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Research Note

A Corpus-Linguistic Analysis of Media Discourses on Nuclear Phase-out in Japan, 2011-2014

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The Fukushima Daiichi nuclear disaster led to catastrophic environmental and economic consequences in Japan, leading to a temporary shift in public attitudes towards nuclear energy not only in Japan but globally. In 2011, the Japanese DPJ-led government gained worldwide attention for their plan to phase-out. However, while some countries seized the opportunity to transition away from nuclear energy and to expand the use of renewable energy sources, the succeeding Japanese government eventually decided to restart nuclear plants in 2012 and to continue to rely on nuclear energy in its energy mix for the time being, despite growing public distrust in the safety of nuclear facilities.

In this article, we will present the results of a corpus-assisted discourse analysis of the contexts and framings of nuclear phase-out by contrasting data from one newspaper (Yomiuri Shinbun) and social media (Twitter) in the period of 2011-2014. Our analysis not only shows the growing media convergence between social media and the mass media and thus their close interrelatedness but also instances in which social media has become more influential than the legacy media outlets.

Keywords: Fukushima, Mass Media, Discourse Analysis, Social Media, Nuclear Energy

1. Existing research on the media framing of nuclear energy in Japan

(1) Pre-Fukushima framing¹ of nuclear power: “safe” and “peaceful”

According to previous studies on mass media coverage of nuclear energy in Japan (Yamakoshi 2015; Kitahara 2011; Itou 2004; Yasuhito Abe 2013; Kinefuchi 2015) — following U.S. President Eisenhower’s famous “Atoms for Peace” speech that aimed at establishing a positive image of atomic energy in Japan after the tragedies of Hiroshima and Nagasaki or the Daigo Fukuryū Maru incident², thereby indirectly pushing Japan to join the U.S. “nuclear umbrella” (Yoshimi 2012) — peaceful use and nuclear non-proliferation became a coupled set. The Japanese mass media, such as the two newspapers, the Asahi and the Yomiuri, played an important

¹ We understand framing as the representation and interpretation of an event in media through a certain perspective in which journalist insert a message to the audience.

² Daigo Fukuryū Maru (Lucky Dragon 5, 第五福龍丸) was a Japanese fishing boat that was eliminated during the U.S. nuclear testing on Bikini Atoll in 1954.

role in promoting the use of nuclear power and its alleged safety until the end of the 1970s. Moreover, after the oil crisis at the beginning of the 1970s, concerns over energy security became an essential issue in Japan, leading to justifications of the necessity of nuclear energy use as a means of economic development and well-being in the editorials of Japan's leading newspapers (Oyama 1999).

Interestingly, the framing of atomic power as a safe technology in the media and in politics was particularly prominent in the aftermath of the Chernobyl accident (1986) in Japan, based on the assumption that Japan's nuclear technology was more advanced than the one used in the USSR. Journalists of the *Yomiuri*, for instance, described the accident at Chernobyl as an "operator error", contrasting it with Japan's technological superiority and technological efficiency (Penney 2012; Yasuhito Abe 2013). Moreover, in the reports about the Chernobyl, the accident was not only opposed to Japan on a techno-nationalistic level, but also related to the tragedy of Hiroshima and Nagasaki by emphasising Japan's commitment to a uniquely peaceful use of nuclear power and Japan's readiness to contribute to the technological development and safety measures of its own nuclear industry (Yasuhito Abe 2013; Funabashi and Kitazawa 2012). Thus, one might argue that — other than for instance in Germany, that was directly affected by radioactive fallout — the nuclear disaster of 1986 was not covered as a potential threat to the Japanese society, which had also to do with the upcoming general elections in Japan at that time (Yamakoshi 2015). Both the *Asahi* and the *Yomiuri* focused on covering the reactions of European media outlets and governments, touching on the rising anti-nuclear protests in Japan only very briefly, thus framing the Chernobyl accident as a problem of others, not Japan's. In Japan, it took at least two years for the anti-nuclear movement to accelerate, leading to growing anti-nuclear sentiments and opposition. A planned test run at Unit 2 of the Ikata Nuclear Power Station in Shikoku in February 1988 poured fire onto the anti-nuclear movement, causing a sequence of protests in 1988-1990 (Avenell 2016). In the course of these events, both newspapers became more differentiated and nuanced in their coverage of the nuclear issue and the Japanese anti-nuclear movement since around 1988, also leading to reports and editorials that questioned the safety of nuclear power plants (Itou 2005; Yamakoshi 2016). Despite some newspapers supported the participants and praised the new anti-nuclear movement, the editorial line of the *Yomiuri* did not significantly change, still taking up a pro-nuclear stance.

When Japan signed the Kyoto Protocol (1997), but not with binding targets, a new framing of nuclear power as a method to effectively reduce carbon emissions appeared in the mass media and in politics. Having the name of Japan's ancient city Kyoto attached to the international treaty, the implementation of the Kyoto Protocol in Japan was also seen as a way to create a positive reputation of Japan at the international level, being one of a group of countries actively contributing to environmental protection. Although particularly conservative media outlets framed nuclear power as a clean way to tackle climate change since the second half of the 1990s, the *Asahi's* stance continued to be critical of the use of nuclear power, starting to suggest raising the share of alternative energy sources and continuing to stress the necessity of tightening the safety measures for nuclear plants (Oyama 1999). Moreover, Itou's study (2004; 2005) on *Asahi* shows that nuclear events that happened in Japan, namely, the Monju nuclear power plant (NPP) accident in 1995, the Tokai-mura nuclear accident in 1997, and the Mihama NPP accident in 2004 boosted more negative evaluation of the safety of nuclear energy, nuclear power plants' ageing and critics of related institutions. Particularly, after the Tokai-mura nuclear accident, the *Asahi* started to raise the question of nuclear phase-out which suggests that national nuclear accidents affected the *Asahi* editorial more than international events (Itou 2005, Tsuchida and Kimura 2011).

