The Takeover of Science Communication – Science Lost its Leading Role in the Public Discourse of Carbon Capture and Storage Research in Daily Newspapers in Germany

Simon Schneider

University of Potsdam

Department for Earth and Environmental Sciences

Karl-Liebknecht-Str. 24-25, Haus 27

14476 Potsdam, Germany

phone: 0049 331 977 5694

simschne@uni-potsdam.de

Abstract. CCS is an important issue that has played a major role in the agenda of scientists, researchers, and engineers. While the media representations of CCS in Germany from 2004 to 2014 showed significant characteristics of a medialization of the topic, this cannot be ascribed to science. Instead, CCS media coverage in Germany was dominated by other stakeholder groups. If Science will stay a pro-active element of science communication, new approaches for future science

5   PR have be deduced to re-strengthen the role of science communication. Among these is the pursuit of a more differentiated understanding of target audiences and regional concerns. Science PR has to accept that the science itself is no longer the only stakeholder and actor within science communication.

1 Introduction

Communication science scholars have debated the interdependencies between the media and public relation offices

10   (Altmeppen, 2004; Raupp & Vogelgesang, 2009) in the realm of science communication. It has been openly discussed whether journalists have turned into PR professionals or whether press offices at universities and research institutions have already taken issue management (Chase, 1977), agenda building (Cobb & Elder, 1997), and even journalistic tasks into their own hands (Schnedler 2011).

Particularly in the case of science journalism, which over the last decade has undergone fundamental changes due to budget

15   and personnel cuts that have led to the closure of many science newspaper departments (Brumfiel, 2009), it can be observed that effective – and despite all doubts sometimes qualitatively valuable – public relations carried out by universities and research institutions has already spearheaded the media coverage of special areas of science. Studies concerning the complex interrelation of PR and journalism (Macnamara, 2014; Williams & Gajevic, 2013; Nelkin, 1995) have shown that PR-dominated science journalism is in fact a reality: "[…] many journalists are in effect retailing science and technology more

20   than investigating it, identifying with their sources more than challenging them" (Nelkin, 1995, p. 164). The level of influence is erratic; Reich, for example, has observed that "Studies have attempted to establish a bottom line for PR-originated input, ranging between 25 to 80 percent of news content" (Reich, 2010, p. 799). This might be related to system-specific differences within the national media landscape as well as the diversity of scientific approaches in the relevant studies (Reich, 2010). Within this context, this study will focus on CCS (Carbon Capture and Storage) technology. CCS

provides valuable insights because of its complex nature that requires scientific interpretation (Schneider, 2006) to enable

members of the public to participate in the political discourse. Moreover, CCS is an area that is not only related to

technological innovations but also to the widely discussed issues of climate change and geoengineering as well. Both are

attracting more and more attention from communication science scholars (Buck, 2013; Anshelm & Hansson, 2014; Nisbet,

5   2009).

1.1 The role of science PR and other actors in CCS-related communication

In Germany, four stakeholders can be found within the area of CCS: research institutions (including universities), energy

providers, political bodies and NGOs, such as the Bund für Umwelt und Naturschutz Deutschland (BUND), World Wildlife

Fund (WWF) and Greenpeace, and local public interest groups (PIGs). All stakeholders have individual aims and goals when

10   they become engaged in communicating CCS and all take part in the competition for publicity. Research institutions and

energy providers have tried to promote CCS as a transitional option to minimize the effects of climate change through the

reduction of carbon dioxide emissions. Therefore, they seek to achieve public acceptance by becoming actively engaged in

efforts to communicate CCS (Praetorius & Schumacher, 2009; Chrysostomidis et al., 2013). Both take an active role in CCS-

related communication through PR offices by sending out press releases, conducting public presentations, or pursuing other

15   means to transmit information. In contrast, the political arena in Germany has shown no great interest in contributing content

and insight to the debate around CSS. Nevertheless, internal struggles within single parties, as well as disputes between state

and federal policies, have become an important part of the media coverage of CCS (Heisterkamp, 2010). NGOs have

demonstrated a predominantly negative attitude toward CCS (Schneider, 2017). The allegation that CCS has been misused to

improve a company's image can be found in the recurring argument that the otherwise climate-wrecking business activities

20   of the energy providers are being "greenwashed" (Smid, 2009). Taking a closer look, some NGOs nevertheless support

research into and the development of CCS as a transitional measure that will allow time for better and more efficient

measures (WWF, 2010; 6). Within this setting, the field of communication science will have to ask whether there are

dominant actors in the communication of CCS. We assume, that (H1) these dominant actors are able to steer the debate in

their favor by setting the framework for CCS as well as by shaping the public assessment of CCS in favor of their own intentions.

Following the observations made by Berinsky and Kinder (2006) that storytelling can guide the audience's own reflections on and interpretations of an issue, modern PR and marketing has most effectively used storytelling for image building and to

5   increase the acceptance of certain issues and products (Sammer, 2014). The PR and marketing work carried out by companies and NGOs is able to promote individual messages by using complex communication models based on storytelling as well as issue management and agenda-building techniques. In respect to topics of the utmost importance for society – such as sustainability and climate change – independent science journalism is essential. But while companies and NGOs can use effective PR and marketing strategies, scientific institutions themselves do not usually include communication departments

10 of equally high professional standards. Therefore, we assume (H2), that scientific field while it can play a significant role in journalistic science communication, is overpowered by professional but instrumentalized PR and marketing by other actors.

