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A global big data assessment of public attitudes towards CCS through the media

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Abstract

Popular opinion plays a critical enabling role in scientific endeavor, influencing the legislation and availability of funding that enables basic research. Yet, while much of science's innovation occurs in controlled laboratory environments away from public view, CCS research, by virtue of its scale, operates largely in the public sphere, making popular perception uniquely critical to its success. This study draws from a cross-section of historical and contemporary media databases to trace the discourse of CCS across the print, broadcast, and web realms, from newspapers to books, television to imagery, web news to web searches, providing one of the first cross-media explorations of the portrayal of the field. Finally, a novel data mining approach is used to extract and characterize the quarter-million people, 140,000 organizations, and 50,000 locations mentioned across the more than 32,000 websites that have discussed CCS over the past five years, constructing a completely automated network diagram that synthesizes the natural "communities" of conversation around CCS, identifying key influencers and the people with whom they are most closely connected.

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1. Introduction

Popular opinion plays a critical enabling role in scientific endeavor, influencing the legislation and availability of funding that enables basic research. Yet, in few fields of discovery is this as starkly evident as CCS in which even small-scale pilot projects require significant local buy-in from the general public to proceed. In 2009 strong public opposition preceded the abandoning of two-high profile sequestration projects: Vattenfall's Schwarze Pumpe sequestration project in Northern Germany and Battelle's pilot in Greenville, Ohio. Both projects had excellent technical characteristics, but succumbed in part to the mobilizing force of negative media coverage. While much of science's innovation occurs in controlled laboratory environments away from public view, CCS research, by virtue of its scale, operates largely in the public sphere, making popular perception uniquely critical to its success.

It takes only a quick glance at the imagery of energy today to see that CCS has a far more negative portrayal than any other energy source. Search Google Images for "natural gas" and the page is filled with artistic renderings of stovetop burners and sleek industrial equipment, while "wind" offers turbines set against cloudless blue skies and "solar" yields gleaming panel arrays. A search for "coal" returns polished black stone, while "oil" emphasizes technological prowess, gleaming metal structures, intricate machinery, and ocean-going superstructures. Even "nuclear power" and "nuclear energy" yield pages of cooling towers and sunny skies, rather than Fukushima or Three Mile Island.

Contrast this with the imagery of "carbon capture" or "carbon sequestration." Search Google Images for either term and the result is pages of technical diagrams and scientific infographics depicting complex pipeline networks and chemical and geologic processes. Search for "clean coal" and the imagery centers on nineteenth century coal mining, dangerous and dirty working conditions, grime-covered laborers, coal-fired power plants with plumes of dark smoke clouding out the sky, and barren landscapes leveled for large-scale mining operations. In short, while the imagery of other energies is dominated by pristine public relations images, the imagery of CCS ranges from highly technical to highly negative.

2. Historical Context

A significant factor complicating the public perception of CCS is the historic contextualization of its terminology over more than a century as a "cleaning" euphemism for the environmental impact of coal-fired energy production. In the nineteenth and early twentieth century, coal producers were increasingly "diluting" their product by adding dust, stones, wood, and other substances to artificially inflate its volume. The practice had become so commonplace by the turn of the century that an 1896 advertisement for flour touted the purity of its product using the metaphor of "clean coal" versus the "19-20[%] dust and dirt" of traditional coal ^[1]. In 1918, a New York Times article titled No More Mine Dirt to be Sold As Coal ^[2] noted inspectors were being posted at mines to improve the purity of coal sold for residential use. By the 1940's, "clean coal" referred to coal that reduced soot and ash emissions in household use ^[3].

