3rd International Conference
on Public Policy (ICPP3)
June 28-30, 2017 – Singapore

Panel T14PO2 Science, Internet & Technology Policy

Designing Sticky Policies:

How to Steer the Co-evolution of Policy and Technology

Title of the paper

Effective Communication:

Avoiding Politicized Science & Technology at JCESR

Author

Matthew A. Shapiro, Illinois Institute of Technology, USA,
shapiro@iit.edu

Date of presentation

June 28, 2017

Effective Communication:
Avoiding Politicized Science & Technology at JCESR

Matthew A. Shapiro
Associate Professor of Political Science
Department of Social Sciences
Illinois Institute of Technology
shapiro@iit.edu

Prepared for the 3rd International Conference on Public Policy (ICPP3)
June 28-30, 2017 – Singapore

Abstract

The U.S. Department of Energy-funded Joint Center for Energy Storage Research (JCESR) fuses together basic research, battery design, and pathways to market, exemplifying the high-risks, high-costs, and market entry-challenges of sustainable energy technology. There are many remarkable characteristics of JCESR, but most notable is the fact that it has thrived in the face of politicized science and technology more generally. Given past political divisiveness over green technology and the current practice of publicly challenging scientists and researchers, JCESR's ability to advance its goals relatively unhindered is a worthy case study. This is attributed to JCESR's pattern of protecting its scientific credibility and enhancing its political relevance. Also important is the media's framing of research related to JCESR, thus separating battery storage R&D from research addressing climate change.

Keywords: politicized science, R&D policy, energy policy, science communication, renewable energy, green R&D, climate change

Introduction

This case study of the Joint Center for Energy Storage Research (JCESR) addresses the relationships between public funding, uncertain science, and science communication. Ultimately, these relationships highlight the link between politics and science and technology (S&T). Given that S&T policies have become increasingly politicized in the wake of the climate change debate (Bolsen, Leeper, and Shapiro 2014), JCESR provides a unique case study. That is, JCESR's targeting of next generation battery technology makes it a prime candidate for politicization by elected officials or special interest groups representing the automotive and/or fossil fuel industries. Despite the political conflict that has arisen for energy-related areas,[1] JCESR has received continued support and avoided political conflict.

It is claimed here that JCESR's ability to prevent – intentionally or otherwise – the politicization of its research efforts reflects its communication approach as well as the nature of its S&T targets. JCESR's research is presented in extremely effective frames, particularly the absence of connections to climate change. JCESR's activities are also conveyed in compelling terms, presenting a pattern of successful productivity, diffusion, and collaboration.

This case study begins with an overview of the evolution of policies that led to the launching and continued funding of JCESR. Next, research on science communication and the politicization of science is presented. Specific attention is given to how credibility is established and maintained and how frames are constructed by scientists and the media. An analysis then follows, focusing on the actual frames conveyed with regard to JCESR and battery storage research more generally. A concluding section discusses strategies and options for research

[1] See , for example, Schenkel (2010) for details about nuclear waste management and biofuel production.

consortia more broadly and provides updates in light of changes proposed under the Trump administration.

Battery storage technology & the development of JCESR

Inventions and innovations in advanced battery technology at JCESR are a function of successfully reducing the high-risks, high-costs, and market entry-challenges of sustainable energy technology. Basic research, battery design, and pathways to market are fused together by integrating discovery science, battery design, research prototyping, and manufacturing collaboration. This requires the careful and sustained promotion of linkages among the most vital players in the energy storage community. It also requires formal R&D policies and immense amounts of funding from Congress.

The state coordinates next generation battery technology because, among other reasons, technology of that type can increase the well-being of society. The economic benefits will be felt directly by the consumer, but next generation battery technology also increases environmental protection across several dimensions. In line with Vig (1988), the government must thus promote and regulate the use of this technology. The origins of the government's involvement – the Department of Energy (DOE) in particular – could be traced to the period following the 1973 OPEC Oil Embargo. To address future energy supply concerns, the Atomic Energy Commission was replaced with the Energy Research and Development Administration (ERDA) in 1975, and the mission of ERDA was transferred to the DOE in 1977. R&D relating to electric vehicles, hybrid electric vehicles, and plug-in hybrid vehicles began earnestly in the private sector in the early 1990s under the LLC, U.S. Advanced Battery Consortium, to which the DOE joined in 1991. The DOE's support of this venture was reconfirmed through the Energy Policy Act of

1992 (Link, O'Connor, and Scott 2015), which states that the DOE "shall conduct… a research and development program on electric motor vehicles and associated equipment… in cooperation with the electric utility industry, and automobile industry, battery manufacturers, [etc.]"[2]

The DOE has been investing in energy storage R&D since 1976. Yet, battery (NiMH and Li-ion) technology research investments began primarily from 1992.[3] This was further bolstered through the Energy Policy Act of 2005, which "accelerate[s] efforts directed toward the improvement of batteries and other rechargeable energy storage systems, power electronics, hybrid systems integration, and other hybrid vehicles technologies" as well as establishes "(1) a research, development, demonstration, and commercial application program for the secondary use of batteries in certain circumstances; and (2) an Energy Efficiency Science Initiative for research grants."[4] The 2007 Energy Independence and Security Act continued this focus with particular attention to the U.S.'s global competitiveness in energy storage systems for electric drive vehicles and electricity transmission and distribution.[5]

JCESR is formally one of the DOE's Energy Innovation Hubs, consortia that integrate basic and applied research to help move scientific discoveries to their eventual application.[6] The model employed is based on the Manhattan Project and AT&T Bell Laboratories. In 2013, Argonne National Laboratory was selected to lead the Batteries and Energy Storage Hub – i.e. JCESR – to focus on "the next generation of electrochemical energy storage for both

---

[2] Complete details of the Act can be found here: https://www.congress.gov/bill/102nd-congress/house-bill/776/all-info?r=4.
[3] See Figure 1.1 and Table 1.1 in Link, O'Connor, and Scott (2015) for details.
[4] Complete details can be found here: https://www.congress.gov/109/plaws/publ58/PLAW-109publ58.pdf.
[5] Complete details can be found here: https://www.congress.gov/110/plaws/publ140/PLAW-110publ140.pdf.
[6] Besides battery research, Innovation Hubs cover nuclear reactor simulation, improvements in the energy efficiency of buildings, and the development of fuels from sunlight.

transportation and the grid."[7] The integration of basic and applied research implies coordination between universities, government research institutes, and the private sector (Etzkowitz and Leydesdorff 2000; Etzkowitz 2003), partnerships that are particularly important with regard to energy technology given the connections between the invention process and the innovation and diffusion processes (Jaffe, Newell, and Stavins 2004, 2005).