(2) Post-Fukushima framing of nuclear energy

On 11 March, 2011, a magnitude 9 earthquake struck the north-eastern coast of Japan. The earthquake on the Pacific coast of Tohoku and the subsequent tsunami led to the nuclear disaster at the Fukushima Daiichi NPP. The world's second largest nuclear disaster led to a shift in the attitudes towards nuclear energy around

the world. It was not only in Japan's neighbouring countries, namely Taiwan, India, South Korea and China, that public concerns regarding the safety of nuclear power plants were raised, but also in European countries, such as Germany, Belgium or Switzerland, eventually leading to the political decision to phase out atomic energy in all three countries (Hindmarsh and Priestley 2015).

In May 2011, Prime Minister Naoto Kan (DPJ) announced to end Japan's nuclear program in reaction to the events in Fukushima and a quickly rising and growing anti-nuclear movement in Japan (Poortinga, Aoyagi, and Pidgeon 2013). Demonstrations lasted until 2013, with the largest taking place on September 2011, June 2012 (in reaction to restart the Ōi NPP), and March 2013. After a landslide victory of the LDP in the 2012 elections, the Abe administration revoked this policy and made its plan public to restart nuclear power plans after approval by the Nuclear Regulation Authority. The Strategic Energy Plan of 2014, also enacted by the Abe administration, explicitly states that Japan sees itself as an "advanced nuclear nation", setting the general energy mix for the subsequent year to include a 20-22% share of nuclear energy (Iimura and Cross 2016). The plan also stated that the "dependency on nuclear power generation will be lowered to the extent possible by energy saving and introducing renewable energy as well as improving the efficiency of thermal power generation, etc." (METI 2014, 24).

Several studies (Hartwig et al. 2016; Yuki Abe 2015; Itou 2012) have pointed out that the Asahi actively promoted nuclear phase-out in 2011, advocating to reduce nuclear dependency and to allow more soft-path alternative energy into the market, evoking a soft path frame. The Yomiuri, in contrast, continued to frame nuclear energy as vital for Japan's economy in the aftermath of the disaster and claimed that the announcement of nuclear phase-out was "amplifying public distrust of nuclear energy policy", potentially leading to a lag in Japan's technological and economic development and inability to contribute to global nuclear security management (Yuki Abe 2015, 95).

2. Research design

(1) Research questions

It is argued that the combination of a strong pro-nuclear advocating fraction of the Japanese mass media (the Yomiuri in particular) and the pro-nuclear stance of the Abe administration are important factors responsible for the fact that nuclear energy still makes up a significant share in the domestic energy mix. Despite the fact that nuclear discourse in the Japanese mass media has been thoroughly studied, studies regarding the development of the discourse on social media are still insufficient, not to speak of studies comparing and relating the public sphere to the "semi-public sphere" of social media (cf. Schäfer et al. 2017, Schäfer 2017). Yet, previous studies (Binder 2012; Li et al. 2016; Rantasila et al. 2018) have examined transnational reaction to Fukushima accident in English tweets, spread of Japanese tweets containing information about radiation (Aoki et al. 2018), the role of influencers in Japanese Twitter after the Fukushima accident (Tsubokura et al. 2018) and Inako (2019) studied professional tweeters and their impact on recipients in Japan.

Hence, considered to be a first step towards cross-media analyses, the focus of this study lies on differences and convergences between the mass media (the Yomiuri Shinbun) and social media (Twitter) regarding the nuclear discourse in Japan, the notion of "nuclear phase-out" in particular, namely, its contexts and framings across media between 2011 and 2014.

In particular, the article will address the following questions:

How did the discourse in reporting about nuclear phase-out changed in different media and over time?

What are the differences in the framing/contextualization of "nuclear phase-out" in different media?

Is it possible to identify changes and/or unilateral or bilateral influences between different media regarding the framing or connotation of "nuclear phase-out" over time?

(2) Corpus collection

We gathered the data for our analysis from a database of the conservative Japanese newspaper the Yomiuri Shinbun and from Twitter. Originally, it was planned to purchase data from the liberal newspaper Asahi Shinbun as well. However, the Asahi does not offer data for research outside Japan, hence we are still working on a solution to this issue. Our Twitter collection comprises a 10%-sample of all tweets from the relevant period (2011-2014). Since we were more interested in finding out about the choice of words in the discourse of nuclear phase-out in general and over time, we have included all articles regardless of its journalistic genre (e.g. report or editorial, for instance). Both corpora we used in our analysis were built by using a list of words relating to either the term “phase-out”³ itself, or to “anti-nuclear”⁴ vocabulary, including hashtags:

脱原発, #脱原発, 脱原子力, 原発停止, 減原発, 卒原発, 原発ゼロ, #原発ノー, 原発を廃止, #nonuke, #stop_genpatsu, #no_nukes, #nonukes, #611nonuke, 廃炉, #hairo, #廃炉, 反原発, #反原発, 原発反対, 反原子力; 再稼働反対, #再稼働反対 (nuclear phase-out/# nuclear phase-out, stop NPP, reduce dependence on NPP, graduate from NPP, zero nuclear, #no NPP, stop NPP, #nonuke, #stop_genpatsu, #no_nukes, #nonukes, #611nonuke, decommissioning, anti-nuclear, against NPP, against restart)

In our corpus, we excluded duplicates (most likely sent by bots, thus causing a potential overrepresentation of certain trends) and identical re-tweets (cf. Schäfer et al. 2017).⁵

Despite the total amount of data in the Yomiuri remained stable throughout our research period, the Yomiuri corpus in 2012 is more than twice as large than in 2011, whereas in 2013 as well as in 2014 our corpus with nuclear phase-out related vocabulary shrank considerably. Moreover, the Twitter corpus for the year 2014 consists of only 36,723 words and as many near-duplicate messages, hence it is not large enough for a representative analysis:

Table 1 Total amount of words in corpora by year

Corpus	2011	2012	2013	2014
Yomiuri	668,416	1,652,904	623,351	622,078
Twitter	5,250, 466	1,504,197	591,483	36,723

The collected corpora were processed using the Japanese morphological analyser and POS tagger MeCab and the ipadic-neologd dictionary (Satou, Hashimoto, and Okumura 2017), which splits Japanese texts into

³ Despite the 廃炉 *decommission* term semantically relating to the phase-out theme, it was not included into search terms for the Yomiuri corpus because it links to news of technical issues of nuclear power plant decommission that were also discussed before the Fukushima accident, and the focus on technical issues remains throughout the investigated period. However, in the Twitter corpus 廃炉 *decommission* is used differently than in the Yomiuri corpus.