In 1970 the first reference to "acid rain" appeared in the Times ^[4], followed quickly by a series of articles connecting industrial pollution (coal-fired in particular) to highly acidic rainfall. Clean coal was thus reinvented the following decade as the use of low-sulfur coal or sulfur-reducing pollution controls to reduce the air pollution of coal burning, and there was even a "Clean Coal Coalition" to lobby on its behalf ^[5]. At the time, the focus was on environmental impact, rather than a changing climate. The Southern Company performed what it termed as the world's first test of "solvent-refined coal" in Georgia in an article titled 'Clean Coal' Test Burn At Georgia Power Plant ^[6], while 1981 saw the first "clean coal" power plant: Clean Coal for Staten Island ^[7]. The proposed Staten Island plant was of particular importance at the time, as "national policy [was to] substitute domestic coal, burned cleanly, for imported oil" ^[7] and this plant would be a test as to whether coal-fired plants could be operated in metropolitan areas if sufficient pollution control systems were employed. From the purity issues of the nineteenth century to the soot concerns and acid rain of the twentieth and the FutureGen projects of the twenty-first, the term "clean coal" has been repurposed every few decades to address a perceived "dirtiness" of coal at the time.

The more technical term "carbon sequestration" first appeared in the New York Times in 1990 as a reference to a large-scale biological sequestration project outlined by the White House ^[8]. Proposing to plant more than a billion trees over 10 years, the administration was trying to "temper the magnitude and speed of the greenhouse effect"

caused by oil and coal consumption. Carbon capture, on the other hand, is the newest of the three terms, debuting for the first time in the Times in 2003 with coverage of the FutureGen project^[9]. None of the three terms has ever achieved significant traction in the New York Times, with clean coal peaking at just 27 articles in a year. However, combined the three terms have had the highest densities of front page, editorial, and letter to the editor appearances of any energy source.

Turning from newspaper coverage to books, Figure 1 uses the Google Books service to trace the percent of all books published each year containing one of the three keywords. The long history of “clean coal” is clearly seen, taking off around 1870, with “carbon sequestration” emerging around 1990 and carbon capture entering use around 1994, around the time that “global change” and “global warming” also enter significant use.



Figure 1 - Percent of all Google Books volumes published each year 1800-2000 containing "carbon sequestration", "clean coal", or "carbon capture"

Three quarters of the American public still rely on television for their daily news consumption^[10], and thus Figure 2 traces the total number of television shows per day mentioning the three terms across the major US television networks monitored by the Internet Archive Television News Archive (<https://archive.org/details/tv>). Other than a single two-month spike at the end of 2010, carbon capture has received little coverage, with clean coal being the term of choice in television coverage of CCS. Indeed, 58.3% of discussion of CCS used the term “clean coal,” 35.8% used “carbon capture,” and just 5.9% used “carbon sequestration.”

Upon closer inspection, it appears that the November-December 2010 carbon capture coverage results nearly exclusively from a large-scale advertising campaign launched by Exxon-Mobil to promote their CCS technology for CO₂-rich natural gas. Exxon-Mobil purchased advertising time across all of the major American television networks over that period, running the same ad continually. The impact of the 2012 US presidential election is seen in the enormous surge in discussion of “clean coal” beginning in July 2012 and ending abruptly on election day.