Consortia established through the DOE's Energy Innovation Hubs were first proposed under the Energy Innovation Hubs Authorization Act of 2010 which, for advanced battery technology research, dovetail with the proposals of the Battery Innovation Act of 2011 and the Consortia-Led Energy Advancement Networks (CLEAN) Act of 2011. We can observe the latest iteration of this policy with the North American Energy Security and Infrastructure Act of 2016, which has passed both the House and the Senate. Proposed under the Act, the DOE shall "enhance the Nation's economic, environmental, and energy security by making awards to consortia for establishing and operating Energy Innovation Hubs to conduct and support, whenever practicable at one centralized location, multidisciplinary, collaborative research, development, and demonstration of advanced energy technologies."[8] Similar language has also been conveyed in the Electricity Storage Innovation Act of 2016 and the Department of Energy Research and Innovation Act of 2017.

Most relevant here is the fact that research conducted at JCESR is consistent with bipartisan energy storage legislation proposed to encourage renewable power. Specifically, the Storage Technology for Renewable and Green Energy Act of 2013 was designed to foster the

---

[7] Complete details can be found here: https://energy.gov/sites/prod/files/2014/09/f18/Grid%20Energy%20Storage%20December%202013.pdf.

[8] Complete details can be found here: https://www.congress.gov/bill/114th-congress/senate-bill/2012/all-info?r=6.

development of renewable energy alternatives for electricity. Through innovative and extant energy storage technologies, the bill's intention was to lower costs for the consumer by tapping into renewable energy developments. Tax credits for investments by businesses were in place to encourage the creation and use of energy storage facilities.

Equally relevant, the storage technology was not dictated nor was the source of energy that would eventually be stored. This meant that the tax credits could be disseminated equally to businesses storing energy produced from coal, nuclear, solar, wind, or any other energy source. A 20 percent investment tax credit up to $40 million per project was provided for storage systems projects connected to the electric grid; $1.5 billion in total investment tax credits was allotted. For the development and incentivization of on-site storage for businesses, a 30 percent investment tax credit up to $1 million per project was provided; $3.3 million in total investment tax credits was allotted. A 30 percent tax credit was also provided for homeowners for energy storage that would be tapped into during off-peak energy use hours.[9] More recently, the Energy Storage for Grid Resilience and Modernization Act of 2016 was introduced in the House to continue these energy tax credits through 2026.

Former Energy Secretary Steven Chu claimed in 2011 that it was then "within grasp… [to] get a battery where the business plans are one-third of the cost of today's batteries, where you can get ranges now that would allow cars instead of 100 miles on a single charge, go 300 or more miles on the same charge…. It's not a pipe dream 30 years from today or 20 years from today. It's in the next decade" (Warren 2011). Thus far, JCESR has developed an organic redox flow battery in which there are two energy-dense liquids that store and release charge while

---

[9] Details can be found here: https://www.energy.senate.gov/public/index.cfm/2013/5/senators-introduce-bipartisan-energy-storage-bill-to-encourage-renewable-power.

passing through the battery and undergoing reduction and oxidation ("redox") reactions. This effectively replaces solid electrodes in the lithium-ion batteries used today with energy-dense organic liquids charging and discharging while flowing through the battery. In real terms, this means a more inexpensive, recyclable, and higher performing battery.[10]

Politicizing science & technology

Politicization refers to the selective investigation of empirically derived evidence about facts and processes in the world. Science can be politicized to substantiate a political position, scientific evidence can be politicized to make claims that are not necessarily consistent with the evidence but advance a political goal, scientific processes may be misconstrued and thus politicized by corporate or government actors for political gain, and politicians may selectively discuss scientific evidence for a political or policy objective (Bolsen and Druckman 2015; Bolsen, Druckman, and Cook 2015; Nelkin 1979).[11] There is always the potential for the politicization of science and research output, but politicization is not the default position of science within the context of politics and policy making.

There are two viable choices for entities like JCESR if the science becomes politicized by interest groups or policy makers. These choices are defined by whether the politicization has occurred directly – i.e. there has been a claim made against a research project – or whether the politicization affects a parallel research project. Direct politicization leaves one clear option:

[10] Additional details about JCESR's recent accomplishments can be found here: http://www.eenewseurope.com/news/doe-energy-innovation-hub-backs-two-key-future-battery-technologies-0.

[11] There are particular implications for energy policy. For example, politicized science about nuclear energy negates the environmental benefits that result from nuclear power (Bolsen, Druckman, and Cook 2014).

scientists and researchers should engage with authority those that are politicizing the science. If the politicization is indirect, the science communicator can remove as many opportunities as possible for the further politicization of science by buffering his/her nonpoliticized research from the politicized research. These choices represent the core concepts science communication and invoke the importance of credibility and relevance (Keller 2009, 2010).[12] That is, researchers can protect their scientific credibility and enhance their political relevance through, respectively, buffering and linking. Keller's (2010) analysis of the 1980 National Acid Precipitation Assessment Program and the 1988 Intergovernmental Panel on Climate Change reveal the simultaneous presence of both communicative strategies. Presenting scientifically neutral research results by buffering research from bias and politicization and linking with politicians to enhance the political relevance of research is essential for technically and economically complex aspects of JCESR's research consortium.

Given the increasing scrutiny of scientists (Guston 2000), receiving messages from credible sources may be effective in shaping the public's opinions (Druckman 2001; Lupia 2013), but the ideal is when scientists function as "honest brokers" and use scientific knowledge to clarify and expand the options available to policy makers (Pielke 2007). There are times when scientists and researchers must advocate for a particular policy, thwarting efforts to establish credibility. Specifically, connections between scientists and advocacy organizations have the potential to politicize the science and highlight real or suspected biases of the scientists (Pielke 2007; Guston 2000). Yet, recent research shows that the scientist's perceived credibility does not

[12] Alternative methods also exist to counteract the effect of politicized science, such as providing ex ante warning about potential politicization of science (Bolsen and Druckman 2015).

decrease when the scientist engages in advocacy, even in pursuit of climate change and energy-related policy options (Kotcher et al. 2017).