⁴ The search terms include anti-nuclear-related vocabulary, assuming that Twitter contributors use anti-nuclear movement terms and phase-out terms interchangeably as opposed to the press coverage. This assumption is partially confirmed by a study on the anti-nuclear movement after the Fukushima accident (Satoh et al. 2014), which concluded that the variety of new terms such as 脱原発依存 *withdrawal from dependency on nuclear energy*, 卒原発 *graduating from nuclear energy*, 減原発 *reducing dependence on nuclear energy*, 縮原発 *reducing dependence on nuclear energy* caused confusion in meanings in literature.

⁵ Despite the Twitter data being filtered to exclude social bots, retweets with added commentaries and slightly modified retweets using different symbols or links to different websites were identified as unique and added to the corpus.

short-unit morphemes. In order to analyse the corpus, a software called CQPweb⁶ was used. CQPweb allows a range of analytical types of analysis to be performed such as keywords, collocation and concordance analysis (KWIC).

3. Methodology

The study relies on techniques central to the field of corpus linguistics: keywords, collocations and concordance analysis.

Keywords are statistically more frequent words in one corpus when compared to another corpus (Scott 2004), giving a compact presentation of the content in which phase-out-related words occur. The keyword analysis in this paper was used to determine words that were significantly more frequent in the Yomiuri sub-corpora and Twitter sub-corpora if compared against the reference corpus. The whole Yomiuri corpus of the same period was used as reference corpus for the Yomiuri, and a sample of general tweets gathered in September 2017 was used as reference corpus for the Twitter corpora. Using the reference corpus of the same genre helps to avoid genre-specific vocabulary. Analysis of keywords in such a way showed the elements of the discourse that remained stable in all periods or specific to one period. Retrieved keywords are represented as the list of words ordered according to the statistic value. For this analysis, the log-likelihood (LL, a measure of significance) value was used. The top 50 keywords were retrieved in each period for each media and grouped by key semantic categories (see Appendix) to identify their use in discourses of nuclear energy and related topics, following the approaches of Baker (2015) and McEnery (2015). The table excludes function words, such as particles, discursive words, reporting verbs and mentions in Twitter.

Collocation analysis helps to clarify and specify the meaning of a search word in a specific context and to identify common ideas associated with the search word, therefore giving indications about the ideological framing of a search word beyond the usage of a certain word to describe similar things (connotation). The idea that the attributes of the collocate provide an insight into the meaning of the node in a given discourse is described as semantic prosody. Semantic prosody is a qualitative approach of collocation analysis in corpus linguistics based on a word's connotation derived from its collocates, that are "positive or negative in their evaluative orientation" (Hunston and Thompson 2000, 38). Louw defined this as the "consistent aura of meaning with which a form is imbued by its collocates" (Louw 1993, 157).

According to John Sinclair, collocation refers to "the occurrence of two or more words within a short space of each other in a text" (Sinclair 1991, 170). However, the most important feature of collocates in corpus linguistics is frequency, thus a more accurate way of defining collocations refers to the fact if the occurrence of a lexical item is more frequent than it is expected by chance within the given window (Stubbs 1995; Baker et al. 2008; McEnery and Wilson 2001). In our case, collocates were calculated within the span of five words to the right and five words to the left (5L5R) of the search word. The LL score was used to calculate the strength of these collocations. For the purposes of this paper 20 most frequent collocates were analysed.

Concordance technique, also known as keywords in context (KWIC), is a list of all occurrences of a search word or phrase with its co-text on both sides. The concordance analysis is a qualitative approach used in corpus linguistics and discourse analysis, making corpus linguistics study more interpretative. Analysis of surrounding co-text of a search word (concordance lines) can reveal not only typical grammatical patterns, a common set of words and phraseologies, but the difference of the meaning of the search word, identify themes and attitude and, more importantly, to reproduce a context (Hunston 2002).

⁶ CQPweb is a web-based corpus interface that allows to search corpora for words and patterns of varying size and perform linguistic analysis by applying various kinds of quantitative analysis.

4. Results and discussion

(1) The transition of “nuclear phase-out”⁷-related terminology across media over time

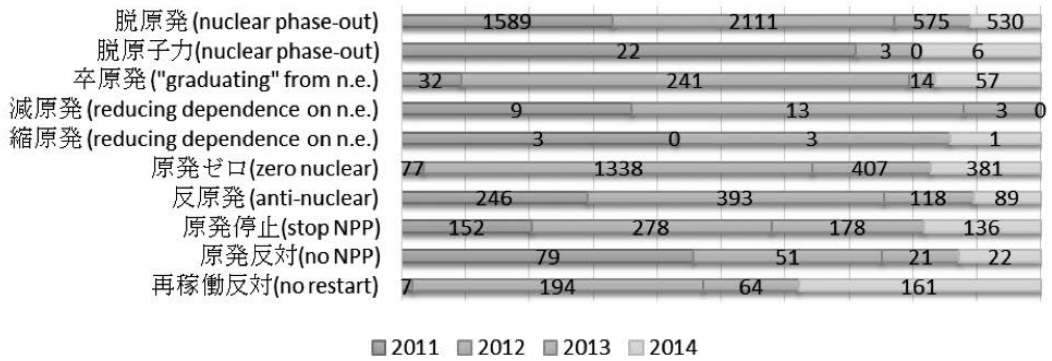


Figure 1 Absolute frequencies of nuclear phase-out-related terms in the Yomiuri in 2011-2014