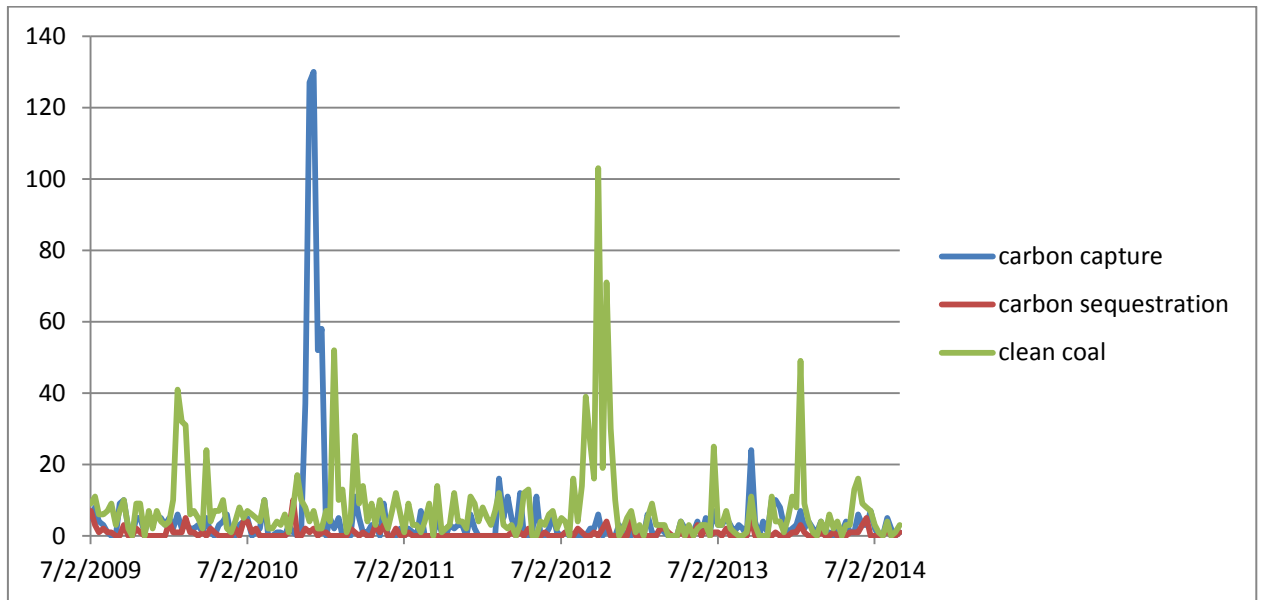


Figure 2 - Number of television shows per day mentioning carbon capture, carbon sequestration, or clean coal, as monitored by the Internet Archive Television News Archive

Finally, Figure 3 relies on the Carbon Capture Report's (<http://www.carboncapturereport.org/>) monitoring of more than 31.7 million energy and climate change-related online news articles to trace the volume of online discussion of CCS (all three terms combined) over the same time period as Figure 2. The Carbon Capture Report does not break the three terms out separately, so it is only possible to measure their combined popularity. Here, CCS coverage is seen to peak in September to early December 2009, with discussion of the reactivation of Futuregen, before decreasing linearly through the fall of 2013 and stabilizing since. The July-November 2012 presidential election surge of television coverage does not appear to have transitioned to the online sphere.