Even more problematic are those instances when it does not even matter what scientists say or do. Science-based communications are impacted by partisanship (Nisbet 2005; Jasanoff 2011), and, for the receivers of these communications, these effects are exacerbated when science-based communications are politicized (Kitcher 2001; Jasanoff and Wynne 1998; Sarewitz 1996, 2004; Jasanoff 1987; Pielke 2002, 2007). Climate change is now the classic example of politicized science-based discussions. When Republican consultant Frank Luntz recommended to lobbyists and members of Congress that, based on contrarian scientists, climate change be framed as scientifically uncertain (Nisbet 2009), he effectively fueled the widespread use of an uncertain-science frame by conservative organizations and industry representatives (McCright and Dunlap 2003; Oreskes and Conway 2010). This eventually provided a foundation for false equivalence between climate science and deniers of this science, a condition that remained in place from 1990 to 2002 (McCright and Dunlap 2003; Boykoff and Roberts 2007). While this process could be initially attributed to the media,[13] the ideological divide among our elected officials and the general public is now self-sustaining (Bolsen and Shapiro, n.d.).

Climate change is also relevant because of its connection to energy policies that would expand the use of renewables like solar and wind. In this way, JCESR's research goals run parallel to those which address some of the biggest problems from climate change: establishing and meeting greenhouse gas (GHG) emissions reduction targets, transitioning energy production from fossil fuels to renewables, and facilitating an energy infrastructure revolution that would

[13] The dominant global trend indicates that the most prolific journalists present the scientific consensus (Bruggemann and Engesser 2014).

allow households to produce their own power in tandem with public utilities. In other words, JCESR's R&D focus is easily connected to climate change, green technology, and green R&D.

While the GHG emissions reductions that would occur from the widespread use of energy storage technology are significant (Hittinger and Azevedo 2015), the use of energy storage technology does not reduce GHG emissions on its own. This highlights a key assumption made here: the connections made between renewable energy sources and next generation battery technology are discounted by the same elected officials and segments of the public that disparage anti-fossil fuel-related policy. Also seemingly unrecognized by policy makers is the fact that carbon and other GHG emissions decrease from more widespread integration of energy storage in general (de Sistemes, Jenkins, and Botterud 2016), when coupled to electric vehicles (Zhao, Noori, and Tatari 2017), or when connected to renewable energy sources in a behind-the-meter setup (Fisher and Apt 2017).[14] Given that energy storage R&D can bolster the shift toward renewable energy and away from fossil fuels, it is puzzling that it is not politicized.

Research questions & methods of analysis

The mechanism that highlights the extent to which science is politicized – and energy storage research in turn – is frames. Frames in a communication highlight particular aspects that could be relevant for particular policies or issues (Druckman 2001), impacting people's beliefs, attitudes, and intentions. They are never neutral but force a select way of defining a problem (Entman 1993; O'Neill et al. 2015). Media frames in particular have been shown to shape public attitudes about energy alternatives, such as biofuel use, particularly the negative economic

[14] This information is available to members of Congress through the Congressional Research Service's highlights of the energy storage-GHG emissions connection. See, for example, Parfomak (2012).

effects of biofuels for consumers (Delshad and Raymond 2013).[15] This could be the result of how ethanol has been framed in the media, i.e. as a policy issue rather than as technology or economic issues (Kim et al. 2014). This distinction could be attributed to the strong presence of special interests – i.e. ethanol industry representatives – rather than public officials (Takahashi et al. 2017). In any case, energy-related frames in the media have taken a particular hold in terms of energy responses to climate change (see Gamson and Modigliani (1989) and Weisskopf (1988)).

Communicating about science and technology is challenging on its own, but the potential for the politicization of S&T is a confounding factor. For the JCESR case, with its close proximity to GHG-reducing technologies and other "green" R&D, it is necessary to examine whether or not it has fallen into the mire of politicized science. To this end, the following two research questions are proposed:

RQ1: *How have buffering and linking strategies occurred by members of JCESR?*

RQ2a: *How are media outlets and the public interpreting the information associated with JCESR?*

RQ2b: *Is JCESR-related information in the media conveyed in a way that minimizes its politicization?*

These research questions are not necessarily independent of each other. Indeed, one should assume that media reports and, in turn, public opinion about battery storage research/JCESR is impacted by effective buffering and linking strategies.

Keller (2010) is invoked to confirm that buffering and linking strategies are occurring at JCESR. To properly determine whether both set of strategies are occurring, i.e. to answer RQ1, it

---

[15] Even subtle differences between energy alternatives, such as "biofuels" and "ethanol" matter (Cacciatore, Scheufele, and Shaw 2012).

is necessary to outline JCESR's general practices in terms of writing reports, engaging in peer review by science experts, controlling the research agenda, engaging in intraorganizational buffering, seeking decision-maker input, providing transparency in its procedures, summarizing findings for policy makers, and allowing decision-makers to review reports and nominate expert participants. Evidence is drawn from interviews with JCESR's administration, relevant documents from JCESR's archives, and content analysis of JCESR's official online content.[16]

To assess media-based reporting about JCESR in pursuit of answers to RQ2a and RQ2b, data are drawn largely from media reports citing JCESR. These media reports of JCESR are based on JCESR's news article database, where a total of 198 verified articles is listed.[17] Comparisons between JCESR's list of articles and those generated independently (via Google) revealed approximately twice as many articles in the latter,[18] but this difference could be attributed to duplicates in the Google search output.[19] These data are triangulated with content analysis of co-occurring terms based on Google Trends,[20] which is an indicator of public opinion as well as an indicator of demands for specific policies (Oehl, Schaffer, and Bernauer 2017). Most importantly, news and web searches relating to science are aligned with media coverage (Segev and Baram-Tsabari 2012; Baram-Tsabari and Segev 2015).

[16] The JCESR homepage (http://www.jcesr.org/), and all JCESR pages linked to the homepage, was accessed on 5/1/2017.
[17] The database can be found here: http://www.jcesr.org/newsroom/in-the-news-2012/.
[18] The Google news search page for the JCESR-related search can be located at this page.
[19] For example, on 3/27/2015, *UChicago News* published the article authored by Laura Alesio, "Author provides inside look at Argonne National Laboratory's efforts to build a 'super battery'" while the same article was published on 3/30/2015 at Phys.Org.
[20] Google Trends can be found at the following website: https://trends.google.com/trends/.

Results

Regarding RQ1, buffering and linking strategies are in fact occurring at JCESR. Accounting for Keller's (2010) list, there is evidence of writing reports and engaging in peer review by science experts through the collaborations among members of the JCESR consortium and 100 industrial, university, trade, and non-profit organizations – a network of individuals and institutions across the United States as well as internationally. In just three years of operation, more than 170 papers have been published, 43 invention disclosures have been filed, and 25 patent applications have been filed. JCESR also actively contributes its concepts and algorithms for simulating liquid organic molecules – more than 16,000 – to the Materials Project database. The Materials Project is used by hundreds of scientists daily and have more than 4,500 users worldwide.

