Article

MEDIA CULTURE &SOCIETY

Media, Culture & Society
35(4) 454–471

DOI: 10.1177/0163443713483794
mcs.sagepub.com
SAGE

Technoscientific promotion and biofuel policy: How the press and search engines stage the biofuel controversy

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Abstract
What are the conditions for the public understanding of biofuels and how do the media shape these conditions under the influence of a new production of knowledge? This article investigates how the biofuel controversy plays out in the Swedish press and Google search engine results and analyses winners and losers in the tight attention economy of contemporary media. It describes different visibility strategies biofuel stakeholders employ in both media arenas, and identifies a form of technoscientific promotion that hybrid actors use to succeed in the day-to-day struggle for media attention. To conclude, it raises broader societal questions of the contemporary blurring of knowledge boundaries and the emergence of new information hierarchies and their biases. By understanding how contemporary media shape controversies, we can address the democratic potential of both mass media and science.

Keywords
biofuel, press, search engines, controversy, strategic communication, science policy

Introduction

As with many other science-related controversies, for example genetically modified organisms (GMOs) and chemicals, the debate on transport biofuel is characterized by

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high political stakes, engaged publics and expert disagreement. The role of the media is often positioned at the centre of these debates, seen as an arena where public trust can be regained through democratic deliberation. Media's ability – or inability – to represent complex issues, balance interests, include multiple voices and manage uncertainties has attracted much scholarly interest (see, e.g. Allan et al., 2000). Furthermore, the ongoing commercialization of the media and resulting content biases have been critically discussed (Herman and Chomsky, 2002). How these mechanisms play out in the biofuel controversy will be investigated in this article.

In the case of biofuels, the relationships between global warming, biofuel feedstock provision and cultivation, biochemical and thermochemical industrial conversion processes, land use practices, food safety and poverty, deforestation, and biodiversity are extremely complex and lack expert consensus. Political efforts to transition from an oil-dependent to an oil-free transport sector are equally complex phenomena, as they engage multiple societal sectors and stakeholders, such as industry, forestry, agriculture, infrastructure, environment and research, further exposing political disagreement. Such societal transitions challenge existing power structures and have a bearing on everyday life. In Europe, the biofuel controversy started to escalate between 2007 and 2008 as uncertainties grew concerning the sustainability of biofuels, a concept previously taken for granted. Scientific analyses were not consistent: they either revealed that biofuels were reliable, effective and sustainable or that they were ineffective, costly, morally dubious and environmentally damaging. In fact, science itself has become a site of struggle in the context of the biofuel controversy.

In Sweden, the government started to heavily promote biofuels at the beginning of the 21st century. At that time, the Swedish government introduced a number of measures, such as tax exemptions, a pump law, green car bonuses and other subsidies. In addition, the Swedish government invested financially in so-called 'second generation' biofuels – biofuels derived from cellulose feedstock. The official political expectation, which dates back a hundred years, has been to make use of Swedish forests to promote the emergence of a new green high-tech industrial sector that would generate jobs, economic growth and scientific competitiveness (Eklöf et al., 2012). Since 2007, the consumption of ethanol, in particular, increased dramatically and became a central issue of debate (Eklöf, 2011). Although the European Union (EU) amended its first biofuel directive of 2003, the dust has still not settled on the issue, neither in Sweden nor abroad.

The central question thus is: What are the conditions for the public understanding of biofuels and how do the media shape these conditions in the Swedish context? To answer this question, we investigate how the biofuel controversy is negotiated in both old and new media – in this case, the Swedish press and Google search results. In this analysis, we focus on visibility strategies and what we call technoscientific promotion, the latter seen as a style of communication that has emerged in relation to changed conditions for knowledge production and corporate media. By drawing on analytical concepts from the field of Science and Technology Studies (STS) and critical (new) media studies, we discuss new modes of knowledge production and the role media play in staging controversies. After describing our study and mixed methods approach, we present winners and losers in the tight attention economy of the press and search results, we describe how these winners and losers try to gain visibility in both media arenas and

we identify what features of technoscientific promotion hybrid actors use in the day-to-day struggle for media attention. To conclude, we raise broader societal questions of the contemporary blurring of knowledge boundaries and the emergence of new information hierarchies and their biases in both media environments. By understanding how contemporary media shape controversies, we can address the democratic potential of both mass media and science.

New modes of knowledge production and new communication strategies

Over recent decades, there has been an increased political pressure on established knowledge institutions, such as universities, to be more open to societal needs, to demonstrate their industrial usefulness and to conform to increasingly refined evaluations. In some accounts, this transition has been understood as predominantly beneficial (Etzkowitz, 2008; Gibbons, 1994; Nowotny et al., 2001); in others, it has been described more critically (Bok, 2003; Slaughter and Leslie, 1997; Weingart and Maasen, 2007). Most accounts, however, point to an increased blurring of boundaries between industry, academia and government as a dominant feature of this new mode of knowledge production. The transition from 'mode 1' to 'mode 2' in the terminology of Gibbons (1994) involves, among other things, that knowledge production is taking place in the 'context of application'. This has taken the form of, as far as the Swedish case is concerned, raised levels of external funding of university research, resource concentration into large-scale projects and centres of excellence, research priorities that involve multiple stakeholders, increased emphasis on technology transfer and entrepreneurial activities, as well as an overall market orientation of both internal management and public relations (Benner, 2009; Engwall and Nybom, 2007; Whitley and Gläser, 2007).