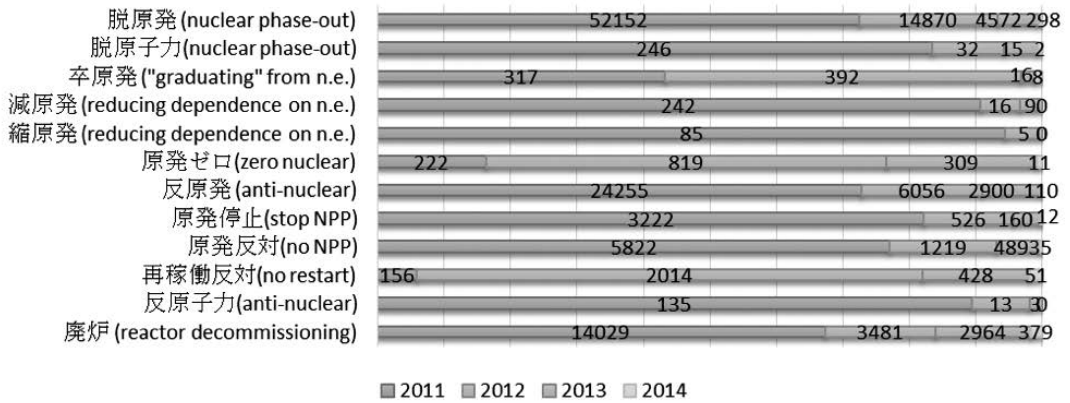


Figure 2 Absolute frequencies of nuclear phase-out-related terms in Twitter in 2011-2014

Figure 1 and Figure 2 summarize the distribution of the nuclear phase-out discourse-related terms used when compiling our corpora over time and across media. In the Twitter corpora, 脱原発 nuclear phase-out keyword ranks number one between 2011 and 2013, giving way to 廃炉 decommissioning in 2014. Furthermore, most of the instances of all terms decline steadily throughout the researched periods in line with the shrinking corpora size. On the contrary, it is already interesting to note the 脱原発 nuclear phase-out keyword never occurs at the top of the keyword lists in the Yomiuri corpus, dropping from rank two in 2011 to five in 2014, whereas 原発 nuclear power plant and (再)稼働 (re)start become more and more frequent. By 2014, (再)稼働 (re)start (in the Yomiuri) and 廃炉 decommissioning (in Twitter) replace 脱原発 nuclear phase-out, clearly showing a contrast between media discourses in the Yomiuri and the semi-public sphere of Twitter with regard to nuclear energy. In the Yomiuri corpus (再)稼働 (re)start keyword ranked two and three versus 脱原発 nuclear phase-out which ranked fifth. In the Twitter corpus 廃炉 decommissioning surpassed 脱原発 nuclear phase-out and ranked first.

The term 原発ゼロ zero nuclear shows an upward trend in 2012 and becomes almost as frequent as 脱

⁷ In this study we use the term “nuclear phase-out” as an umbrella term for the words related to nuclear phase-out and anti-nuclear movement.

原発 *nuclear phase-out* between 2013 and 2014. Other terms used frequently in 2012 include 再稼働反対 *against restart*— being connected to anti-nuclear demonstrations, most specifically with the demonstration on 29 June 2012 against the restart of Ōi NPP in Fukui Prefecture — or 卒原発 “to graduate from NPP”, which is often referenced to Yukiko Kada (leader of the Tomorrow Party of Japan, 日本未来の党), who was one of the first who used it in June 2011 in mass media. However, our data show that this term, in fact, appeared first on Twitter, namely in March 2011 (the beginning of the time frame of our corpus), and in Yomiuri only three months later. カダ *Kada* is also one of the top collocates of the phrase 卒原発 “to graduate from NPP” in the whole Yomiuri corpus. In 2012 Yukiko Kada started a political campaign to run in the general elections in 2012, actively using the term in her campaign to appeal to the users of social media. With the dissolution of the party on May 2013, the frequency of the term drastically decreases in both corpora, which could be taken as proof of the fact that Kada was unsuccessfully trying to actively change the framing of nuclear phase-out during her campaign by using this catchy term.

(2) Keywords analysis

In our keyword analysis, we studied the framing of nuclear phase-out in relation to politics, geography, safety issues, and renewable energy.

As shown in the table in our Appendix, nuclear phase-out occurs predominantly within political discourse in news media, while the tweets reflect citizens’ stances against nuclear energy of protest movements. This lines with the assumption that the predominant functions of social media lie in the ability to engage in the political sphere and to actively participate in and influence decision making (Zappavigna, 2012).

In 2012, the range of themes within each corpus and shared topics between media is notably smaller, with the main themes established in 2011 repeating and evolving over time. The main focus in the Yomiuri corpus is unambiguous and refers to politics, and to elections in particular. The dominance of election-related vocabulary is caused by (a) the general election held on 16 December 2012, (b) the 23rd election of the House of Councillors held on 21 July 2013, (c) the Tokyo gubernatorial election held on 9 February 2014 and (d) the general election held on 14 December 2014. The share of election-related vocabulary in the Yomiuri corpus takes up approximately 60%, suggesting that nuclear phase-out discussion was strongly related to campaign promises of politicians’ manifested in the electoral agenda discourse of the various candidates and parties. In Twitter, the theme of nuclear phase-out correlated with elections, especially in 2012 (Heinrich et al. 2018; Heinrich and Schäfer 2018).

In addition, nuclear phase-out and its various semantic instances were also related to other political issues in both media in 2012-2013, namely other election’s campaign messages like 消費増税 *consumption tax increase*, 環太平洋経済連携協定 *the Trans-Pacific Partnership Agreement* and TPP, 消費税 *consumption tax*, 増税 *tax increase*. This suggests that politicians used nuclear phase-out to attract voters at least in the immediate aftermath of the Fukushima disaster. On Twitter, these keywords link to the agreement or disagreement with politicians or manifestation of users’ consent with a political agenda.