Evidence of administrative oversight is provided in the context of the JCESR administration's efforts to bring together transportation and grid research efforts, as well as to manage the entire process of discovery, design, prototyping, and manufacturing. Transparency in JCESR's procedures is verified by a content analysis of JCESR's active website, where announcements, interviews, and a full compilation of articles listed in the media, among many other items, are listed. And evidence of JCESR's summarizing of findings for policy makers and allowing and encouraging policy makers' involvement with JCESR's reviews is seen with combined governance and Energy Storage Advisory Committees, where strategies are announced, funding is refined, strategic prototype targets are set, in person meetings with the DOE where prototype targets are presented, and full program meetings take place to review progress and strategies. JCESR's leadership also engages vigorously in outreach to both the community and members of Congress. Whether to share findings at universities, at battery-related conferences, on Capitol Hill (e.g., "National Lab Day on the Hill," on 4/20/2016), at the Congressional Battery Energy Storage Caucus as well as the Senate Science, Energy and Natural Resources Committee, or at an "annual affiliate day" in the Chicago area for 97 affiliates of JCESR's efforts, there is a consistent effort to share JCESR's progress with politicians, colleagues, and potential manufacturing partners.

Before presenting the analysis of the news media and Google Trend data in pursuit of answers to RQ2a and RQ2b, a pause is necessary to contextualize the nature of public opinion in the U.S. regarding renewable energy. Given the politicization of science, GHG-related science particularly, one could assume that there is no consensus in terms of support for renewable energy. We know that, over the 1979 to 2006 period, people living in the U.S. considered energy to be an important issue, ranging from 72 to 92 percent of those surveyed. There has also been strong support for energy efficiency and R&D on renewable energy technologies, and there has similarly been strong support for policies to support their commercialization (Bolsen and Cook 2008). More specifically, 89 percent of Americans support the creation of more solar panel farms, and 83 percent support the creation of more wind turbine farms. This can be compared to significantly less support for the creation of offshore drilling (45 percent), nuclear power plants (43 percent), fracking (42 percent), and coal mining (41 percent) (Pew Research Center 2016). Importantly, these positions are largely held across all ideological sub-groups, while there is much less consistency across ideological sub-groups in terms of support for coal, fracking, offshore oil drilling, and nuclear power plant expansion (Pew Research Center 2016).[21] These

[21] Economic incentives plays a role in these positive positions toward renewable energy. Among those who have already installed or have seriously considered installing solar panels at home, representing 41 percent of the American public (50 percent for those aged 18-49), 92 percent cite as a reason, "to save money on utility bills" (Pew Research Center 2016).

views are becoming increasingly stronger over time, presented in Figure 1.[22] Climate change may be a politicized issue, but renewable energy use and transitions toward renewables is widely supported.

Figure 1 here

To answer RQ2a, a comparison of Google-related trends for several energy-related topics indicates how media outlets and, in turn, people are interpreting information associated with JCESR. Presented in Figure 2 with regard to online web searches and, in Figure 3, with regard to online news searches, energy storage research avoids scrutiny, relatively speaking. Solar power dominates web searches over time, while renewable energy, wind power, and lithium-ion battery-related web search have search values ranging from 5 to 20. Searches of “energy storage” are lowest when compared to these other four topic areas. There are some clear differences between web searches and news searches when comparing the patterns presented in Figures 2 and 3. First, web searches are cyclical while news searches are not, an important point when considering the face that connections between non-cyclical search trends are more consistent with media reporting (Segev and Sharon 2016).[23] This increases confidence in the fact that searches presented in Figure 3 reflect news about these five energy-related issues. Second, searches for news on these five topics has increased notably since the beginning of 2016,

[22] While people support energy efficiency and innovations, there is, however, a slow deployment of low-carbon energy technologies (Peterson, Stephens, and Wilson 2015).
[23] There are, however, some “cyclic” terms that are less correlated with news coverage when compared with the correlation been “ad hoc” terms and news coverage (Segev and Sharon 2016).

including news relating to energy storage. Indeed, energy storage news searches in 2017 surpassed searches in the news on the topic of lithium-ion batteries.

Figure 2 here

Figure 3 here

Focusing on searches related only to energy storage, presented in Figure 4, news searches and web searches have largely experienced similar trends over time. Yet, since the beginning of 2016, news searches on this topic have increased and now equal web search trends. More revealing here are the patterns of co-occurrence between "energy storage" and other terms. Focusing exclusively on the web content sought most commonly with the "energy storage" term, "where a value of 100 is the most commonly searched query, 50 is a query searched half as often, and a value of 0 is a query searched for less than 1% as often as the most popular query,"[24] the five most-commonly sought words/terms with "energy storage" are the following (with relative scores): battery storage (100), battery energy storage (95), solar energy (85), solar energy storage (80), energy storage molecule (75). "Renewable energy storage" (30) was ranked 13th on this list. Turning to the news content sought most commonly with the "energy storage" term, the five most-commonly sought words/terms with "energy storage" are the following: battery energy storage (100), battery (100), solar (35), solar energy storage (30), renewable energy (15). People, the media, and quite likely policy makers tend to conflate energy storage with solar energy and, to a lesser degree, renewables.

[24] Complete details can be found here: https://support.google.com/trends/answer/4355000.

Figure 4 here

Shifting away from media coverage of battery storage, one must address specifically the media coverage of JCESR itself. This is done here through an assessment of the extent to which JCESR has been politicized in the 198 articles published from late November 29, 2012 to early May 2, 2017. The accumulation has been linear with a slight increase since 2015 in the number of articles published, presented in Figure 5. The top-ten outlets highlighting JCESR in terms of the number of articles over the 2012-2017 period are as follows: *Forbes* (7), *Crain's Chicago Business* (5), *Green Car Congress* (5), *Nature* (5), Phys.org (5), *Chicago Sun-Times* (4), *Midwest Energy News* (4), *Nanowerk* (4), *Christian Science Monitor* (3), and *Inc.* (3).

Figure 5 here

Analysis of cooccurrence networks and subsequent keyword searches of text summarizing each of the 198 articles indicates that there is mention of "climate change" in only 11.4 percent of articles (6.5 percent of articles mention "global warming"). There were no mentions of GHG emissions. The most commonly used words in the news are measured by their degree centrality, i.e. by words that are most likely paired with other words.[25] These are listed alphabetically as follows: battery/batteries, cars/vehicles, cost, electric/electricity, energy, grid, innovation, lithium/lithium-ion, power, research, researchers/scientists/experts,

[25] Degree centrality is based on the Fruchterman Reingold Algorithm in NodeXL (Smith, 2014). This replicates what is done using program (e.g., FullText) to generate a co-occurrence matrix from text (see Leydesdorff and Hellsten (2005) for details).

technology/technologies. News reports have thus been focusing primarily on the job at hand for JCESR: the engagement of researchers in R&D related to lithium-ion batteries, energy storage, and innovations, as well as the costs related to the electrical grid and automobiles.