These phenomena are not entirely new, however. The fact that scientific communities have always had different professional motives and interests in communicating with the 'outside' world – be it political establishments, the public or the media – calls into question its role as a neutral knowledge provider (Ekström, 2004). These motivations shed light on the way that scientific knowledge is designed or packaged to meet the requirements and interests of different audiences *before* the media frames the issue. Science communication becomes a way of promoting recent research results, competing for funding, recruiting students and securing public support for the credibility, productivity, integrity and accountability of science. This mediation process is inescapable in the communication of science, whether it is scientists or journalists who act as 'senders' (Scanlon et al., 1999). In the past two decades, we have witnessed an increased media orientation of science though (Rödder et al., 2012). This trend may be understood against a backdrop of research institutions being encouraged to become more publicly engaged with wider audiences, while at the same time adapting their activities to meet the needs of industry. This change marks a more explicit shift from the traditional idea of science communication as an obligation or service to the public, motivated on a democratic basis, to the idea of science communication as a tool for pursuing strategic goals, such as increased research funding and student enrolment. This market orientation of science communication, partly stemming from the dismantling of established

industry–academia–government boundaries, has been analysed on different levels and within different areas (Bauer & Bucchi, 2007; Cheng, 2008). According to Bauer (2008), hyperbole and sensationalism have become normal modes of operation in scientific public relation activities. Not only universities and research centres engage in strategic science communication, but professional press services are also integrated parts of high-impact scientific journals these days (Franzén, 2012). In the biofuel case, experts from many different areas have been highly visible in the media to describe and adjudicate the scientific and political implications of biofuels. These experts are often tied to different networks, which remain widely non-transparent to the public, as we will show in our analysis.

The role of the press and search engines in staging controversies

The increasing market and media orientation of science communication corresponds to an ongoing commercialization of the media itself. Traditionally, mass media was seen as a tool to inform citizens and guarantee a democratic political culture. Like controversies, interpreted as an act of 'exploring and learning about possible worlds' (Callon et al., 2009), mass media was conceptualized as a 'laboratory' where technoscientific developments can be negotiated and future scenarios tested (Oudshoorn, 2003). In contrast, scholars from critical media studies (Herman and Chomsky, 2002) argued that mass media should not merely be seen as providing arenas where controversies are negotiated, but rather as actively shaping the very conditions under which controversies play out in the public. These conditions have to do with the economic interests of media corporations as well as journalistic framing practices, such as what is considered newsworthy (Allan, 2010). Herman and Chomsky (2002) introduced the concept of the 'propaganda model' to exemplify how commercial interests and business models influence the content mass media produce, since corporate media have to satisfy not only their audiences, but also their advertising clients. Furthermore, the emergence of public relations has been described as tightly connected to the needs of capitalist democracies (Davis, 2000; Herman and Chomsky, 2002). Public relation strategies – pushing forward both industrial and governmental interests – have been criticized as constructing 'hegemonic discourses' about scientific issues, such as genetic engineering, and undermining public debate (Weaver and Motion, 2002: 337). Press releases, in particular, function as highly effective strategies to influence news coverage on science-related controversies from the outside and increase the media presence of public and private institutions. A successful press release mimics journalism in style and content, shortens the time and effort needed to produce news, and maximizes the chances to catch a journalist's attention.

Similarly, the Internet, and the search engine Google most particularly, has become a site of struggle for attention. While the Internet was described as a decentralizing democratic technology in its early days (Berners-Lee and Fischetti, 2000; Kahn and Kellner, 2004), critical studies have pointed to information hierarchies and commercial biases introduced by search algorithms undermining the 'democratic ideal of the web' (Mager, 2012b) or the web's potential to become a new or even 'better public sphere' (Gerhards

and Schäfer, 2010). According to Brin and Page (1998), the founders of Google, the PageRank algorithm would provide a mathematical way of ranking search results since it uses the number and quality of links a website gets as an indicator of the value of that website (among other factors such as clicks from users). On the contrary, Introna and Nissenbaum (2000) argued that search engines systematically privilege major, well-connected websites at the expense of smaller ones, often those providing counter-cultural viewpoints. Accordingly, website providers have started to use search engine optimization (SEO) techniques to gain a better position in search results. Furthermore, advertising-based business models such as the 'service for profile model' (Elmer, 2004) contribute to commercialization tendencies of web information. In the 'personal information economy' (Elmer, 2004; Rogers, 2009) users get services for free, while 'paying' with their data, which are turned into so-called user profiles and sold to advertising clients to better target advertising to users' desires and needs.

Search engines may hence be seen as having incorporated the capitalist ideology (Mager, 2012a) in a way that resembles the mass media 100 years ago. The commercialization of search engines triggers SEO strategies and practices of buying sponsored results, a trend that needs to be investigated in greater detail.