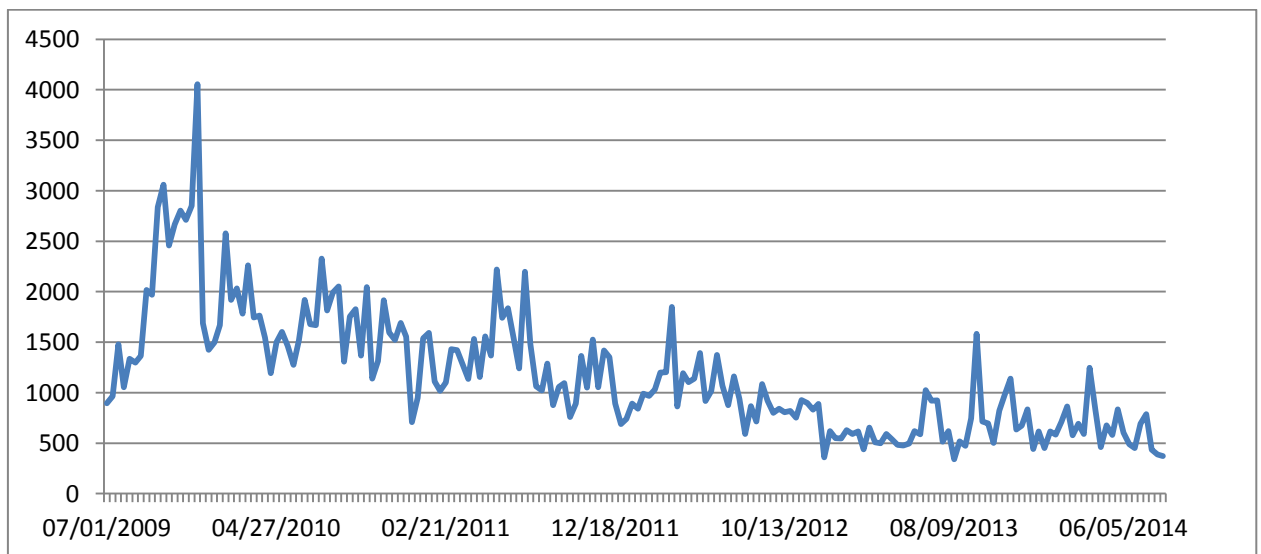


Figure 3 – Combined volume of CCS discussion across online news media as monitored by the Carbon Capture Report

The Carbon Capture Report tracks a variety of energy technologies, including biofuels, coal, geothermal, hydroelectric, natural gas, nuclear, oil, solar, and wind. Figure 4 shows what percentage of CCS coverage also mentions one of these other technologies. The fact that only 44.6% of CCS coverage mentions coal means that roughly 55% of CCS discussion online uses either “carbon capture” or “carbon sequestration.”

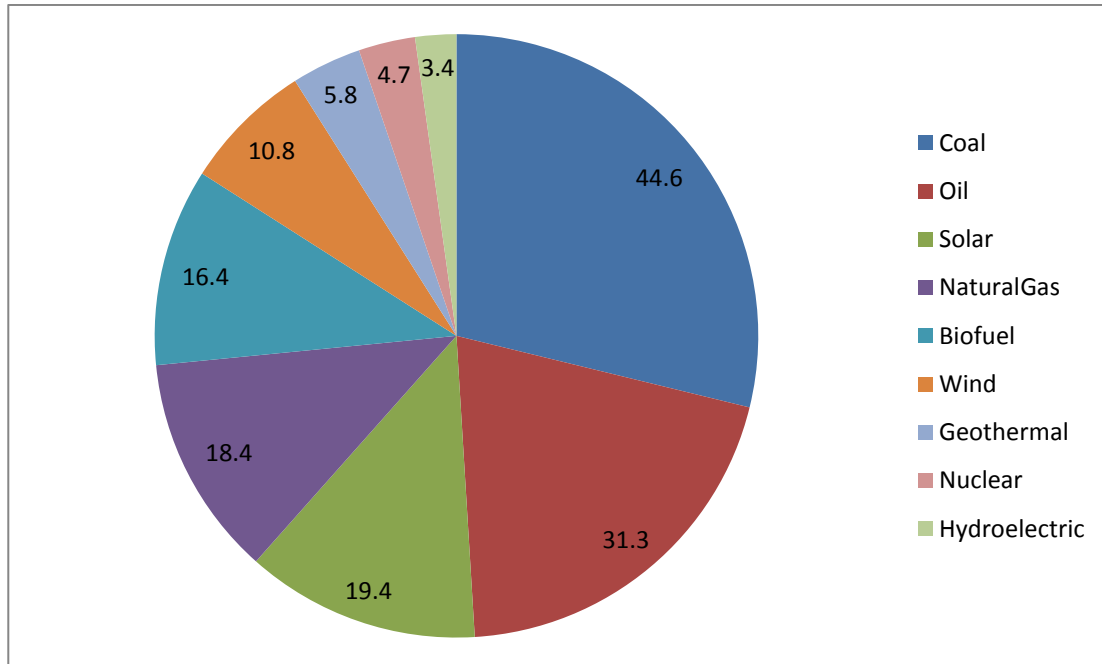


Figure 4 – Percent of online CCS news coverage mentioning other energy types

Of course, simply because the news media emphasizes a particular topic does not necessarily mean that the increased coverage will lead to increased public interest. Figure 5 uses the Google Search Trends service (<http://www.google.com/trends/>) to measure the relative search volume of each of the three CCS terms. Google Trends does not return the actual number of searches, instead normalizing the graph according to the peak number of searches for any of the terms on a given week. The late entrance of “carbon capture” into the public vocabulary is clear, as is the near-equivalence of all three terms since 2010. It appears that “clean coal” was used nearly as often as “carbon sequestration” from 2004 (the start of Google Trends data) through the fall of 2008.