1.2 Legitimacy and acceptance as driving forces for medialization

Kohring (1997) identifies the need for acceptance as a driving force behind the increased popularization of science. Adding to Kohring's observation, we can see the need for legitimacy as an additional driving factor. Social-science scholars agree

15 that acceptance is built up by individual risk-benefit assessment (Kraeusel & Möst, 2012; Tokushige et al., 2007; Wallquist et al., 2012; L'Orange Seigo, 2013). Other important factors in increasing levels of acceptance are individually approved opinion leaders, as well as the personal sociopolitical background and life story that guides individual interpretations of communication content (Visscher et al., 2011; Nippa et al., 2014). Consequently, if science PR seeks to increase acceptance and legitimacy (Jarren & Röttger, 2009, p. 33; Hoffjann, 2007, p. 127), science communication has to be linked to matters of

20 topical relevance to enable individual communication partners to assess the risk-benefit ratio individually. Science communication has changed in this respect in the past few decades, and medialization can be seen as one result of this change (Kepplinger & Post, 2008; Meyen, 2009). Science communication now has a central focus on highlighting the relevance of science for individuals and society (Herrmann-Giovanelli, 2013, p. 65f). Nevertheless, this is not sufficient to further increase acceptance and legitimacy. Affective attitudinal components cannot be fully controlled by science

communication, but they are of the utmost importance for building up acceptance and legitimacy (Finucane et al, 2000). The

following analysis of media representations of CCS therefore seeks to locate observable aspects that will help to identify

mechanisms of acceptance and legitimacy building. The importance of individual risk-benefit assessments is one such

observable aspect; a strong journalistic focus on risk-benefit ratios, the emphases of opinion leaders, as well as a clear

5   integration of emotional language serve as indicators of an intended acceptance and legitimization approach.

1.3 The organization of CCS-related communication in Germany

The scientific field – and within the thematic framework of CCS this means the earth sciences – is only populated by

communicators and communication tools of limited professional standard. Still, only a relatively small number of research

institutions maintain professional outreach offices specialized in earth sciences to communicate complex and multilayered

10   topics. At the same time, energy companies, while they contain well-staffed professional communication offices, have

exhibited only low-level enthusiasm for outreach related to CCS. Their reticence has been motivated by the fickle actions of

and lack of support from the third stakeholder group: the political arena. Without a fixed legal framework for investing in

CCS, companies have understandably shied away from engaging in public debates about it. CCS-related communication as

triggered by politics has also not occurred because of internal disagreements within parties and between the state and federal

15   political levels (Heisterkamp, 2010). The effectiveness of CCS-related communication has been demonstrated by NGOs in

relation to planned but later canceled projects in Hürth and Schleswig-Holstein, as well as the wave of protests that

accompanied CCS projects in eastern Germany. Here, NGOs such as Greenpeace and the BUND used established tools to

engage the public in their strong campaigns against CCS. One of the most successful models for achieving this included the

use of powerful frameworks in CCS-related communication focused on emotions. The 2013 article by Greenpeace titled

20   "Death from the Chimney: How Coal-Powered Energy Ruins our Health" ("Tod aus dem Schlot – Wie Kohlekraftwerke

unsere Gesundheit ruinieren") (Greenpeace, 2013) provides an example of the utilization of the emotional framework.

Science communication has meanwhile faced a dilemma, namely that, as part of the scientific tradition, science

communication is strongly aligned with facts rather than emotion. Even more problematically, Dunwoody and Peters address

a potential "systematic misconception of the recipients' interests" (Dunwoody & Peters, 1993, p. 334) by the scientific field,

since appeals to emotion as well as storytelling techniques are used by the media. At the same time, the cognitive components of communication are neglected in favor of affective communication. Therefore, since recipients can decide individually whence to get their information, journalistic representations of science have become the favored source to obtain facts because affective communication deals with topicality. If the scientific field were to switch to using emotion-

5   based communication, familiar communication patterns would be abandoned. How this would affect levels of acceptance and the legitimacy of science among the public cannot be foreseen; therefore, science is trapped in "emotionless communication" behavior. At the same time, the media follows internal systems of logic that are resampled in the news value model. The selection of "newsworthy" content obviously results in an overemphasis on risk that overrides the factual communication of science. The transformation of cognitive information into affective communication is boosted by science

10 PR. Because science PR is in competition with PR efforts from other societal arenas, such as politics, sports, the economy, and others, it seems reasonable for science PR to use selection processes similar to those of the media. Thus, science PR has already increased science communication's focus on risk and benefit, on demands and expectations, while the recipient expects facts and research-based information from science to inform their individual interpretative and decision-making processes.

15 **2 Analysis design**

To gain a better understanding of the role of science PR within the media coverage of CCS in Germany, a long-term case study was conducted that covered daily newspaper articles from January 2004 until December 2014. This time frame begins with the substantial funding of CCS research and development projects by the German Federal Ministry for Education and Research (BMBF) and ends with the month that followed a final decision upon CCS law in Germany.

20   The data used for the analysis was taken from a media database that contains about 120 million articles from German newspapers.1

---

[1] At the Freie Universität Berlin in Germany, the wiso Press database was used. This database included more than 120 million articles by German daily newspapers within the time frame of our analysis. More information about the database and the sources and titles that are included in it can be found on the GENIOS website (www.genios.de).

To get a representative sample, we searched in the online accessible archive for the keywords "Kohle" (coal) and "CCS."2 The keyword CCS was selected because of its widely established use in the scientific and political arenas. The utilization of this simple, first selection process resulted in a list of N = 5,150 articles. One hundred and ninety-two articles were deleted from the sample due to their international origins. This is based on the fact that we did not have in-depth insights

5   into the political and scientific environments of other countries, and regional influences on the relevant media coverage could not be determined in detail. Eighteen press agency articles were also deleted from the list, since the analysis is designed to focus on stakeholders and their influence on the coverage. Taking press agency releases into account would bias this analysis in favor of said agencies. Because of the setup of the database we used, various examples of double posting were identified. These result in the multiple use of single articles in different newspapers printed by one publisher. We also deleted articles of

10   less than one hundred words in length, letters to the editor, and commentaries. The resulting list of nbasic = 2,809 articles is called the basic list and was used for headline analysis.

