extent of wind power in the state is not directly proportional to the extent of state-level discourse about wind represented in the media. Our comparative analysis of frames within which risks and benefits are presented in newspaper articles provides insights on the contextual differences in wind discourse among these three states. Massachusetts discourse emphasizes the risks of wind technology through aesthetic and cultural, environmental, and health and safety frames. Texas discourse reflects the state's strong energy-industry history and tends to focus on the business perspective of wind energy through an economic frame (most wind articles appearing in business sections) with comparatively little risk discourse. Minnesota discourse about wind technology appears to be generally positive with prevalent environmental framing, and, unlike Massachusetts, the dominant risk frames in Minnesota are not aesthetic/cultural or environmental but are within the technical and economic frames.

As the climate change issue has grown in salience throughout the USA, this analysis shows that so has the frequency with which wind technology discourse is explicitly linked to climate change mitigation in all three states. Despite this increase which was

particularly pronounced in the year 2007, many articles about wind technology still do not make an explicit connection with climate change but focus instead on more tangible, local aspects of wind power, such as progress on a specific wind project or specific challenges, or opportunities associated with wind power development. The low levels of association with climate change mitigation identified in this study may have some positive implications, however, if this result is considered within the emerging climate change communication literature that highlights the importance of overcoming the intractability of climate change by integrating climate change messages with other more tangible issues and priorities (Moser & Dilling, 2007).

By building on and adapting Luhmann's (1989) ecological communication theory in the design of the frame analysis, this research provides an empirical application of Luhmann's theory of functional systems. By assessing and comparing the framing of risks and benefits associated with one climate change mitigation technology in newspapers, we demonstrate the variety of different frames within which wind power can be presented, and we are able to connect the comparative frequency of these frames with variation in the social context of the three states. Luhmann claims that isolated communication within discrete functional systems limits society's effectiveness to respond to environmental challenges, and further he suggests that communication between and among these function systems is required to enhance society's capacity to respond to environmental threats. Our analysis demonstrates the power of the news media to integrate various different frames facilitating communication between different function systems. Following Luhmann's theory, this integration may be improving societal capacity to respond effectively to environmental threats, including climate change. Our results demonstrate that the news media's tendency to integrate different frames or function systems is dependent on and varies with the state-level context within which both the media and the issue or technology are embedded.

This analysis also suggests that energy technology proponents should integrate in their communication strategies frames other than the environmental or climate change mitigation benefits of the technology, and decisions on which other frames to include should be responsive to the local and regional context of the place where the communication is to occur.

Recognizing that media analysis is a useful approach to probing public discourse, because the news media provides both a representation of public discourse (Gamson & Modigliani, 1989), and a pathway to influence public perception (McCombs, 2004), this study provides a valuable context and initial contribution to a more complex integrated comparison of factors influencing the deployment of climate mitigation technologies. Building on this media analysis, these results will be integrated with a detailed comparative review of recent trends in wind technology deployment as well as climate and energy policy, and assessment of institutions, laws, and policy actors in the three states applying the SPEED framework (Stephens *et al.*, 2008). Through this process of integrating this media analysis with other complementary analysis of state-level variation in factors contributing to energy technology deployment, we hope to improve understanding of the interconnected

socio-political influences on energy technology deployment. The ultimate goal of this larger research effort is to identify insights that will enable energy modelers, policy makers, energy professionals, state planners, and other stakeholders to develop and implement more effective strategies to accelerate the deployment of emerging energy technologies for climate change mitigation. While this study focused on variation in state-level discourse of wind power, the results provide insights on contextual differences related to climate and energy discourse that can be applied to considering challenges and opportunities associated with the deployment of other energy technologies with climate change mitigation potential.

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