Beginning a few months before the 2008 presidential election, the American Coalition of Clean Coal Electricity (ACCCE) retained the Hawthorne Group to tie CCS into the campaign trail. Handing out clean coal t-shirts and hats at campaign rallies, the organization’s “200,000-strong grassroots citizen army” managed to “nearly [turn] candidate events into clean coal rallies.”^[11] Indeed, a Wall Street Journal article in October 2008 credits the media initiative as having played a significant role in pushing the candidates to embrace clean coal: “as Election Day nears, both candidates are competing over who will do more to support clean-coal initiatives...For that, some credit belongs to Stephen Miller...president of the [ACCCE].”^[12] From Figure 5 it is clear that this public relations initiative, which transformed the presidential campaign cycle into a platform for clean coal, was enormously successful in generating public interest in clean coal, more than quintupling total search volume over the September-November period.

However, this surge in interest was short-lived, with search traffic linearly decreasing over the following five years. As of August 2014, search volume is now less than half what it was before the 2008 presidential election and appears to be on a continued downward decline in interest.

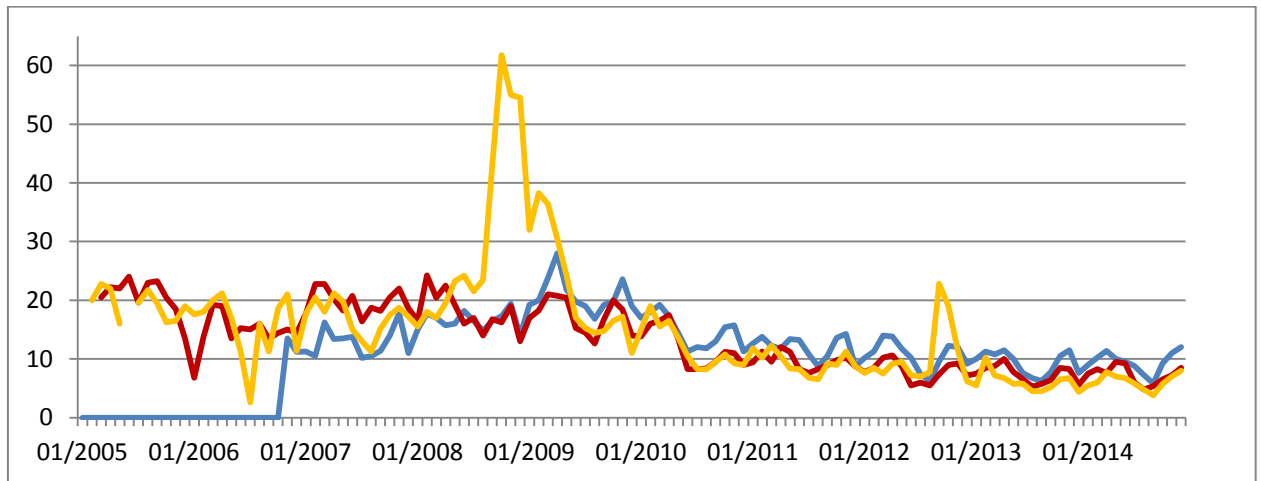


Figure 5 - Google search volume (Y axis is normalized by peak clean coal searches) - carbon capture (blue), carbon sequestration (red), clean coal (yellow)