To conduct a qualitative content analysis a further reduction through the application of a temporal filter was necessary. This temporal filter consists of a quasi-week sum of articles for each day. This quasi-week sum results from adding the number of articles from one day to the number of articles for both the three previous and three following days. Consequently, the

15   reduction is based on the concept of reducing the number of artifacts and biases due to single events or dossiers (an overview of a topic from one newspaper that consists of many articles with different foci). Weekly artifacts, such as science-related issues for a single day or weekend, were also reduced through the quasi-week sum approach.

[Figure 1]

Figure 1: quasi-week-sum plotted per day. All articles of days with a quasi-week-sum of 40 and more (solid line) as well as all articles
20   *from Mai 2007 and February 2013 (solid circles) were included in the analysis.*

All articles from days with a quasi-week sum of equal or more than 40 were included within the quantitative content analysis. In addition, the period of greatest publication on the topic from 2007 and 2013 was included within the analysis in

---

2 Because of the frequent use of CCS as an abbreviation for the Congress Centrum Suhl (Suhl Convention Center), a method to exclude Suhl was formulated within the search term: (CCS AND Kohle*) NOT Suhl.

order to get publications from all five phases of the issue-attention cycles (Downs, 1972). After applying this temporal filter, nfilter1 = 569 articles (about 20% of the basic list) were analyzed in the qualitative content analysis.

2.1 Observing medialization

According to Schäfer (2008, p. 206) and Marcinkowski (2015, p. 74), medialization of a topic is recognizable via three indicators: extent, plurality, and a high level of controversy. With more than 5,000 articles in ten years, media coverage of CCS can be described as extensive. Taking weekends into account, CCS has been a topic of newspaper coverage to the extent of 1.6 articles a day on average (3.5 articles in the month of the most extensive media coverage). Furthermore, the regional extent of coverage can be shown by looking at the newspaper titles and their regional distribution. Eighty-nine titles (individual newspapers) covered CCS, which were distributed throughout Germany. About 19% of articles about CCS were published in nationwide publications. As a result, the indicator of extent can be observed both on a temporal as well as on a spatial plane.

Since plurality as well as the level of controversy can only be determined through a quantitative content analysis, the following chapters are dedicated to these indicators.

2.2 The thematic plurality of CCS media coverage

The temporal evolution of CCS coverage was predominantly driven by political developments within this ten-year time frame. Without the recurring political debates about a CCS law in the German Bundestag, CCS would not have been given such extensive media coverage. Nevertheless, the quantitative analysis demonstrated that other issues related to CCS were able to set the media agenda – at least for a few weeks – as well. Most clearly, the at least partly strong and intense waves of protest in eastern Brandenburg, as well harmful communication by single stakeholders, were covered in the politics-oriented publications. It is also noticeable that, despite its significant relevance for public discourses about sustainability and climate change, only days after the final decision about a CCS law was reached, CCS nearly completely vanished from the media agenda. While research on CCS and in the pilot plant Schwarze Pumpe, where CCS was tested on an industrial scale, was carried out for a number of years after 2012, journalists did not see that there were any more incentives for media coverage.

This first impression allows us to conclude that science on its own did not have the means to influence the media agenda. This is also supported by a descriptive analysis of the key thematic elements represented in the media coverage. Six key aspects were responsible for more than 80% of the media coverage.

[Figure 2]

5   *Figure 2: Distribution of key thematic aspects (569 articles).*

Four of these aspects correlate directly with the temporal evolution of CCS. Another key aspect is energy policy. This shows that journalists did not hold the scientific field to be the only relevant societal system within the area of CCS. Instead, by focusing on energy policy one can show that journalists view the economic as well as the political arena to be relevant

10 stakeholders. None of the key thematic aspects are directly related to science or technology.

While 80% of the media coverage is dominated by six key aspects, the remaining 20% is divided among 20 other aspects. These cover areas such as CCS in relation to fracking or the anticipated displacement of small villages due to increased coal-mining activities. Taking this broad portfolio of key thematic aspects into account, we can identify plurality, at least to some extent, within the media coverage of CCS.

15 Another indicator of plurality within the coverage of CCS can be observed by looking at the thematic evolution of the topic in German newspapers. In early reporting on CCS, journalists focused on events such as the Durban Climate Change Conference. These events provide an entry point for CCS to gain coverage in the media, which are accompanied by the few overview articles that can be found in the ten-year time frame of the study. Most of these articles are also closely related to climate protection frameworks that quickly disappear to make way for those related to technological development and

20 pioneering ideas attributed to the participating German industries. The opening of the pilot plant in Spremberg (Schwarze Pumpe) can be seen as the endpoint of this period, which produced only a few articles on the CCS technology itself. Only six months later, CCS media coverage begins to focus on political frameworks. The debate and controversies that surround the first and, later, the second draft of a German CCS law dictate the journalists' approach toward CCS for nearly two years. In 2011 the decision by The Federal Institute for Geosciences and Natural Resources (BGR) not to publish a study about

25 geological sites with storage potential for carbon dioxide in Germany exploded the political framework with articles that focused on the societal responsibility of CCS and energy providers. Surprisingly, the issue of withholding a study about

potential storage sites did not generate as much media attention as one might expect. This shows that this particular scientific study was not considered to be of the utmost importance by journalists throughout Germany. Subsequent publications used – once again – the political framework of controversies and debates to cover CCS. This changed at the end of 2011 with Vattenfall's announcement that it was ending CCS-related research and development in Germany. After this, economic and

5   social frameworks became dominant, mixed with those centered around energy politics, labor market policy, and the projected end of Germany's use of coal as an energy resource. In mid-2012 media coverage switched back to political frameworks related to the final decision about a German CCS law. For the first time regional demands and expectations became dominant. As some states in Germany already asserted that they would not allow CCS within their borders, others quickly followed. This led to the de facto death of CCS utilization in Germany.