JCESR is framed in the media as an advocate for the public and for policy makers by ultimately reducing energy costs and pollution. Journalists do not highlight any of the potentially politicizing aspects of the research consortia: JCESR's budget, the long-term and uncertain nature of its efforts, and the connections between JCESR's work and other green R&D projects, such as renewables. This is surprising given that energy storage-related news, based on the Google Trends data, is moderately connected to renewables. Nevertheless, the most important factor here is the rare connection made specifically between JCESR's work and broader S&T-related efforts to reduce anthropogenic climate change.

Conclusion

Science communication scholars have explored strategies to deal with the challenges of conveying information to the media, policy makers, and the public (see, for example, Bolsen and Shapiro (n.d.)). JCESR provides another example of successful science communication, conveying the work it does effectively, highlighting benefits and costs, avoiding politics and value-laden debates, and avoiding any discussions of risk. Specifically, JCESR eschews mentioning the connection between its research accomplishments and climate change. Stated earlier, the GHG emissions reductions that would result from improvements in energy storage technology are significant (Hittinger and Azevedo 2015). The fact that they are occurring indirectly is crucial for JCESR's success; energy storage technology does not reduce GHG emissions but, rather, bolsters the implementation and ultimate successes of other emissions-reducing technologies, such as renewables.

The government can play an active role in depoliticizing science, but that has not been the case under the Trump administration, where Obama's Climate Action Plan has been dismantled, and R&D even tangentially related to climate change is being revamped. Before the presidential inauguration, Trump had asked for the names of DOE employees that were involved with climate change, and there were discussions about reductions to the DOE's Office of Energy Efficiency and Renewable Energy's (EERE) 2018 budget (Mooney 2017). This budgeting approach is a common practice now for President Trump: an earlier budget proposal showed cuts for the National Institutes of Health from $31 billion to $25.9 billion, for earth science at NASA by $200 million, to drop climate change research entirely from the EPA, and also to drop clean energy research at the DOE (Atkin 2017). Regardless of the logic behind these changes – ostensibly to preserve the purity of market forces for technology development (Mufson 2017) – they tend to shine a light on the R&D efforts of research consortia like JCESR. It has effectively become even more hazardous to allude to connections between next generation battery research and renewable energy research. There are testimonials to this effect: "'I think you're seeing a combination of people trying to stay below the radar so they don't get whacked, and also trying to morph so they can accommodate what the new administration's point of view is going to be,' said Adam Cohen, who served as deputy undersecretary for science and energy at the Energy Department" (Mooney and Rein 2017).

In other words, through the use of the bully pulpit and reiterated through budget proposals, President Trump's energy R&D focus explicitly connects renewable energy – and energy storage in turn – with climate change and Obama's Climate Action Plan. Shifts directly impacting R&D pursuits, including JCESR, include renaming/replacing the DOE's Clean Energy Investment Center with the "Energy Investor Center." Founded in 2016 to guide private sector investors toward renewable technologies, "clean and alternative" terminology has virtually disappeared from the website of the Center (Mooney and Rein 2017).[26] At JCESR, despite a pattern of science communication relatively free of politicization thus far, this will likely require bolstered efforts to protect its scientific credibility and enhance its political relevance.

[26] See a side-by-side comparison of the before-and-after versions of the Center's website here: https://www.washingtonpost.com/news/energy-environment/wp/2017/05/26/just-dont-call-it-climate-change-rebranding-government-in-the-age-of-trump/?utm_term=.07736664cd16.

References

Atkin, Emily. 2017. “Trump’s Budget Is a Middle Finger to Science.” *New Republic*, March 16. https://newrepublic.com/minutes/141384/trumps-budget-middle-finger-science.

Baram-Tsabari, Ayelet, and Elad Segev. 2015. “The Half-Life of A ‘teachable Moment’: The Case of Nobel Laureates.” *Public Understanding of Science* 24 (3): 326–37.

Bolsen, Toby, and Fay Lomax Cook. 2008. “The Polls - Trends: Public Opinion on Energy Policy: 1974-2006.” *Public Opinion Quarterly* 72 (2): 364–88.

Bolsen, Toby, and James N. Druckman. 2015. “Counteracting the Poilticization of Science.” *Journal of Communication* 65 (5): 745–69.

Bolsen, Toby, James N. Druckman, and Fay Lomax Cook. 2014. “How Frames Can Undermine Support for Scientific Adaptations: Politicization and the Status-Quo Bias.” *Public Opinion Quarterly* 78 (1): 1–26.

Bolsen, Toby, James N. Druckman, and Fay Lomax Cook Cook. 2015. “Citizens’, Scientists’, and Policy Advisors’ Beliefs about Global Warming.” *The ANNALS of the American Academy of Political and Social Sciences* 658 (March): 271–95.

Bolsen, Toby, Thomas J. Leeper, and Matthew A. Shapiro. 2014. “Doing What Others Do: Norms, Science, and Collective Action on Global Warming.” *American Politics Research* 42 (1): 68–89.

Bolsen, Toby, and Matthew A. Shapiro. n.d. “The U.S. News Media, Polarization on Climate Change, and Pathways to Effective Communication.” *Environmental Communication*.

Boykoff, Maxwell T., and J. Timmons Roberts. 2007. “Media Coverage of Climate Change: Current Trends, Strengths, Weaknesses.”

Bruggemann, Michael, and Sven Engesser. 2014. “Between Consensus and Denial: Climate Journalists as Interpretive Community.” *Science Communication* 36 (4): 399–427. doi:10.1177/1075547014533662.

Cacciatore, Michael A., Dietram A. Scheufele, and Bret R. Shaw. 2012. “Labeling Renewable Energies: How the Language Surrounding Biofuels Can Influence Its Public Acceptance.” *Energy Policy* 51 (December): 673–82.

Delshad, Ashlie, and Leigh Raymond. 2013. “Media Framing and Public Attitudes toward Biofuels.” *Review of Policy Research* 30 (2): 190–210.

Dickson, David. 1988. *The New Politics of Science*. Chicago: University of Chicago Press.

Druckman, James N. 2001. “On the Limits of Framing.” *Journal of Politics* 63 (4): 1041–66.