3. Network Structure

The online narrative surrounding CCS is extremely diverse, with over 32,000 websites mentioning a quarter-million people, 140,000 organizations, and 50,000 locations over the past five years alone. Making sense of such a diverse ecosystem of politicians, academics, journalists, environmentalists, and private citizens requires the ability to synthesize the natural “communities” of conversation, identifying key influencers and the people with whom they are most closely connected. Figure 6 offers a prototype computational synthesis of the person co-occurrence network of online CCS discourse. Here, all 250,000 person names were extracted from CCS news coverage monitored by the Carbon Capture Report and names which appeared together in a news article were connected based on co-occurrence. Only those names appearing in at least 10 different news articles and which co-occurred with at least one other name in 20 or more articles were retained, yielding a network diagram of 817 names and 2,956 connections. Each node represents a person name, sized based on total volume of mentions, with the connections between them representing names which co-occur frequently in news coverage, suggesting some degree of connection or similarity. An algorithm known as a “community finder” was applied to the final network diagram, which groups the names into clusters in which members of a given cluster co-occur more frequently with each other than with other names and each cluster is given its own color. The specific color of each group is assigned at random by the software, but nodes with the same color co-occur more frequently with each other.

Immediately clear is the green cluster at center, encompassing senior American policymakers such as President Barack Obama, Secretary of Energy Steven Chu, and former Vice President Al Gore. Extending the core green cluster downward is a smaller subcluster of politicians and administrators strongly contextualized in the discussion over “cap and trade” legislation, including Rick Boucher and Gina McCarthy. Directly beneath is a red cluster comprised of American lawmakers who have either served on a Congressional energy committee or have sponsored significant energy-related legislation. Members of this group include Senators Lindsey Graham, Jay Rockefeller, Mary Landrieu, and Debbie Stabenow. At the top-right in purple are climate sceptics like Ken Haapala, Anthony Watts, Andrew Montford, and Steve McIntyre, while at upper-left in yellow are Australian politicians like Ross Garnaut, Kevin Rudd, and Martin Ferguson, and in the upper-center are British politicians including David Cameron, Ed Miliband, Gordon Brown, and Tony Blair. On the periphery of each of these clusters are Wall Street analysts and reporters who feature prominently in the commentary and news reporting on those figures. For example, Karolin Schaps and Alex Morales are most closely associated with the British political cluster, reflecting their roles as Reuters and Bloomberg News London reporters, respectively. Tom Friedman, on the other hand, is most closely associated with Al Gore and the American cluster, reflecting his greater emphasis on domestic American politics relating to CCS and climate change.