10   This outline of the thematic evolution of CCS coverage demonstrates pluralization. Moreover, the usage of a political framework that is oriented toward conflicts within parties and between state and federal policies shows that there are high levels of conflict within a topic that originates from the scientific field. Therefore, the third indicator for medialization can be observed as well. While the media coverage of CCS is dominated by political frameworks, the observation of medialization cannot be attributed to science. Because science obviously does not play a major role in the media coverage of CCS but politics

15   does, it can be justified that the medialization of politics can be observed through an analysis of the coverage of CCS. Due to the even greater relevance of public acceptance and legitimization to politics, this is not surprising. What is surprising is that a scientific topic can be dominated by the medialization of politics and that scientific actors have to step back in favor of political actors. To identify whether this transfer of actors has implications for the coverage of a scientific topic, the following chapter will take a closer look at those actors and how they shape the coverage of CCS in German newspapers.

20   **2.3 Actors and processes of agenda building**

All individual persons and institutions were counted as actors, as long as they were mentioned in the body text of the articles (this excludes headlines). Since intense research about the positions and functions of the actors was necessary, this detailed analysis was done through a randomized sample of $n_{random} = 255$ articles (10% of the basic list). The sample was tested to resample the distribution of publication titles found in the basic list.

Two hundred and forty-nine individual actors were identified, who were mentioned 1,050 times altogether. The energy provider Vattenfall dominates this list with 249 mentions. When the 67 mentions of Tuomo Hatakka, who was the country chairman of Vattenfall in Germany at this time, are also added to this list, it amounts to roughly 20% of all actor mentions. This is surprising because Vattenfall is not the only energy provider who has been involved in CCS in Germany.

5 Others, such as E.ON, RWE, and EnBW, began work on CCS projects as well and also gained a lot of attention from NGOs and were targeted by protests from PIGs. Nevertheless, all three account for only 55 mentions (5%) within the overall total. Looking at the articles that mention energy providers more closely, about 47% of them communicate in a positive or highly positive manner. Only 21% of these articles demonstrate a negative or highly negative attitude toward CCS.

Matthias Platzeck, minister president of Brandenburg from 2002 to 2013 (56 mentions), and Ralf Christoffers,

10 minister of economic affairs and European affairs of Brandenburg from 2009 to 2014 (36 mentions), account for 8% of all actors mentioned in CCS articles. While both were advocates of CCS in Brandenburg, both were also connected to negative communication about CCS. Forty-seven percent of articles that mention Platzeck and 87% of articles that mention Christoffers demonstrate negative to highly negative attitudes toward CCS. This observation is based on internal conflict within the Social Democratic Party of Germany (SPD). In contrast to the SPD at the national level, the SPD at the Brandenburg state level

15 approved of CCS and coal mining.

The only actor from the German scientific community present within the media coverage of CCS was the BGR with 31 mentions (3% overall). The only individual scientist named in articles about CCS was Ottmar Edenhofer, an internationally renowned expert on climate economy at the Potsdam Institute for Climate Impact Research (PIK). He was mentioned six times. Other science-related terms such as "scientist," "science team," "researcher," "climate scientist," "geologist," or even "expert"

20 make up 114 mentions (11%) altogether. The content analysis shows that 66% of all the articles that mention actors from the scientific field are connected to the positive communication of CCS.

[Table 1]

Table 1: Distribution of the trend in notion in relation to main actors (255 articles)

25 While the detailed analysis of actors in the media coverage of CCS reveals the striking dominance of economic and political actors, this result cannot be transferred to the whole of newspaper coverage of CCS unquestioningly. Since the media

coverage of CCS correlates strongly with the political evolution of the topic, the obvious dominance of actors from the political and economic arenas has to be expected. Nevertheless, integrating the observation of this correlation with results from the analysis of actors shows that scientific events and scientific input does not have an impact on the media coverage. Neither the storage site assessment conducted by the BGR nor well-regarded international conferences such as the CCS Status Meetings

5   conducted by the R&D Programme GEOTECHNOLOGIEN were able to attract journalists' attention toward CCS.

Of great importance here is that the analysis of actors in newspaper coverage of CCS in Germany shows striking differences in communicated attitudes toward CCS. While articles featuring actors from politics take a slightly negative stance on CCS, articles focused on NGOs and PIGs are strongly dominated by negative communication of the topic. In contrast, articles featuring actors from an economic background are dominated by positive attitudes toward CCS. The analysis also

10   supports the conclusion that articles featuring actors from the scientific field are also dominated by positive communication of CCS.