Entman, Robert M. 1993. “Framing: Toward Clarification of a Fractured Paradigm.” *Journal of Communication* 43 (4): 51–58.

Etzkowitz, Henry. 2003. “Innovation in Innovation: The Triple Helix of University-Industry-Government Relations.” *Social Science Information* 42 (3): 293–337.

Etzkowitz, Henry, and Loet Leydesdorff. 2000. “The Dynamics of Innovation: From National Systems and ‘Mode 2’ to a Triple Helix of University-Industry-Government Relations.” *Research Policy* 29 (2): 109–23.

Ezrahi, Yaron. 1990. *The Descent of Icarus: Science and the Transformation of Contemporary Democracy*. Cambridge, MA: Harvard University Press.

Fisher, Michael J., and Jay Apt. 2017. “Emissions and Economics of behind-the-Meter Electricity Storage.” *Environmental Science & Technology* 51 (3): 1094–1101.

Gamson, William A., and Andre Modigliani. 1989. “Media Discourse and Public Opinion on Nuclear Power: A Constructionist Approach.” *American Journal of Sociology* 95 (1): 1–37.

Guston, David. 2000. *Between Politics and Science: Assuring the Integrity and Productivity of*

Research. Cambridge, MA: Cambridge University Press.
Hittinger, Eric S., and Ines M. Azevedo. 2015. “Bulk Energy Storage Increases United States Electricity System Emissions.” *Environmental Science & Technology* 49 (5): 3203–10.
Jaffe, Adam B., Richard G. Newell, and Robert N. Stavins. 2004. “Technology Policy for Energy and the Environment.” In *Innovation Policy and the Economy, Vol.4,* edited by Adam B Jaffe, Josh Lerner, and Scott Stern. Cambridge: MIT Press.
———. 2005. “A Tale of Two Market Failures: Technology and Environmental Policy.” *Ecological Economics* 54 (2–3): 164–74. doi:DOI: 10.1016/j.ecolecon.2004.12.027.
Jasanoff, Sheila. 1987. “Contested Boundaries in Policy-Relevant Science.” *Social Studies of Science* 17 (2): 195–230.
———. 2011. “Making the Facts of Life.” In *Reframing Rights: Bioconstitutionalism in the Genetic Age,* edited by Sheila Jasanoff. Cambridge: MIT Press.
Jasanoff, Sheila, and B. Wynne. 1998. “Science and Decisionmaking.” In *Human Choice and Climate Change, Vol 1: The Societal Framework*, edited by S. Rayner and E.L. Malone. Columbus, OH: Battelle Press.
Keller, Ann C. 2009. *Science in Environmental Policy: The Politics of Objective Advice*. Cambridge: MIT Press.
———. 2010. “Credibility and Relevance in Environmental Policy: Measuring Strategies and Performance among Science Assessment Organizations.” *Journal of Public Administration Research and Theory* 20 (2): 357–86.
Kim, Sei-Hill, John C. Besley, Sang-Hwa Oh, and Soo Yun Kim. 2014. “Talking about Bio-Fuel in the News: Newspaper Framing of Ethanol Stories in the United States.” *Journalism Studies* 15 (2): 218–34.
Kitcher, P. 2001. *Science, Truth, and Democracy*. New York: Oxford University Press.
Kotcher, John E., Teresa A. Myers, Emily K. Vraga, Neil Stenhouse, and Edward W. Maibach. 2017. “Does Engagement in Advocacy Hurt the Credibility of Scientists? Results from a Randomized National Survey Experiment.” *Environmental Communication* 11 (3): 415–29.
Leydesdorff, Loet, and I. Hellsten. 2005. “Metaphors and Diaphors in Science Communication: Mapping the Case of ‘Stem-Cell Research.’” *Science Communication* 27 (1): 64–99.
Link, Albert N., Alan C. O’Connor, and Troy J. Scott. 2015. *Battery Technology for Electric Vehicles: Public Science and Private Innovation*. New York: Routledge.
Lupia, Arthur. 2013. “Communicating Science in Politicized Environments.” *Proceedings of the National Academy of Sciences* 110 (3): 14048–54.
McCright, Aaron M., and Riley E. Dunlap. 2003. “Defeating Kyoto: The Conservative Movement’s Impact on U.S. Climate Change Policy.” *Social Problems* 50 (3): 348–73.
Mooney, Chris. 2017. “Trump Aims Deep Cuts at Energy Agency That Helped Make Solar Power Affordable.” *Washington Post,* March 31.
Mooney, Chris, and Lisa Rein. 2017. “Don’t Call It ‘Climate Change’: How the Government Is Rebrainding in the Age of Trump.” *Washington Post*, May 26.
Mufson, Steven. 2017. “Trump’s Budget Owes a Huge Debt to This Right-Wing Washington Think Tank.” *Washington Post,* March 27.
Nelkin, Dorothy. 1979. “Science, Technology, and Political Conflict: Analyzing the Issues.” In *Controversy: Politics of Technical Decisions,* 9–22.
Nisbet, Matthew C. 2005. “The Competition for Worldviews: Values, Information, and Public Support for Stem Cell Research.” *International Journal of Public Opinion Research* 17 (1): 90–112.

———. 2009. "Communicating Climate Change: Why Frames Matter for Public Engagement." *Environment* 51 (2): 12–23.

O'Neill, Saffron J., H.T.P Williams, T. Wiersma, and M. Boykoff. 2015. "Dominant Frames in Legacy and Social Media Coverage of the IPCC Fifth Assessment Report." *Nature Climate Change* 5: 380–85.

Oehl, Bianca, Lena Maria Schaffer, and Thomas Bernauer. 2017. "How to Measure Public Demand for Policies When There Is No Appropriate Survey Data?" *Journal of Public Policy* 37 (2): 173–204.

Oreskes, Naomi, and Erik M. Conway. 2010. *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. New York: Bloomsbury Press.

Parfomak, Paul W. 2012. "Energy Storage for Power Grids and Electric Transportation: A Technology Assessment."

Peterson, Tarla Rai, Jennie C. Stephens, and Elizabeth J. Wilson. 2015. "Public Perception of an Engagement with Emerging Low-Carbon Energy Technologies: A Literature Review." *MRS Energy & Sustainability: A Review Journal* doi:10.155.

Pew Research Center. 2016. "The Politics of Climate."

Pielke, Roger A. 2002. "Policy, Politics, and Perspective: The Scientific Community Must Distinguish Analysis from Advocacy." *Nature* 4166: 367–68.

———. 2007. *The Honest Broker: Making Sense of Science in Policy and Politics*. Cambridge: Cambridge University Press.