Against the backdrop of these theoretical considerations, we pose the following research questions:

> In the biofuel controversy, what actors are most prominent in the Swedish press and Google search results?
>
> What role do press releases, hyperlink strategies, advertising and sponsored search results play in the representation of the controversy in the two media domains?
>
> How does technoscientific promotion shape the controversy within the new mode of knowledge production?

Methods

To answer these research questions, we used a mixed methods approach consisting of press materials and search engine results, including selected press releases, hyperlink networks and advertising. The combination of press and search engine analyses enables us to gain insights in two major media arenas where scientific (and other) controversies are negotiated and staged. With this investigation we aim to show that neither 'old' nor 'new' media are objective or neutral arenas, but rather highly contested spheres where corporate and public interests meet with media logics and commercial interests. How these mechanisms work out in each media arena and what actors benefit from these dynamics in the Swedish biofuel context will be discussed in detail. Besides following their own, media-inherent logics – human editors versus automated algorithms, substantive content versus link indexes, news stories versus websites – the press and the web, search engines in particular, also mutually influence and co-construct each other. Media corporations have settled on the web and publish their stories online, while online discourses increasingly influence classical media debates, as the Arab spring has shown dramatically.

The main body of our empirical material consists of articles from the Swedish press and Google search engine results we collected and archived from April 2011 to June 2011. For the press articles, we used the database Mediearkivet (Retriever), accessed through the Umeå University library, which includes newspapers, national and local, news magazines and news service material from all major media corporations. Initially, we used the same search terms (in Swedish) for the press and Google searches, ranging from the most generic ones, such as 'biofuel' [biodrivmedel], and more specific ones such as 'ethanol', 'biogas' and 'biodiesel', to phrases or combinations of words commonly used in the controversy, such as 'biofuel and climate change' [biodrivmedel och klimatförändringar] and 'food versus fuel' [mat eller bränsle]. The rationale for selecting these words and phrases was that they would cover three important (although overlapping) areas; biofuels generally, ethanol in particular (since the Swedish biofuel controversy primarily revolved around this fuel) and green cars. The last category was additionally captured by using the term 'super green car bonus' [supermiljöbilspremie], a policy suggestion that was very topical during the studied period. The retrieved population of articles based on the search terms 'biofuel' and 'ethanol' and 'super green car bonus' were 595 in number. For the actor and press release analyses, these articles were further reduced. In the actor analysis the ethanol articles were selected from 10 newspapers most frequently publishing on the topic, which gave a total of 130 articles. For the press release analysis, 55 news articles were analysed (excluding debate articles).

For the Google search results, we queried the same keywords in Google.se.[1] We decided to focus on Google because it has become the most dominant search engine in Sweden with a market share of more than 95% (Statcounter, 2012). We saved the queries as video files with the software *ScreenFlow* (two weeks per month). We extracted the top 30 results of each keyword, including paid links, and systematically ordered them in an Excel file keeping the rank over time. Because the search produced relative stable results, we used two days per month (for each keyword) for a closer analysis. Altogether, we analysed 1440 search results, plus sponsored links and their corresponding websites.

To answer our first research question, we categorized all actors present in the press and search results, their frequency and position, and what viewpoint on the controversy they expressed – a basic content analysis. To answer the second research question, concerned with visibility strategies, we analysed press releases in relation to selected news articles, linking strategies of actors present among the first 30 Google results as well as sponsored links. To track press releases, we searched for the actors' websites, which usually collect recent press releases. To gain insights in linking strategies and how they stabilize search results (since links are still a central factor in the ordering of Google search results and hence SEO strategies), we used the network visualization software Issuecrawler, which performs different types of analyses according to the settings chosen.[2] For the purpose of our analysis, we experimented with the different software settings to grasp linking patterns from various angles and investigate how they influenced the position of certain actors in search results. Finally, we specifically analysed sponsored search results in relation to various keywords and what actors made use of Google AdWords[1], the service allowing website providers to pay for their presence in sponsored results.

To answer our third research question, on technoscientific promotion, we specifically focused on hybrid actors, which lay across our actor categorization scheme, the

industry–policy–academia nexus in particular. This helped us identify specific features of technoscientific promotion, co-configured by strategic science communication and the attention economy of old and new media.

Winners and losers in the attention economy

Having coded all actors prominently featuring in the press and search results, six basic categories emerged: Policy, Industry, Academia, Non-governmental Organization (NGO), Media, and Public. In the Swedish press, media actors themselves figured as individual journalists writing opinion pieces or chronicles and commenting on recent biofuel events. The overall balance between actors present in the press over the whole period (April–June 2011) is reflected in Figure 1.

Among industrial actors, fuel and car companies – such as Preem, SPBI (Swedish Petroleum and Biofuel Institute), Volvo and Scania – dominated. Among policy actors, the Swedish government and government agencies – such as the Swedish Energy Agency, the Swedish Transport Agency and the Swedish Transport Administration – were featured most frequently in terms of national bodies, whereas regional or municipal energy and environmental boards were prominent on lower levels. Actors within the Academia category were mostly individual or collectives of researchers affiliated with universities or other public institutions for higher education. What is most striking in this overall picture is the significant predominance of three main actor types: the industry–policy–academia nexus. In fact, as we discuss below, some actors even fell into multiple or all of these categories and thus had a 'hybrid' character.