The results of this mixed quantitative-qualitative analysis do surprise because it would be expected that by enabling the public to participate in an open and transparent discourse a topic such as CCS, which has great social and ecological relevance, would be dominated by science and scientific approaches. Nevertheless, the political arena shapes the journalistic

15   coverage of CCS in German newspapers. It seems that conflicts within the political realm are considered by journalists to be the most newsworthy. Therefore, in support of results from an earlier study by Pietzner et al. (2014), the dominant focus in German newspapers is on politicians and disputes between them over CCS. Scientific perspectives on CCS are considered to be even less important than the positions of NGOs and PIGs. Furthermore, it seems that the scientific field is unable to establish itself as a relevant source of information for journalists. Whether this is because of limited resources for outreach within

20   scientific bodies or due to a misconception of how journalists seek out their sources remains unclear. Nevertheless, these results support the findings of Trumbo, who analyzed media coverage of climate change in the US:

The more alarming aspect of the results of this study is that, relatively speaking, scientists left the debate as it heated up. In fact, scientists found themselves sharing a shrinking proportion of growing media attention during an important part of the public debate over climate change. (Trumbo, 1996, p. 281)

2.4 The lack of a reason for the weaknesses of science PR

As the basis for identifying reasons for the weakness of science PR in relation to other social systems, we will take the concept of functionally differentiated societies into account. Holzer (2011, p. 55f) observed, strongly informed by Marcinkowski (1993) and others, that there is no hierarchy within societal systems (Hoffjann, 2007, p. 20). While self-

5   observation is conducted among the public through descriptive medias (Hoffjann & Arlt, 2015, p. 7ff; Marcinkowski, 1993, p. 53), critical journalism is also used as a service unit that allows for a second level of observation that finally leads to efficient and constructive self-imaging. This process becomes even more complex since functional systems try to interact with journalism actively through the use of system-immanent PR efforts. Thus, all functional systems do sustain their own PR bodies – even journalism supports media PR that finally leads to journalism about the media itself (Hoffjann & Arlt, 2015, p.

10   71f). Focusing on the relation between journalism and science again, what has previously been discussed leads to the conclusion that science journalism – the part of the journalistic field that deals mostly with science – does not serve science but society (Luhmann, 1992, p. 633 ff.; Kohring, 2005, p. 282 ff.). Consequently, journalism does not seek to respond to the demands and expectations of science but those of society. Therefore, the scientific field needs to realize that journalism does not work according to the demands and expectations of science. What is more, science journalism, in responding to the

15   demands of society, does not focus on science at all but on scientific topics relevant to the public agenda. It is not organized around what science wants journalism to communicate. Instead, science journalism is founded on the external observation of science. In other words, science journalism is not all about science.

Science PR has to recognize that science journalism will not communicate issues and themes that originate from the scientific field alone. Science journalism will always seek to focus on the relations between science and society and other

20   functional systems. As long as science PR is trapped in the conception that science journalism serves science as a means of communication rather than seeing science journalism as a way to emphasize scientific-social relevance, science PR will fail to gain attention on a large scale. There needs to be shift within science and science PR to help change the image of journalism into one of a relation manager rather than a service provider. Within the CCS context, this shift has not occurred. Instead, other areas of society, such as politics and economics, have filled the gap between science and society and thus dominate the

25   journalistic coverage of CCS.

3 Conclusion

In contrast to previous studies about medialization in the area of topics related to climate change (Nisbet, 2009; Schäfer & Schlichting, 2014), internal scientific conflict as well scientific uncertainty (Schneider, 2016) did not play a significant role in newspaper coverage of CCS. In fact, and verifying the hypotheses H1, we can show, that there are dominant

5   actors that shape the media representation of CCS, media coverage of CCS was decoupled from science. Instead, verifying H2, it was strongly linked with politics and economics. Science PR has had no effect on journalists' work on this topic. This might be related to a misconception of the services offered by and functions of journalism in respect to society from the scientific perspective. In addition, it seems that the lack of emotion in science PR might be another obstacle. While science itself demands that science PR follows scientific logic (for example, to focus on verifiable facts), NGOs and PIGs prefer

10   emotional communication. If science wants to reestablish its position as a strong and constructive communication partner for journalists, science PR has to move toward a more intense deployment of emotion.

Without such a change, journalistic communication will focus on actors from NGOs and PIGs because of the greater newsworthiness attributed to emotions and conflict. Since a focus on NGOs and PIGs, as well as conflicts within politics, would imply negative attitudes toward CCS, media coverage of CCS will also become dominated by negative positions on the

15   topic. In fact, 41% of all observed articles published about CCS in German newspapers show this effect. This observation contrasts with studies that show how innovative technology and research is predominantly communicated in positive ways (Weaver et al., 2009).

If science is to reassert its role as an established, reliable, first-choice partner for science journalism, it has to increase its own understanding of the need to forge strong and diverse links with other functional systems within society. Science PR

20   has to focus more than ever on emotions and social relevance. Otherwise, different systems within society will increasingly dominate the presentation of science, leading to disproportionate emphasis on an external and heteronomous image of science. Narrative frameworks have to be established that allow society to perceive relevance in research and development. Nevertheless, the strategic utilization of narrative frameworks has to be carefully devised:

When frames are conceived as given, the role of communication is seriously constrained as they can only convey their

25   message within the cultural framework of the target audience. When frames are conceived as dynamic, communicators can

intervene in the contest of frames either by modifying a communication frame or creating a new interpretation of reality. (Olmastroni, 2014, p. 12f)

Frames used by science do not have to target emotions alone: they have to respond to the demands and expectations of the recipients as well. If science can foster links to the individual environments of the recipients on a socio-cultural level, it

5 will be able to demonstrate its everyday relevance even more successfully. This analysis of media coverage of CCS in German newspapers has shown that we are already at the point where science has been replaced by other systems within society as the primary communicator of scientific topics. Science – and science PR – has to accept that it does not have the unique right to talk about science.

4 Supplement link (will be included by Copernicus)

10 **5 Competing interests**

The authors declare that they have no conflict of interest.