———. 2012. "Basic Research as a Political Symbol." *Minerva* 50 (3): 339–61.

Sarewitz, Daniel. 1996. *Frontiers of Illusion: Science, Technology, and the Politics of Progress*. Philadelphia: Temple University Press.

———. 2004. "How Science Makes Environmental Controversies Worse." *Environmental Science & Policy* 7: 385–403.

Schenkel, Roland. 2010. "The Challenge of Feeding Scientific Advice into Policy-Making." *Science* 330 (December 24): 1749–51.

Segev, Elad, and Ayelet Baram-Tsabari. 2012. "Seeking Science Information Online: Data Mining Google to Better Understand the Roles of the Media and the Education System." *Public Understanding of Science* 21 (7): 813–29.

Segev, Elad, and Aviv J. Sharon. 2016. "Temporal Patterns of Scientific Information-Seeking on Google and Wikipedia." *Public Understanding of Science*.

Sistemes, Fernando J. de, Jesse D. Jenkins, and Audun Botterud. 2016. "The Value of Energy Storage in Decarbonizing the Electricity Sectory." *Applied Energy* 175 (1): 368–79.

Smith, M. 2014. "NodeXL: Simple Network Analysis for Social Media." In *Encyclopedia of Social Network Analysis and Mining*, edited by Reda Alhajj and Jon Rokne.

Takahashi, Bruno, Carol Terracina-Hartman, Katheryn Amman, and Mark S. Meisner. 2017. "Policy, Economic Themes Dominate Ethanol Headlines." *Newspaper Research Journal* 38 (1): 119–33.

Vig, Norman J. 1988. "Technology, Philosophy, and the State: An Overview." In *Technology and Politics*, edited by Michael E. Kraft and Norman J. Vig. Durham: Duke University Press.

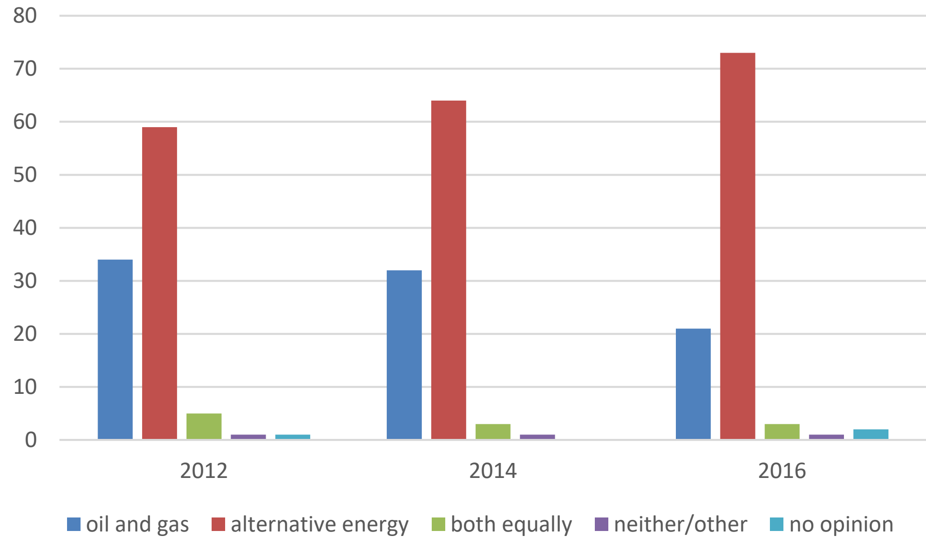
Warren, Michael. 2011. "Energy Secretary Steven Chu on Electric Cars." *The Weekly Standard,* April 3. http://www.weeklystandard.com/chu-electric-cars/article/556135.

Weisskopf, Michael. 1988. "Two Senate Bills Take Aim at 'Greenhouse Effect.'" *Washington*

Post.
Winner, Langdon. 1988. "Do Artifacts Have Politics?" In *Technology and Politics,* edited by Michael E. Kraft and Norman J. Vig. Durham: Duke University Press.
Zhao, Yang, Mehdi Noori, and Omer Tatari. 2017. "Boosting the Adoption and the Reliability of Renewable Energy Sources: Mitigating the Large-Scale Wind Power Intermittency through Vehicle to Grid Technology." *Energy* 120 (1): 608–18.

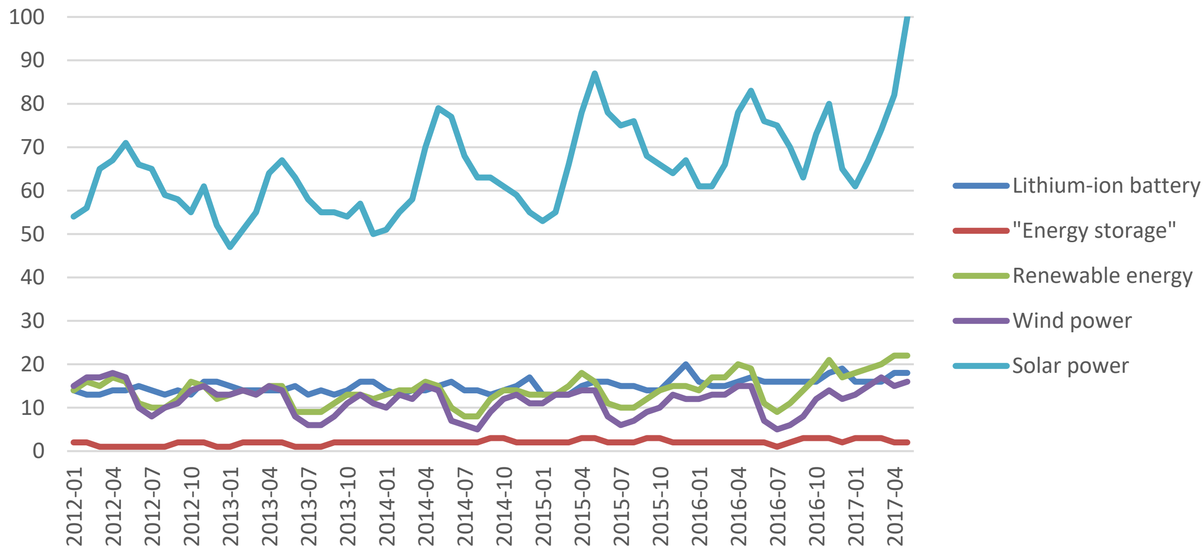
Figures and Tables

Figure 1. Public views regarding U.S. energy production distribution (percentage)