During the period of analysis, certain issues were particularly topical, such as the anticipated consequences of the implementation of the EU fuel quality directive and the governmental announcement of a new version of the green car premium. State agencies, whether as biofuel research and development (R&D) funders or regulators, such as the Swedish Energy Agency and the Swedish Transport Agency, dominated these debates. Of course, the Swedish government, which announced a new green car premium at the

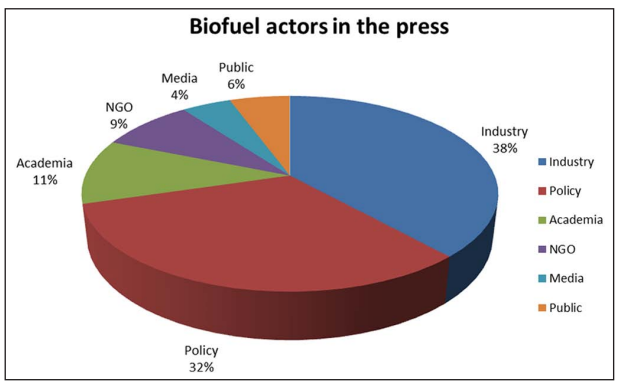

Figure 1. Biofuel actors in Swedish press articles.

time, also played a major role in these debates (Borg and Carlgren, 2011). For many commentators, these activities marked a watershed moment as the new premium did not include ethanol cars, which had been the flagship of Sweden's previous political commitments. Overall, these articles were mostly concerned with Swedish biofuel policy – either representing new policy suggestions, reactions to them or redefinitions of the scope of options available in the first place. New industrial initiatives to develop or demonstrate the usefulness of biofuels were launched, government agencies' reports were presented and expert analyses discussed.

The views on biofuels expressed in the articles escape any crude pro or con categorization. Actors can be against one particular biofuel, but support another, or they can be opposed to certain subsidies or regulatory measures, but agree on the overarching environmental or industrial policy. Generally, news pieces were more positive or neutral in their tone, reporting on new industrial developments, agency reports, fuel price fluctuations, research results, etc. Debate articles, inherently conflict laden as they were, expressed more negative views. However, both types of articles appeared to be operating within the 'sustainable biofuels' discourse, agreeing that biofuels can have both good and bad sides and that policy should be about figuring out how to support the good varieties. The public, as is often the case, was a rather absent figure: politicians, experts, industrialists and journalists refer to or speak on behalf of the public, rather than the public speaking for itself.

Contrary to initially high hopes regarding the Internet as being an inherent democratic technology, the picture of the biofuel controversy in Google search results did not differ much from the image drawn in the Swedish press. Large, well-established policy actors, industrial players and academic institutions dominated the top of Google.se. Moreover, large media corporations themselves had become omnipresent in top search results, particularly national and local newspapers, but also online press services and portals. A summary of the top 30 results of the search for 'biofuels', April–June 2011, is depicted in Figure 2.

As in the Swedish press, the industry–policy–academia nexus dominated the debate according to Google search results (besides the media also heavily promoting technoscientific actors). If sponsored links were included in the analysis, the number of industrial actors grew significantly, since biofuel companies (such as Preem or the car industry) mainly advertise with Google AdWords. However, the distribution of actors differed according to different keywords. Let us look at the top 10 results of the search for 'biofuel' and compare it to the search for the term 'food versus fuel' (which has become *the* buzzword for controversial biofuel debates in 2007–2008, in the English speaking world and beyond).

The search term 'biofuel' mainly triggered websites from the Swedish government, the Swedish Energy Agency, the Swedish Audit Office, Lund and Chalmers University, large Swedish media corporations and large companies such as the Swedish ethanol producer SEKAB (similar results were found for other generic search terms, such as biogas or biodiesel). Furthermore, Google directed us to web portals such as the website Miljö Fordon, a collaboration between the cities of Stockholm, Göteborg and Malmö promoting 'clean vehicles' in Sweden, financially supported by the EU (rank number 1). Accordingly, the issues discussed on top of Google ranged from official accounts on

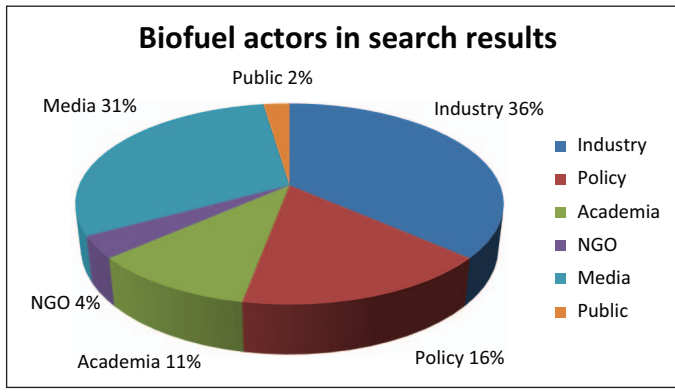

Figure 2. Biofuel actors in Google.se top 30 search results; query 'biodrivmedel'.

biofuels concerned with national and European policy strategies, academic discussions about life cycle analyses of biofuels and their energy consumption and media debates on newly published reports, one of them by the Norwegian fuel company Statoil, to an industry-informed celebration of ethanol as a sustainable alternative to fossil fuels. Sweden's lively engagement and investments in the biofuel sector as such were hardly criticized on these websites.