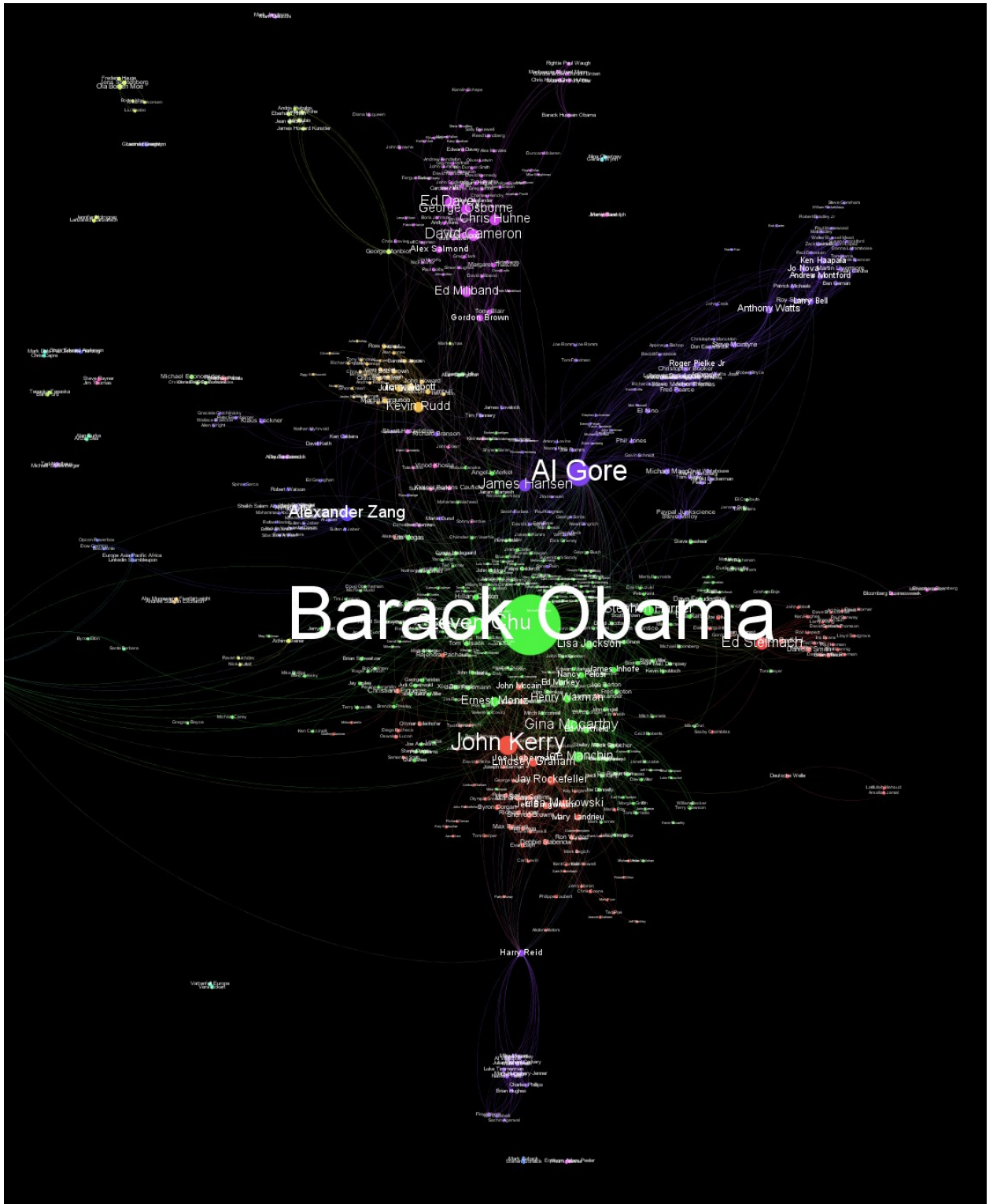


Figure 6 – Co-occurrence network of person names in online CCS news coverage

4. Conclusions

The media ecosystem around CCS is seen to be highly fragmented, with events (such as the 2012 presidential election) resonating in one medium and not others. This is a critical finding, as it reinforces the need to monitor news coverage across multiple modalities, rather than just the online sphere. The influence of the US presidential elections of 2008 and 2012 on public awareness of CCS and media coverage of the field is highly nuanced, with the initial burst of coverage and interest subsiding quickly after the election. The field appears to be experiencing a nearly linear decline in search volume over the past several years, suggesting it is rapidly fading from public attention.

The ability of an automated computer algorithm to sift apart the natural communities of CCS discourse without human intervention presents a powerful new methodology for understanding the discourse surrounding a field like CCS. In particular, the methodology's ability to identify politicians associated with specific subtopics like "cap and trade" or the climatic aspects of CCS or particular congressional leadership positions, as well as its ability to tease out geographic focus of individuals and to identify key reporters for each cluster, suggest this offers a public relations kit in a box. Using the information in the visualization above, it is possible to readily identify both key influencers in each community (the larger nodes) and the reporters and analysts who focus most prominently on them. With further development it will be possible to generate this network diagram on an ongoing basis, automatically detecting emerging leaders and communities and offering near-realtime insights into the global conversation around the field.

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Acknowledgments

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