The topic of “restart” became more prevalent in 2012, if opposed to 2011. At that time, protest against this policy grew stronger, particularly assuming shape in the weekly large-scale anti-nuclear demonstrations in front of the office of the prime minister. The salience of this topic is represented by the keywords 大飯原発 Ōi NPP, 大飯原発再稼働 *restart of Ōi NPP*, 関電 KEPCO, and 首相官邸 *Office of the Prime Minister*, linking it directly to the messages of the aforementioned demonstration.

In 2014, the instances of the keyword 脱原発 *nuclear phase-out* declines rapidly in our Twitter corpus. This suggests that the term 脱原発 *nuclear phase-out* disappeared from the Twitter sphere as the protests died away. This tendency can also be observed with regard to the appearance of hashtags related to the protest movement, such as #nonukes or #脱原発 *nuclear phase-out*. In recent scholarship on social movements and the use of social media, hashtags are considered as an important tool for “connective action” (Bennett and

Segeberg 2013). Despite these hashtags were the most frequent in 2014, no single message tagged #nonukes and only 75% of messages tagged # 脱原発 *nuclear phase-out* were connected to the topic of nuclear phase-out.

We will now discuss the different framings of nuclear phase-out across media in the remaining part of our article in detail.

(3) Framing 1: Nuclear phase-out in a political context

An analysis of the keywords associated with political actors helps to understand how key actors changed their terminology regarding an issue, and thus the way in which they frame it politically or ideologically over time. Whereas the mass media is not only an important tool for politicians or the government to communicate their political agenda to the people, but also fulfils the function to criticize or appeal to political actors and thus performs its function as watchdog role in democratic societies, Twitter is also not merely used as an instrument in political campaigning, but as a channel to criticize and raise discontent from the bottom-up perspective of civil society, namely individuals or social movements.

As for the period of our study, the keywords 首相 *prime minister* and 菅首相 *Prime Minister Kan* are associated with nuclear phase-out saliently in both corpora only in 2011. More importantly, however, is the fact that in the Yomiuri corpus the term 退陣 *resignation* together with 正式 *formal*, 即時 *instant*, 居座り *stay put* also linking to this topic are among the top 20 collocates of the keyword 菅首相 *Prime Minister Kan*, hinting at a campaign against DPJ-politician Kan orchestrated by the Yomiuri. Other collocates include 13日 *thirteenth day of the month*, 記者会見 *press conference*, 6日 *sixth day of the month* and 記念式典 *memorial ceremony*, referring to two speeches delivered by Kan on July 13th and on the occasion of Peace Memorial Ceremony on August 6th, in which he demanded a decrease in the dependence on nuclear energy. Already two days after the first event, it was criticized in the Yomiuri that this was allegedly Prime Minister Kan's personal idea, proposed without prior consulting with the government. This suggests that despite Prime Minister Kan being the most active advocate of nuclear phase-out among the heads of the government, in the Yomiuri, his decision was represented as inappropriate, thereby destabilizing the prime minister. Despite Kan's resignation being requested by the politician Takeo Nishioka (西岡武夫) on May 19th, according to the Yomiuri, our data shows that the keywords 退陣 *resignation*, 危機 *crisis* and 失敗 *failure* in the Twitter corpus link to the demonstration held on April 16 entitled “菅首相の退陣、脱原発社会” “*Resignation of the prime minister, nuclear-powered society*” with the slogan “菅首相は危機対応に失敗した責任を取れ!” “*Prime Minister Kan, take responsibility for failing to respond to the crisis!*”.

Despite being a proponent of nuclear phase-out, Kan was also under attack from the Twitter sphere at the time, putting him in an almost impossible position to act properly. Whereas the Yomiuri was getting at him for his allegedly single-handed demand to reduce the use of nuclear energy, Twitter users started to demand the shutdown of the Hamaoka NPP, something he eventually ordered on May 6th 2011. In the Twitter corpus, 浜岡原発 *Hamaoka NPP*, 停止 *stop*, and 要請 *request* are among the most frequent collocates of 菅 *Kan* in 2011. Interestingly, the Yomiuri mentions the Hamaoka NPP for the first time only after Prime Minister Kan demanded its shut down, thus it was not a matter reported by the Yomiuri previous to the shutdown. In the Twitter sphere, an analysis of concordances 菅首相 *Prime Minister Kan* + 浜岡原発 *Hamaoka NPP* show that 11 out of 30 random concordance lines include a positive evaluation of Prime Minister Kan's action, with affirmative phrases such as 英断 *excellent decision*, もっと頑張れよう *let's do more*, 頑張ってください *good luck*, えらい *well done*, 祈る *pray*, やったぞ *he did it* being used in these tweets. By contrast, this decision was accompanied more saliently by criticisms of editorial writers of opposing politicians in the Yomiuri.

In general, as already mentioned, the term of phase-out was more and more disassociated from the political realm in the following years. Thus, 野田 *Noda* co-occurs with the term nuclear phase-out seven times, whereas there are no co-occurrences of Prime Minister Abe with 脱原発 *nuclear phase-out* and only five co-occurrences

with 原発ゼロ *zero nuclear* in our Yomiuri corpora. In those rare cases when Prime Minister Abe co-occurs with nuclear phase-out, the other frequent collocate is 見直す *revise*, hinting at the discontinuation of nuclear phase-out policy. The term 原発ゼロ *zero nuclear* most likely refers to Genpatsu Zero no Kai (Group for Zero Nuclear Power), a trans-party group of politicians that published a list of Japan's most dangerous nuclear reactors in Japan. In the Yomiuri, Abe is quoted as having said the following:

首相は「『原発ゼロ』で電力を安定的に保てるのか。責任ある立場として、ゼロと言うことは出来ない」と強調した。(The prime minister stressed “Can we keep power stable with 'Zero Nuclear'? We can not say that 'zero' is a responsible position.”) (2013/07/21).