References

Altmeppen, K. (2004). Schwierige Verhältnisse: Interdependenzen zwischen Journalismus und PR (1st ed.). Wiesbaden: VS

15   Verlag für Sozialwissenschaften. http://doi:10.1007/978-3-322-80469-3

Anshelm J., Hansson A. (2014). The Last Chance to Save the Planet? An Analysis of the Geoengineering Advocacy

       Discourse in the Public Debate. Environmental Humanities, 5, 101-123. https://doi:10.1215/22011919-3615433

Berinsky, A. J., Kinder, D. R. (2006). Making Sense of Issues Through Media Frames: Understanding the Kosovo Crisis.

       The Journal of Politics, 68, 640–656. http://doi: 10.1111/j.1468-2508.2006.00451.x

20 Brumfiel, G. (2009). Supplanting the old media? Nature, 458, 274-277. http://doi:10.1038/458274a

Buck, H. J. (2013). Climate Engineering: Spectacle, tragedy or solution? A content analysis of news media framing. In C.

       Methmann, D. Rothe, B. Stephan (Ed.): Interventions: Interpretive Approaches to Global Climate Governance:

       (De)constructing the Greenhouse (pp. 166-181). Florence: Routledge.

Chase, W. (1977). Public issue management: The new science. Public Relations Journal, 33 (10), 25– 26.

Chrysostomidis I., Perumalpillai S., Bohm M., Crombie M., Beynon E., & Lee A. (2013). CO2 Capture Project's CCS

Stakeholder Issues Review and Analysis. Energy Procedia, 37, 7832-7839.

http://doi:10.1016/j.egypro.2013.06.676

5   Cobb, R. W., Elder, C. D. (1971). The Politics of Agenda-Building: An Alternative Perspective for Modern Democratic

Theory. The Journal of Politics. 33 (4), 892–915. http://doi:10.2307/2128415

Downs, A. (1972). Up and Down with Ecology—the Issue-Attention Cycle. The Public Interest, 28, 38–50.

Dunwoody S., Peters H. (1993). Massenmedien und Risikowahrnehmung. In Bayerische Rück (Ed.): Risiko ist ein Konstrukt

(pp.317-343). München: Bayerische Rück.

10 Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits.

Journal of Behavioral Decision Making, 13, 1-17. http://doi:10.1002/(SICI)1099-0771(200001/03)13:1<1::AID-

BDM333>3.0.CO;2-S

Greenpeace (2013). Der Tod aus dem Schlot - Wie Kohlekraftwerke unsere Gesundheit ruinieren. Retrieved from

https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/greenpeace-studie-tod-aus-dem-schlot-

15   s01652.pdf

Heisterkamp, I. (2010). Hintergrundpapier: Genese und Scheitern des deutschen CCS-Gesetzgebungsverfahrens (2008-

2009). Bonn: Germanwatch e.V.

Herrmann-Giovanelli I. (2013). Wissenschaftskommunikation aus der Sicht von Forschenden – Eine qualitative Befragung

in den Natur- und Sozialwissenschaften. Konstanz: UVK. http://doi:10.5771/1615-634x-2014-2-289

20 Hoffjann, O. (2007). Journalismus und Public Relations – Ein Theorieentwurf der Intersystembeziehungen in sozialen

Konflikten (2nd ed.). Wiesbaden: VS Verlag für Sozialwissenschaften. http://doi: 10.1007/978-3-531-90744-4

Hoffjann O., Arlt H.-J. (2015). Die nächste Öffentlichkeit – Theorieentwurf und Szenarien. Wiesbaden: VS Verlag für

Sozialwissenschaften. http://doi: 10.1007/978-3-658-09373-0

Holzer, B (2011). Die Differenzierung von Netzwerk, Interaktion und Gesellschaft. In M. Bommes & V. Tacke (Ed.), Netzwerke in der funktional differenzierten Gesellschaft (pp. XX-XX). Wiesbaden: VS Verlag für Sozialwissenschaften. http://doi: 10.1007/978-3-531-92597-4_3

Jarren O., Röttger U. (2009). Steuerung, Reflexierung und Interpenetration: Kernelemente einer strukturationstheoretisch begründeten PR-Theorie. In U. Röttger, Theorien der Public Relations: Grundlagen und Perspektiven der PR-Forschung (2nd ed.). Wiesbaden: VS Verlag für Sozialwissenschaften. http://doi: 10.1007/978-3-531-91360-5_2

Kepplinger H. M., Post S. (2008). Der Einfluss der Medien auf die Klimaforschung. Forschungsmagazin (pp. 25-28). Mainz: Johannes-Gutenberg-Universität Mainz.

Kohring, M. (1997). Die Funktion des Wissenschaftsjournalismus: ein systemtheoretischer Entwurf. Wiesbaden: VS Verlag für Sozialwissenschaften. http://doi: 10.1007/978-3-322-86877-0

Kohring, M. (2005). Wissenschaftsjournalismus – Forschungsüberblick und Theorieentwurf. Konstanz: UVK.

Kraeusel, J., & Möst, D. (2012). Carbon capture and storage on its way to large-scale deployment: Social acceptance and willingness to pay in Germany. Energy Policy, 49, 642-651. http://doi: 10.1016/j.enpol.2012.07.006

L'Orange Seigo S. (2013). Public Perception and communication of Carbon Capture and Storage (CCS). Dissertation. ETH Zürich No. 21302. http://doi: 10.1016/j.rser.2014.07.017

Luhmann, N. (1992). Die Wissenschaft der Gesellschaft. Frankfurt am Main: Suhrkamp.