The very specific phrase 'food versus fuel', however, triggered more critical results. Since the media coined the term, media corporations clearly dominated the top of Google, mostly international media due to the English term, but also Swedish news services since Google.se localizes its search results according to the Internet Protocol (IP) address of the computer. Although Wikipedia was ranked number one, NGOs, such as Journey to Forever, involved in environment and rural development work in Asia and Africa, and the National Wildlife Federation, concerned with protecting wildlife and habitat, were featured among the 'top ten seats' (Introna and Nissenbaum, 2000). This result is significant, since the latter websites rarely made it to the top, no matter what search terms were chosen. Contrary to generic terms predominantly pointing users to official accounts, specific and clearly critical terms were required to reach more marginal viewpoints on social and environmental impacts of biofuels, such as rising food prices and deforestation. Another interesting aspect concerning the 'food versus fuel' results was that most articles were written in 2007 and 2008, when the food versus fuel debate peaked. This result crucially challenges the perception of the Internet as a 'fresh' medium and shows that some pieces of Internet information were quite out-dated (at least in Google search results, as the results differed in Google news services). The stability of search results was additionally confirmed by our analysis of search results over time. Except for a handful of websites having dramatically risen or fallen during our period of observation, most websites managed to hold pretty much the same rank over time.

The analysis of Swedish press materials and search engine results clearly shows that not all actors have the same voice in the negotiation of the biofuel controversy. Rather,

established policy institutions, traditional universities and industrial heavyweights are more visible than those found on the margins, NGOs and individual blogs in particular. Contrary to widespread assumptions of the web as a tool for democratizing knowledge and strengthening counter-cultural voices, representations of the biofuel controversy in search results show that the policy–industry–academia nexus succeeds in populating the top of Google search results, reifying offline power relations, such as those performed in the press.[3] Only when very specific, technical terms, such as 'food versus fuel', are used, does the user discover more marginal viewpoints. This finding confirms the media convergence thesis put forward by Seale (2005) and Nettleton et al. (2005): there is a convergence between old media – and their tendency to privilege official accounts – and new media, undermining the latter's celebrated diversity of viewpoints on controversial issues. These findings also show that alliances between policy, industry and academic actors and new modes of knowledge production have permeated both the Swedish press and Google search results. The following sections describe how these actors managed to gain presence in old and new media and what strategies they used.

Visibility strategies in the press and search engine results

The actor analysis for both the press and search engine results revealed a dominance of two major actor categories – policy and industry. These categories were followed by academia. Our analysis of press releases, link networks and advertising practices shows why these actors were more prominently featured in media materials and search results than others. One important strategy to enhance media presence in the printing press is through the use of press releases, which is a way of distributing news directly to the media in a format that conforms to media standards. Press releases can enhance an organization's brand, perform 'damage control' or otherwise strengthen influence over media output.

To assess the extent to which press releases had influenced press content on biofuels during the studied period, we took a sample of news articles and looked online for press releases that could be connected to those articles. What we found was that close to 50% could be tracked back to press releases.[4] This confirms the increasing trend of relying on external sources to save time and money. Instead of pursuing their own stories, news organizations use ready-made press releases, mostly written by public institutions or companies promoting their own agenda. Preem's press release serves as illustration of this trend. As mentioned earlier, the fuel company Preem was actively looking for media attention during our period of analysis. On 18 February 2011, Preem started launching its new fuel blend, *Evolution diesel*, in press releases and large-scale advertising. The new fuel contained 15% pine oil, produced from pulp and paper industry residues, allegedly reducing carbon dioxide emissions by 16%, compared to fossil diesel. On 31 March 2011, the Minister for Rural Affairs, Eskil Erlandsson, inaugurated the fuel (Figure 3).

The political weight of the event was underscored by the presence of the Minister who, according to the press release, saw Swedish forests as an unequalled source of welfare and industrial feedstock. The fuel was presented as unique 'world news'. When Thomas Ögren, press officer at Preem, was interviewed by the newspaper *Uppsala Nya Tidning* on 13 April, he referred to the Swedish forests as 'Sweden's

Figure 3. Michael Low (Preem) and Eskil Erlandsson, Minister for Rural Affairs, inaugurate Evolution diesel. Photo: Preem.

Klondike'[5] (Meijer, 2011). Both press releases and adverts were directed at new customers, as they clearly asserted that buying the fuel meant reducing CO_2 emissions without felling more trees (the fuel is made from forestry residues), while paying the same price as for other fuels.

What we see here is a strong emphasis on the environmental importance of these techniques and fuels for combating climate change, while at the same time providing future opportunities for economic growth and welfare. The content of the press release was adjusted to common news value criteria in the sense that it was clearly about novelties – research innovation and new unique industrial products. It also addressed one of the top political priorities in the last decade, global warming. The overall weight of this message stemmed from the joint strength of the actors presented: the Minister for Rural Affairs inaugurating Preem's Evolution Diesel fuel.