Instead, nuclear phase-out is more closely connected to the policies of the Abe administration, particularly the keyword アベノミクス *Abenomics* (economic policies introduced by the Abe administration) appears amongst 安倍政権 *Abe administration* in the Yomiuri in 2013. Collocates of these two keywords suggest an assessment of his policies (評価 *evaluation*, 効果 *results*) and a critical stance towards the policies regarding, for instance, nuclear phase-out of other politicians prior to the upcoming elections (i.e. 批判 *critique* and 副作用 *side effect*), thus creating negative semantic prosody of the keywords. The collocate 良い *good* (30% of instances), which usually has positive semantic prosody, and 景気 *business* (36% of instances) are used in negative constructions in the Yomiuri corpus. The only collocate among the top 20 used positively is 期待感 *hopes*.

On Twitter, 自民党 *LDP* is the only political party mentioned among the top 50 keywords in the Twitter 2013 corpus and is more tightly connected with phase-out on Twitter in contrast to Yomiuri. The first top three collocates 没収 *confiscations*, プラカード *placard*, 関係者 *affiliate* link to the negative reaction to the news “安倍総理の福島演説で原発廃炉プラカードを自民党員が没収” “LDP members seized nuclear decommission placard during Prime Minister Abe's speech in Fukushima” with links to internet media. 自民党 or 自民 *LDP* and 原発推進 *nuclear promotion* are not only strong mutual collocates of each other in 2013 tweets but LDP is the only political party that collocates with 原発推進 *nuclear promotion*. However, that tendency could be observed already for 2012 as well.

The other frequent collocates include 勝つ *win*, 大勝 *great victory*, and 圧勝 *clear victory*, which appeared on the next day after the results of elections were announced. On the whole, such words have discourse prosody to refer to positive events. But in the Twitter corpus, they rather evoke a negative prosody evaluation, linking it to the questions why/how LDP was able to win despite being pro-nuclear. The negative appraisal of the news was highlighted with particles and phrases such as interactional particles だろう / でしょう with the meaning *isn't it right?*, の + ? (sentence-final particle, imply question), が信じられない *I don't believe that*, 間違いないでしょう *no doubt, right*, 疑問を放置 *leave questions*, に対して *against* or to discontent with the results of the elections conveying feelings of sadness and anger. Regarding the grammatical patterns used in tweets, such messages aimed not just to show the frustration, negative affect and judgments of the users, but also aimed at creating or maintain an online community by means of phatic communication (Miller 2008) of anti-nuclear and like-minded people for “connective action”. The same is also true for two other frequent collocates in the Twitter 2013 corpus, namely 落とす *let fall* and 公式 *official*, often being accompanied by hashtags such as #自民を落とせ #脱原発 #let fall LDP #nuclear phase-out, even when the message itself did not contain nuclear energy-related information.

(4) Framing 2: nuclear phase-out in a geographic context

Keywords belonging to the semantic category *country* and *region* can give an idea of the spatiality or dissemination of the term nuclear phase-out and how its geographical context shrank from the international to the local. In the first period, both media referred to the conditions in other countries, particularly Germany. The term ドイツ *Germany* is among the top 50 keywords in the Twitter 2011 corpus (ranked 43, compared with Yomiuri: 85). It is argued that it was particularly the critical coverage of the Fukushima accident in Germany's mass media that played a great role in mobilizing for anti-nuclear protests, something Gono'i (2015) has

described as “boomerang effect”. Despite ドイツ *Germany* not being among the top 50 keywords in Yomiuri, it is a strong collocate of 脱原発 *nuclear phase-out*.

In both media, Germany often appears as collocates of スイス *Switzerland* and イタリア *Italy*, namely countries in which the Fukushima accident led to a significant political change regarding nuclear energy, as opposed to, for instance, フランス *France*, a country that decided to continue nuclear energy usage. Moreover, a closer look at concordance lines reveals some differences in media. In the Yomiuri, the collocates 国内 *domestic*, 2022年 *2022*, 決める *decide*, 事故後 *after the accident*, 17基 *17 reactors*, 全廃 *complete decommissioning* refer to the debates in Germany on domestic energy issues. Furthermore, Germany colligated with the exemplifying particle など *and so on* (in 77% of cases), のような *like* (in 100% of cases), coordinate conjunction や *and* (in 50% of cases), setting Germany as a bad example with further commentaries regarding the consequences that countries, which decided to phase-out, were going to face in the energy market. This suggests that the Yomiuri was trying to save the face of nuclear energy by framing it as an economically vital source of energy.

On Twitter, geographical collocates can be grouped in three semantic sets: (a) countries with a strong public opinion leaning towards phase-out, (b) countries that had large-scale demonstrations, or (c) where nuclear phase-out was turned law. Hence, if appearing together with スイス *Switzerland* and イタリア *Italy* Japan is placed in a group with countries phasing-out or seen as a country where nuclear phase-out is discussed as a desirable outcome. However, this is most prevalent in the case of Germany, where grammatical patterns following the keyword ドイツ *Germany* suggest that the users were taking Germany’s course as an ideal model (such as the exemplifying particle など *and so on* (in 50% of instances), the coordinate conjunction や *and* (in 76% of instances) and with the meaning “like”, “in a manner” (のような / のように (in 75% of instances), の様に (in 88% of instances), みたいに (in 80% of instances) and 見習う *follow the example* (in 64 % of instances). Below is one example of this pattern:

Twitter: 代替エネルギー（太陽光、地熱、風力、バイオマス）は脱原発の決め手にはならないが、シフトすべき。決め手じゃないからやる価値がない、などという話でもない。原発はトータルコストが掛り過ぎる。ドイツに見習おう。日本はこの分野で遅れ過ぎた。省エネニッポンは、もう過去の話。京都議定書は見直せ。(Alternative energy [solar, geothermal, wind, biomass] is not the deciding factor for nuclear phase-out, but it should be shifted. It is not about being not worthwhile because it is not a decisive factor. The nuclear power plant takes too much total cost. Let’s follow Germany. Japan was too late in this field. Energy saving Nippon is in the past. Review the Kyoto Protocol.) (2011/04).