Macnamara, J. (2014). Journalism – PR relations revisited: The good news, the bad news, and insights into tomorrow's news. Public Relations Review, 40, 739-750. http://doi: 10.1016/j.pubrev.2014.07.002

Marcinkowski, F. (1993). Publizistik als autopoietisches System. Politik und Massenmedien. Eine systemtheoretische Analyse. Opladen: Westdeutscher Verlag GmbH. http://doi: 10.1007/978-3-322-87740-6

Marcinkowski F. (2015). Die „Medialisierung" der Politik – Veränderte Bedingungen politischer Interessenvermittlung. In R. Speth & A. Zimmer (Ed.): Bürgergesellschaft und Demokratie (pp. 71-99). Wiesbaden: Springer. http://doi: 10.1007/978-3-658-09433-1_4

Meyen M. (2009). Medialisierung. Medien & Kommunikationswissenschaft, 57, 23-28. Hamburg: Nomos Verlagsgesellschaft.

Nelkin D. (1995). Selling Science: How the press covers science and technology. New York: Freeman.

Nippa M, Lee R P (2014). Gesellschaftliche Akzeptanz der Kohle und die Zukunft der deutschen Kohleforschung. Chemie Ingenieur Technik, 86, 1669–1677. http://doi: 10.1002/cite.201300190

Nisbet M. C. (2009). Communicating Climate Change. Why frames matter for public engagement. Environment: Science and Policy for Sustainable Development, 51(2), 12-23. http://doi: 10.3200/ENVT.51.2.12-23

Olmastroni F. (2014). Framing war: public opinion and decision-making in comparative perspective. New York: Routledge.

Pietzner K., Schwarz A., Duetschke E., Schumann D. (2014). Media Coverage of four Carbon Capture and Storage (CCS) projects in Germany: analysis of 1.115 regional newspaper articles. Energy Procedia, 63, 7141-7148. http://doi:10.1016/j.egypro. 2014.11.750

Praetorius B., Schumacher K. (2009). Greenhouse gas mitigation in a carbon constrained world: The role of carbon capture and storage. Energy Policy, 37, 5081-5093. http://doi: 10.1016/j.enpol.2009.07.018

Raupp, J. & Vogelgesang, J.(2009). Medienresonanzanalyse – Eine Einführung in Theorie und Praxis. Wiesbaden: VS Verlag für Sozialwissenschaften. http://doi: 10.1007/978-3-531-91605-7

Reich Z. (2010). Measuring the Impact of PR on Published News in Increasingly Fragmented News Environments - A multifaceted approach. Journalism Studies, 11, 799-816. htp://doi: 0.1080/14616701003760550

Sammer P. (2014). Storytelling – die Zukunft von PR und Marketing. Köln: O'Reilly Verlag.

Schäfer, M. (2008). Medialisierung der Wissenschaft? Empirische Untersuchung eines wissenschaftssoziologischen Konzeptes. Zeitschrift für Soziologie, 37(3), 206 – 225.

Schäfer M., Schlichting I. (2014). Media Representations of Climate Change: A Meta-Analysis of the Research Field. Environmental Communication, 8(2), 142-160. http://doi: 10.1080/17524032.2014.914050

Schnedler, T. (2011). Getrennte Welten? Journalismus und PR in Deutschland. nr-Werkstatt, 20. Wiesbaden: NetzwerkRecherche.

Schneider S. (2006). Interpreting Science. Proceedings of the Interpreting World Heritage Conference, San Juan, Puerto Rico (pp. 155-158), Retrieved from http://www.ntcu.edu.tw/hcwu/7/9.pdf

Schneider S. (2016). Communicating Uncertainty: a challenge for science communication. In J. L. Drake, Y. Y. Kontar, J. C.

Eichelberger, S. T. Rupp & K. M. Taylor (Ed.): Communicating Climate-Change and Natural Hazard Risk and

Cultivating Resilience – Case Studies for a Multi-disciplinary Approach. Springer International Publishing.

http://doi: 10.1007/978-3-319-20161-0

5   Schneider, S. (2017): Der öffentliche Diskurs um die geologische Speicherung von Kohlenstoffdioxid (CCS)

- Strukturgeographische Differenzierungen und ihre Implikationen für die Medienpräsenz wissenschaftlicher

Forschung in deutschen Tageszeitungen am Beispiel von CCS. Berlin: LIT Verlag.

Smid K. (2009). Greenpeace: Stellungnahme zum Referentenentwurf Gesetz zur Regelung von Abscheidung, Transport und

dauerhafter Speicherung von Kohlendioxid. Retrieved from

10   https://www.greenpeace.de/sites/www.greenpeace.de/files/CCS-stellungnahme-final_0.pdf

Tokushige, K., Akimoto, K., & Tomoda, T. (2007). Public perceptions on the acceptance of geological storage of carbon

dioxide and information influencing the acceptance. International Journal of Greenhouse Gas Control, 1, 101-112.

http://doi: 10.1016/ S1750-5836(07)00020-5

Trumbo, C. (1996). Constructing climate change: claims and frames in US news coverage of an environmental issue. Public

15   Understanding of Science, 5, 269-283. http://doi: 10.1088/0963-6625/5/3/006

Visschers, V. H., Keller, C., & Siegrist, M. (2011). Climate change benefits and energy supply benefits as determinants of

acceptance of nuclear power stations: Investigating an explanatory model. Energy Policy, 39(6), 3621-3629.

http://doi: 10.1016/j.enpol.2011.03.064

Wallquist L., Visschers V. H., Dohle S., & Siegrist M. (2012). The role of convictions and trust for public protest potential in

20   the case of CCS. Human and Ecological Risk Assessment, 18, 919-932.

http://doi:10.1080/10807039.2012.688719

Weaver D., Lively E., Bimber B. (2009). Searching for a Frame: News Media tell the story of technological progress, risk,

and regulation. Science Communication, 31(2), 139-166. http://doi: 10.1177/1075547009340345