However, practices of strategically enhancing visibility were not only found in the press, but also in search results. Our analysis of the way websites are interrelated according to hyperlink connections revealed why actors from the policy, industry and academic arena were more prominent in Google than smaller websites such as those from NGOs. The link network in Figure 4 shows how websites appearing in the top 30 results of the Google search for 'biodrivmedel' were interlinked.[6]

The network shows that large institutions such as governmental bodies, universities and media corporations were heavily interconnected, as indicated by the size of the nodes, representing the number of links the websites got from the network. In particular, the Swedish Energy Agency, the Swedish government and the Swedish parliament gained a central position in link networks because they received lots of links from other policy institutions, but also from media corporations, social media sites such as Wikipedia and industrial actors such as the ethanol producer SEKAB. These connections may be seen as reflecting a common strategy, since industrial actors usually try to raise their credibility and status by pointing to official websites such as the Swedish government

website; a strategy similar to enrolling official bodies in their offline marketing strategies. Preem even linked to the environmental organization World Wildlife Fund (WWF) in attempt to show its environmental awareness. WWF, however, did not link to Preem, demonstrating an asymmetrical pattern in the politics of affiliation, which Rogers and Marres called an 'act of silencing through inaction' (Rogers and Marres, 2000). Offline relations and dynamics have thus been reified online. Established institutions from the policy–industry–academia conglomerate used their connections to build tight networks that increased user traffic and raised their position in search results, since Google also uses the number and quality of links a website gets to measure its rank (among other factors mentioned earlier). Linking strategies may hence be seen as contributing to the 'media convergence' thesis (Nettleton et al., 2005; Seale, 2005), since offline relations constitute online connections, which, in turn, result in good search engine positions.

Furthermore, investing in professional SEO and advertising campaigns strengthened large and often corporate players with large enough budgets to pursue these techniques. As with paying money to promote products in advertorials, the strategy of paying money to market products in search results has become common. In particular, biofuel companies, the car industry and some NGOs made use of Google's AdWords service,

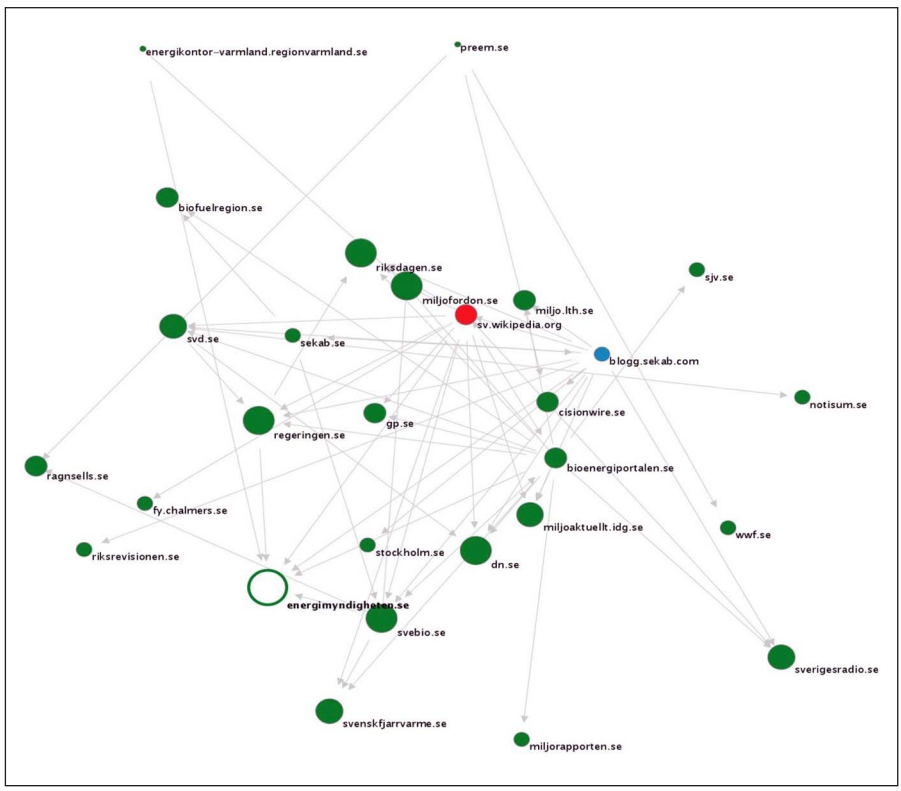

Figure 4. Hyperlink network of Google.se top 30 results; query 'biodrivmedel', created with Issuecrawler.

which allows website providers to pay money to be present on top or on the right side of the 'organic' results. Sponsored links were present in all the Google searches we conducted, but they were particularly prominent when using terms such as 'green car' [miljöbil], which triggered a myriad of car producers featuring biofuel cars and biofuel companies such as Preem and its newly launched fuel *Evolution diesel*. Given the fact that more than 50% of Internet users do not distinguish between organic and sponsored search results (Fallows, 2005), the amount of commercial information presented by Google may be considered troubling. Rather than being a neutral technical tool presenting search results in a 'mathematical' way, as Google claims, Google's 'capital accumulation cycle' (Fuchs, 2011) clearly shaped the way biofuel information was presented and hierarchized in search results. Compared to advertorials only playing a minor part in print media, sponsored search results played a major role in the way the biofuel controversy was negotiated online, especially when the search history and cookies were activated and hence used to personalize search results, which is the default setting in Google and other search engines.