In general, international references of this kind became less significant in the subsequent years from both media, thereby leading to a strong re-localization of this event and its global consequences in Japan and thus also a collapse of a formerly transnational protest movement.

(5) Framing 3: Nuclear phase-out and safety

As was mentioned earlier, the Yomiuri framed nuclear energy and Japanese NPPs as *safe* and *reliable*. Despite inquiries of the Fukushima accident that revealed numerous flaws in the safety of Japanese NPPs, pro-nuclear ideology still permeates the agenda of Yomiuri articles. This is clear from the safety-related vocabulary which includes 安全性 *safety*, 安全 *safety*, 安全対策 *safety measures*, which all share common enhancement-related vocabulary such as 強化 *strengthening*, 高める *enhancement*, 最優先 *top priority*, 向上 *improvement*, 新基準 *new standard*, 世界最高 *best in the world*. Furthermore, 安全 *safety* in the Yomiuri corpus is connected to reports or references of expertise by the International Atomic Energy Agency (IAEA) and conferences regarding the strengthening of safety measures, framing Japan’s involvement as (a) having learned its lesson and obligation to learn from the accident and (b) making a contribution to international safety measure development. Below is one example belonging to this group:

Yomiuri: 野田首相が原発事故の早期収束と、原子力の安全利用を国際公約として表明した。事故から得られた教訓を生かし、世界の原発の安全性向上に貢献することが日本の責務だ。(Prime

Minister Noda declared the early resolution of the nuclear accident and the safe use of nuclear energy as an international commitment. It is Japan's responsibility to contribute to improving the safety of nuclear power plants around the world by learning lessons from the accident (2012/08/06).

Tweets containing 子供 *children*, 守る *protect*, 危険 *dangerous* as collocates of nuclear energy emphasize the perspective of the victims and potential dangers of nuclear power. Thereby nuclear energy is framed as a runaway technology (Gimson and Modigliani 1989), with nuclear phase-out as the only means of rescue. By contrast, public safety issues do not appear in the Yomiuri corpus as top-ranking keywords.

Another keyword in the Twitter 2014 corpus which contributes to the runaway framing is 噴火 *eruption*, which links the dangers of nuclear energy to the eruption of Mount Ontake in September 2014. Thereby, this incident revived the anti-nuclear discourse by reminding that tectonic and volcanic situation in Japan poses a direct threat for the safety of NPPs. In particular, the volcanic activity is collocating with the restart of 川内原発 *Sendai NPP* located in Kyushu, which is an area with an active volcano. However, the term 脱原発 *nuclear phase-out* is rarely used in 2014 in this case, instead, words and phrases such as 廃炉 *decommissioning*, 原発止める *stop NPP*, 原発反対 *against NPP*, 再稼働反対 *against restart* appear more often, allowing the assumption that a total withdrawal from the use of nuclear energy is not very prevalent in 2014 even in the Twitter sphere. Moreover, this case shows very vividly as well as the fact that the formerly international and transnational proportions of the Fukushima incident had already shrunken to the level of the national (Japan) or even local (a plant in Kyūshū).

(6) Framing 4: nuclear phase-out and renewable energy

Renewable energy as a theme appears in the top collocates only in 2011. The representation of renewable energy reveals another aspect of preparedness for nuclear phase-out. The most frequent collocates shared by keywords 再生可能エネルギー *renewable energy* and 自然エネルギー *natural energy* in both media belong to growth- and promotion-related vocabulary (導入 *introduction*, 普及 *spread*, 拡大 *expansion*, 開発 *development*, 増やす *increase*, 利用 *use*, 活用 *application*, 推進 *promotion*, 促進 *facilitation*), representing alternative energy as a developing field.

Other collocates, such as 特措 *special measure*, 買い取り *purchase*, 義務 *duty*, 電力会社 *power company*, refer to the introduction of 再生可能エネルギー特別措置法 *the Renewable Energy Special Measures Law*, discussed in the Yomiuri. Furthermore, the Yomiuri often refers to the share of renewable energy in Japan's energy mix (割合 *percentage*, 占める *account for*, 量 *amount*, 比率 *ratio*) and its costs (コスト *cost*), framing alternative energy as energy that is economically inefficient and not developed enough to replace nuclear power. Thus, the share-related vocabulary often co-occurs with phrases reporting the small share of alternative energy, e.g. わずかに約1% *barely about 1%*, 約1%にすぎない *no more than about 1%*, 1%程度にすぎない *no more than some 1%*. The term コスト *cost* co-occurs with quantifying vocabulary such as 高い *high*, 何倍もの *multi*, 下げる *reduce*, 低下 *cut down*, creating negative prosody around renewable energy in the nuclear phase-out discourse, as the following example from the Yomiuri shows:

Yomiuri: 火力発電は地球温暖化対策と逆行する。風力などの自然エネルギーは何倍ものコストがかかり、現状では安定供給は困難だろう。(Thermal power generation goes against global warming countermeasures. Wind power and other natural energy cost many times more, and at present, a stable supply will be difficult) (2011/06/19).

In Twitter, collocates contributing to the soft path frame, refer to energy shift-related vocabulary, such as 転換 *transition*, シフト *shift*, 移行 *change* and colligate with the particle へ, used to indicate a direction, and are linked to messages that support the transition to new types of energy. In addition, collocates such as 100% or 社会 *society* are also to debate on the energy transition. Positive representation of renewable energy of this kind suggests that discourse in Twitter affirms the use of renewable energy.