Williams A., Gajevic S. (2013). Selling Science? Source struggles, public relations, and UK press coverage of animal-human

25   hybrid embryos. Journalism Studies, 14(4), 507-522. http://doi:10.1080/1461670X.2012.78576

WWF (2010). Positionspapier des WWF zum Energiekonzept der Bundesregierung. Retrieved from

http://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Positionspapier_Energiekonzepts.pdf
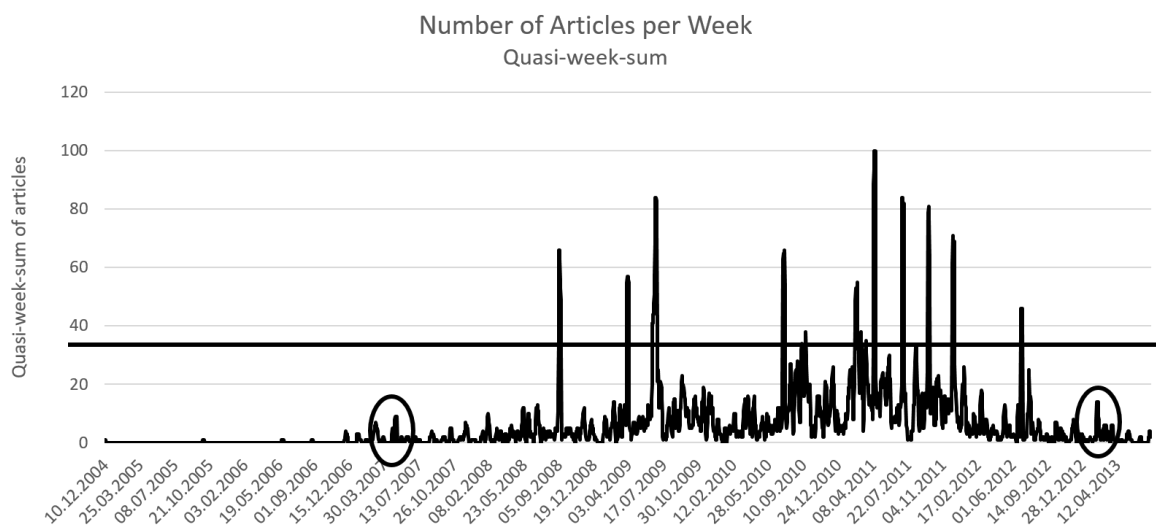
Figure 1: quasi-week-sum plotted per day. All articles of days with a quasi-week-sum of 40 and more (solid line) as well as all articles from Mai 2007 and February 2013 (solid circles) were included in the analysis.
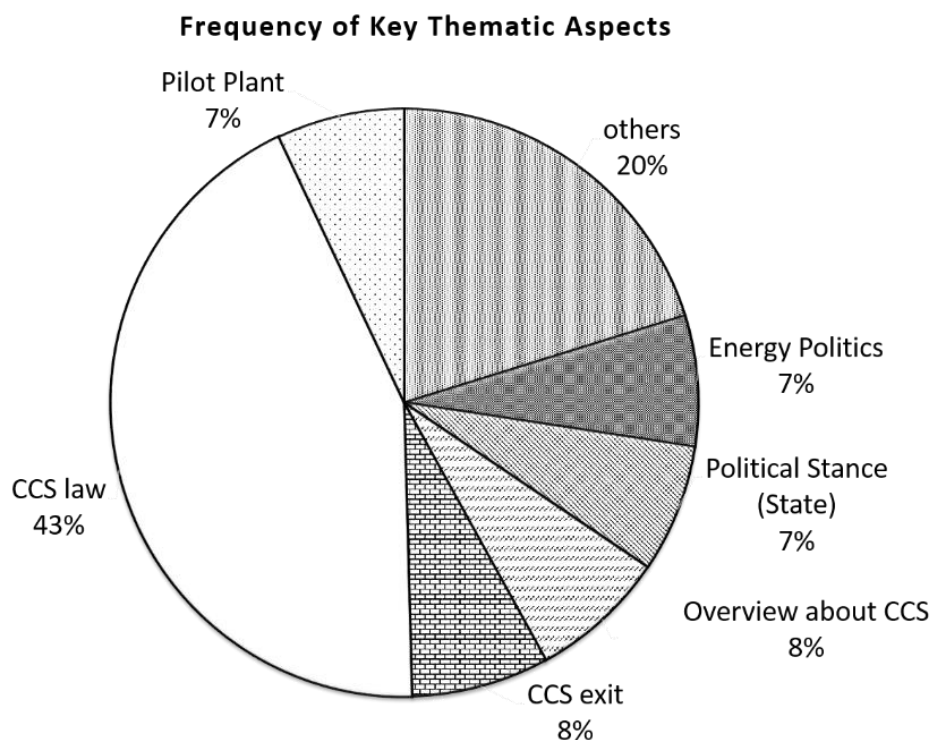
Figure 2: Distribution of key thematic aspects (569 articles).

	highly negative	negative	neutral	positive	highly positive
Politics	16,0 %	31,3 %	22,9 %	23,6 %	6,5 %
Science	6,7 %	20,0 %	6,7 %	46,7 %	20,0 %
NGO	35,5 %	38,7 %	12,9 %	12,9 %	0,0 %
Economy	1,3 %	14,3 %	35,1 %	45,5 %	3,9 %
overall	13,5 %	26,6 %	24,3 %	29,9 %	5,6 %

Table 1: Distribution of the trend in notion in relation to main actors (255 articles)