The analysis of visibility strategies, whether as press releases, linking strategies or sponsored ads, revealed that both the press and search engine results were highly influenced by actors prominently figuring in the articles and search results. Their dominance is not the sole result of independent journalism or a technical/neutral way of ranking search engine results. Rather, established actors used their connections to gain presence in classic media by way of press releases and in organic search results by way of link connections. Furthermore, large and often industrial actors invested money to advertise their products in sponsored links and adverts, which additionally enhanced their visibility. This strategy explains why the policy–industry–academia nexus succeeded in outpacing smaller actors in gaining media presence. Furthermore, as we have already touched upon, policy, industry and academic actors build strategic alliances, raising their prominence even further. These alliances and their communicative strategies are the focus of the next section.

Hybrid actors and technoscientific promotion

According to our analysis of actors and visibility strategies, a tight entanglement of policy, industry and academic actors occurred where each actor drew on the strength of the other. In fact, a number of actors from these different sectors created strategic alliances, resulting in networks or platforms figuring as actors themselves in both the press and search results; we coined them 'hybrid actors' due to their marbled character. The term 'technoscientific promotion' refers to a communicative style employed by hybrid actors that emerges from the new modes of knowledge production. This style features what we call a *bundled presence*, reached by building umbrella organizations where bundles of actors act in concert, pursue common interests and jointly boost their media presence, and a *distributed presence*, achieved by each actor performing individually, but pushing forward common agendas across multiple media and contexts, as we will discuss in detail. This, in turn, produces a blurring of knowledge boundaries – between expert knowledge and policy goals, scientific knowledge production and commercialization, media content and marketing – and is largely non-transparent to the public. Two cases

exemplify hybrid actors and their communication styles arising within the new landscape of knowledge production.

The first hybrid actor, *Fossil Free Fuels* (F3), includes universities, research institutes, fuel and car companies (among them Preem) and the Swedish Energy Agency, as well as other network organizations, such as the *Bio4Energy* centre. The idea behind the collaboration, as was stated in a press release on 10 February 2011, was to secure a higher level of societal 'output' of existing and future research results. This output included building a better knowledge base for policy makers and to enhance the national capacity to stay ahead in international competition, economically and industrially. Pål Börjesson, a scientist from Lund University, stated in the press release that 'the market is almost unlimited' (Press release, 2011). This press release reflects a dominant way of framing biofuels in Swedish policy-making: science serves both politics and industry explicitly and directly and the tight connections between all three actors secure a higher level of scientific output and performance (Eklöf, 2011). The overarching conceptual frame is to advance Sweden's position globally – scientifically, industrially and environmentally – by 'driving' the development of sustainable biofuels. This specific kind of knowledge production is presented as a driving force of both political and industrial development. The communicative style of such organizations therefore comes to resemble ordinary PR and marketing, but also features science at its centre, which confirms the market orientation of much of today's science communication. The F3 platform facilitated a portrayal of all actors pulling together to encourage Swedish biofuel R&D, resulting in a 'bundled presence' of all actors involved. When the F3 centre was initiated in February 2011, many press releases were sent out simultaneously. All press releases contained the same message, but came from a diversity of actors and were distributed to different sectors. This distribution was enabled by the number and diversity of actors participating in the centre and all these actors desired good press. As a consequence, these messages had a better chance of getting more attention than they would have had without the boost of the policy–industry–academia collaboration, hence contributing to a 'distributed presence'.

This combination of bundled and distributed presence was similarly displayed in Google search results. The hybrid actor *Biofuel Region*, an initiative based in northern Sweden, was particularly successful in this regard and therefore serves as a good example. As with the F3 network, the *Biofuel Region* is supported by universities, companies and state, regional and local policy bodies and is designed to increase both the production and consumption of biofuels and to disseminate knowledge about biofuels. The goal of the organization is to 'mobilize, engage and activate' the geographical region in this direction. According to the *Biofuel Region* website, biofuel companies were at the centre of the organization that, along with input from society, universities and nature (trees as raw material) produce biofuels, bioenergy and other bio-products. The bundled presence was also apparent in the links provided on the website. As with joint press releases, the *Biofuel Region* website presented technoscientific actors from different sectors and their primary objective – promoting biofuels. In analogy to simultaneously spreading multiple press releases, hybrid actors gained presence on multiple websites at once, to reach distributed presence. Besides being present on umbrella websites such as the *Biofuel Region* or the *Biorefinery of the Future*, each actor had its own website linked to both the

umbrella websites they were part of and the actors they collaborated with to raise their link connectivity and position in search results. Furthermore, actor conglomerates increased their distributed presence by using social media sites such as Facebook, blogs, and other Web 2.0 services, but also Google AdWords. As a result, the *Biofuel Region*'s website had significant presence in Google search results. The website appeared multiple times among the top 10 of the biofuel query, since its own website, its Facebook page and its members featured the *Biofuel Region* 'brand' (and the different actors involved).