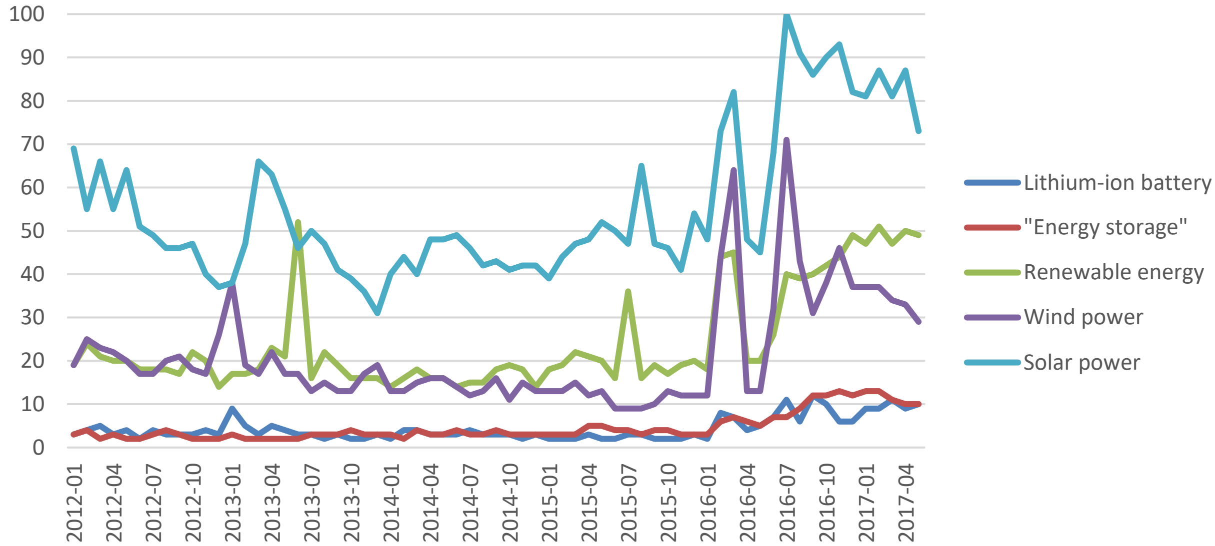
Source: Gallup.com (http://www.gallup.com/poll/2167/energy.aspx)
Note: Question asked, "Which of the following approaches to solving the nation's energy problems do you think the U.S. should follow right now: emphasize production of more oil, gas and coal supplies (or) emphasize development of alternative energy, such as wind and solar power?"

Figure 2. Google search trends of select energy topics, online web interest (U.S.)



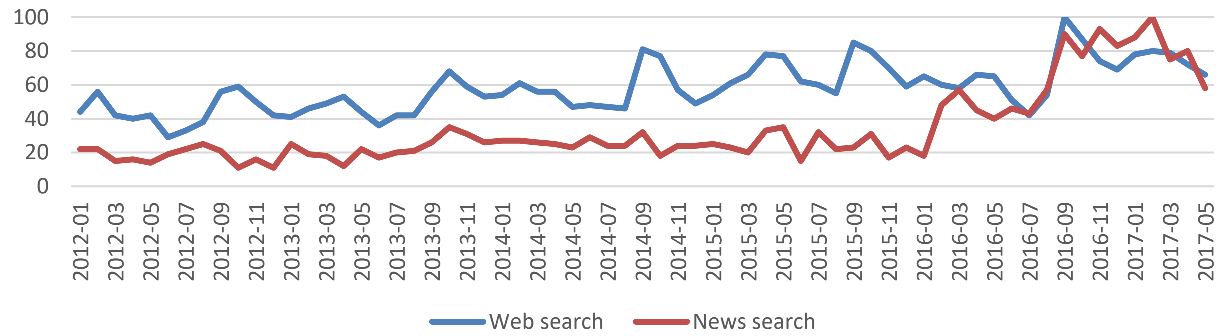
Source: Google web search trends [link] for topics (except for the “energy storage” term). Data accessed June 7, 2017. “Numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. Likewise a score of 0 means the term was less than 1% as popular as the peak.”

Figure 3. Google search trends of select energy topics, online news interest (U.S.)



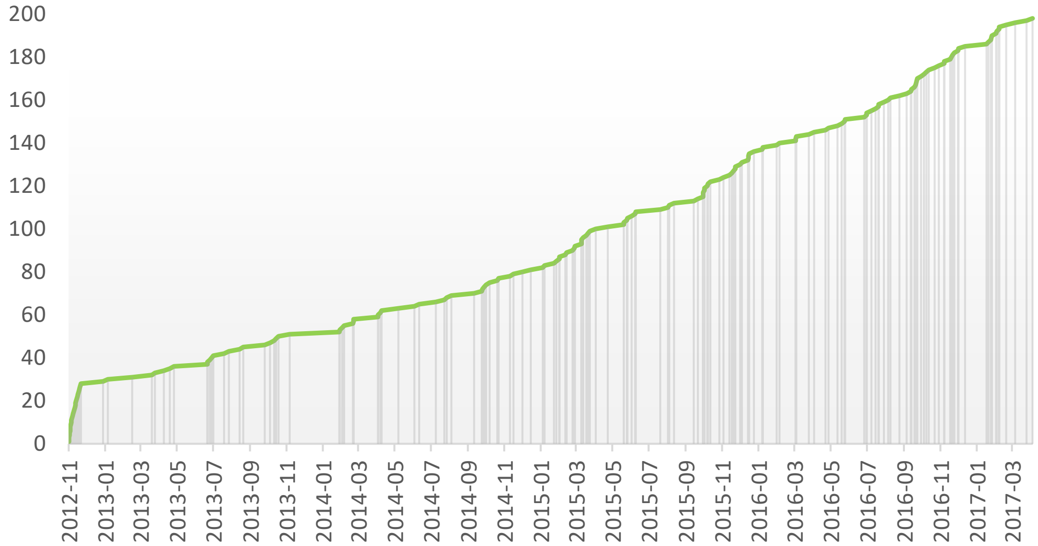
Source: Google news search trends [link] for topics (except for the "energy storage" term). Data accessed June 7, 2017. "Numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. Likewise a score of 0 means the term was less than 1% as popular as the peak."

Figure 4. Google search trends of “energy storage,” online web and news interest (U.S.)



Source: Google web search trends [link] and news search trends [link] for for “energy storage” term. Data accessed June 7, 2017. “Numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. Likewise a score of 0 means the term was less than 1% as popular as the peak.”

Figure 5. Cumulative count of media articles highlighting JCESR in media



Source: JCESR’s news article database [link].