These technoscientific promotion strategies can be seen as a central reason why actors from the policy–industry–academia nexus managed to take on a dominant role in the negotiation of the Swedish biofuel controversy in both the press and search results. The bundled and distributed media presence that followed from such collaborations resulted in a stronger position than they would have had if they were only speaking for themselves. Technoscientific promotion thus figures as a communicational institutionalization of the new modes of knowledge production. At the same time, it additionally contributes to the ongoing blurring of boundaries between policy, industry and academia. The amalgamation of expert knowledge and policy goals, of science and commercial interests and, last but not least, between media content and marketing observed in the Swedish press and Google results, serve as evidence of this trend. Our analysis exemplified how these developments were co-produced by changing research landscapes and the commercialization of old and new media. Clearly, both the new modes of knowledge production and the implications of corporate media, that we discussed at the beginning of the article, should not only be seen as abstract phenomena, but rather as very concretely shaping how controversies play out in media arenas and how they are communicated to the public. As a result, already existing power relations are perpetuated and the democratic potential of the media and its role in helping citizens to 'explore and learn about possible worlds' (Callon et al., 2009) is jeopardized.

Conclusions

Our analysis has shown that not all types of actors have the same voice in negotiating the biofuel controversy in old and new media. On the contrary, the policy–industry–academia nexus better succeeds in gaining media presence than smaller institutions, such as NGOs. This is a result of the increasing market orientation of science communication and the ongoing commercialization of the media. Sophisticated visibility strategies such as planned press releases, linking strategies and professional SEO, as well as buying adverts and sponsored links are in place to enhance actors' presence in biofuel debates, both online and offline. Moreover, techniques of technoscientific promotion are used by networks and platforms made up of political, industrial and academic actors – the hybrid actors. These actors secure an advantage for themselves by building strategic alliances, as this also influences media presence through a 'bundled presence' that features all stakeholders, for example in a single press release or on a common website, and a 'distributed presence' by spreading bits and pieces of their identity through multiple press releases, news management and online formats. Accordingly, and in addition to their already increased prominence, they hit newspaper headlines and figure in the top of Google results. Press releases as a means to influence media content and SEO strategies

as tools to boost one's position in search results – in combination with paid adverts and sponsored links – play into the hands of corporate media, which increasingly rely on external news sources, automated algorithms and advertising-based business models. Our analysis shows how new modes of knowledge production and corporate media mutually contribute to information hierarchies and biases, partly overlapping with traditional power relations due to tendencies of 'media convergence'. These new modes might undermine the democratic potential of both science and the media. Accordingly, biofuels are promoted in both media domains – not in terms of a single specific fuel, but rather under the header of 'sustainable biofuels'.

The other side of the coin, however, is an increase of blurred knowledge boundaries and a lack of transparency in the public sphere. Technoscientific promotion and enhanced visibility strategies are largely non-transparent for regular media users. Neither the use of press releases nor enhanced SEO techniques are comprehensible to media consumers. Even paid content often remains unacknowledged by readers, since both advertorials and sponsored search results mimic original media content disguising underlying business models and market revenues. By understanding underlying power relations, visibility strategies and technoscientific promotion, new ways of communicating controversial issues to the public may be found. This understanding is essential in an age of global risks and media monopolies widely figuring as black boxes. Opaque algorithms and non-transparent flows of communication between journalists and organized interests should be unpacked and critically debated. This article may be seen as a step in this direction, but further efforts are needed to develop more democratic and transparent research and media landscapes.

Acknowledgements

We would like to thank our colleagues at Umeå University for their helpful comments. Both authors have contributed equally to this article and they should both be considered to be first author.

Funding

The work was supported by HUMlab (Astrid Mager's postdoctoral fellowship, 2010–2012) and the research project 'Fuel of the Future', funded by the Swedish research council Formas.

Notes

1. We searched carefully using different computers and changing browser settings (with and without search histories, cookies, etc.) to prevent excessively biased results due to user data stored in browsers and being used to personalize organic and paid results.
2. The Issuecrawler is from the Govcom.org Foundation, Amsterdam, http://govcom.org/. It performs a co-link analysis to map densely interlinked communities of websites, which means it performs two steps of 'exclusion'. Consequently, not all interlinked websites are visualized, but only those websites that get a link from at least two of the original starting points (chosen by the researcher). The interrelations between these 'survivors' are displayed as a network map showing websites as nodes and hyperlinks as links between them. In addition, other settings could be chosen, such as the inter-actor analysis, which analyses how the starting points are interrelated. For more information on the Issuecrawler, see also Rogers (2006, 2009).

3. Wikipedia may be seen as an exception to the rule, since its unique amounts of text and links almost always place it at the top of Google.
4. 25 articles of 55 could be linked to press releases or press invitations.
5. Klondike is the historically famed gold rush region in Canada.
6. Issuecrawler, setting: inter-actor.

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