Furthermore, in the Twitter sphere, an analysis of concordances containing 脱原発 *nuclear phase-out*+ 自

然エネルギー *natural energy* showed that when nuclear phase-out occurs as a second left-hand collocate, it is connected to the keyword by coordinating conjunctions, such as と (25% of instances), や (5.2% of instances), および (0.6% of instances) and symbols such as & (13.2% of instances), slash (28.7% of instances), comma (25.9% of instances), used to signify “and” and “all”. Since conjunctions are used to connect words of similar importance in a sentence, 脱原発 *nuclear phase-out* and 自然エネルギー *natural energy* are often referred to as mutually complementary. This becomes obvious from the following example from our Twitter corpus:

Twitter. 脱原子力と自然エネルギー促進でがんばりましょう。緑の社民党でがんばります。(Let's promote nuclear phase-out and natural energy. Go green Social Democratic Party!) (2011/04).

5. Conclusions

To summarize, we can draw the following conclusions from the analysis of the term nuclear phase-out in the Yomiuri and Twitter corpora. First of all, the study shows a decline in the quantity of nuclear phase-out-related terms in both media in the period studied. Furthermore, the study indicates shifts in the ways those terms are framed in different media. This, however, requires further qualitative and in-depth research.

Regarding the framing of phase-out in the political context, the term does not completely disappear over time. However, the focus in the debate regarding nuclear phase-out shifted from criticisms of PM Kan's pro-nuclear phase-out campaign to the pro-nuclear political campaign of the Abe government and voices criticizing his stance. Our keywords and collocational analysis show no significant link between the term nuclear phase-out and PM Abe and his policy in 2013-2014 in the Yomiuri, whereas in the Twitter sphere disagreement with Abe and LDP was more salient. In addition, we also argued that users on Twitter used the medium to maintain a phatic communion by sharing certain paroles to create connective action.

Regarding the geographical context of nuclear phase-out, we have shown that the contextualization of the Fukushima incident and nuclear phase-out is narrowed from an international political contextualization to the very regional (Fukushima) or even local (e.g. the precarious location of certain NPPs). In 2011, the pro- and anti-nuclear political stance (Kan and Abe) was affirmatively or negatively linked to Germany's decision to phase-out. In the Yomiuri, Germany's nuclear phase-out is contextualized with the potential economic effects of such a drastic energy shift (and potentially also for Japan) and its influence on the global energy market, whereas on Twitter Germany's decision is considered as an example that Japan should follow.

Frames regarding the safety of NPPs or alternatives to nuclear energy appear only in the first period of our study. In the Yomiuri, the frame of “peaceful use” is re-framed in terms of Japan's potential international contribution to the development of safety measures of NPPs if the country would continue to use nuclear energy. On the opposite, nuclear energy is framed on Twitter as a runaway technology being dangerous from a social perspective. Furthermore, whereas renewable energy (and the discontinuation of the use of nuclear energy) is seen as having negative economic effects because of the economic insufficiency of renewable energy in the Yomiuri, on Twitter renewable energy is presented as the only alternative to the runaway nuclear technology, thus evoking a soft path framing.

Overall, the Yomiuri is concerned more with economic issues of a potential nuclear phase-out and more straightforward in regard to framing nuclear energy in a positive way in the post-Fukushima period. This is true for all four categories, namely geographical, political, safety, and renewable energy. By contrast, from the result of our analysis of the Twitter corpus, we can say that nuclear phase-out is represented as a necessary step towards a safe future. Germany is often described as a role model in this case. Furthermore, it has become clear that the Yomiuri did not relate to discourses taking place in social media, but continued to reframe social protests in accordance with its pro-nuclear editorial line.

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Ethics statement

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Appendix

Table 2. Top 50 KW in Yomiuri and Twitter corpora in 2011-2014 organized by themes

Theme	2011	2012	2013	2014
Phase-out	Common: 脱原発 nuclear phase-out, 稼働 operation, 再 re-, 廃炉 decommissioning, 停止 stop, 原発停止 stop NPP, 浜岡原発 Hamaoka NPP Twitter: # 脱原発 nuclear phase-out, もんじゅ Monjuyu	Common: 脱原発 phase-out, (再) 稼働 (re)start Yomiuri: ゼロ zero Twitter: # 脱原発 phase-out, 大飯 原発再稼働 restart of ŌiNPP, 廃炉 decommissioning, 原発停止 NPP shutdown	Common: 脱原発 nuclear phase-out, 再 re- Yomiuri: ゼロ Zero Twitter: 廃炉 decommissioning, # 脱原発 nuclear phase-out	Common: 脱原発 nuclear phase-out, 稼働 operation, 再 re-, 川内原発 Sendai NPP Yomiuri: ゼロ Zero Twitter: 廃炉 decommissioning, 原発停止 stop NPP, (# 脱原発) nuclear phase-out
Political actors	Common: 首相 Prime Minister, 菅首相 Prime Minister Kan, 政府 government Yomiuri: 株主 shareholders, 海江田 Kaeda	Yomiuri: 議員 Congressman Twitter: 橋下 Hashimoto	Twitter: 山本太郎 Yamamoto Taro	Yomiuri: 細川氏 Hosokawa, 外添 Masuzoe, 議員 congressman
Political parties		Common: 未来の党 Future party Yomiuri: 党 party, 自民党 (自民, 自) LDP, 民主党 (民主) DPJ, 共産 Communist party, 維新の会 Japan Innovation Party, 新人 newcomer, 陣営 camp; 政党 political party, 維新 restoration Twitter: 政府 government	Common: 自民党 LDP Yomiuri: 民主党 (民主, 民) DPJ, 共産党 (共産) Communist party, 自民 / 自 LDP, 幸福実現党 Happiness Realization Party, みんなの党 Your party, 維新 Restoration party, 党 party	Yomiuri: 自民党 (自民, 自) LDP, 党 party, 共産党 (共産) Communist party, 民主党 (民主) DPJ
Politics	Yomiuri: 転換 shift, エネルギー政策 energy policy, 政策 policy, 原子力政策 nuclear energy policy Yomiuri: 選lections, 知事 governor, 民主党 DPL, 候補 candidate	Yomiuri: 政策 policy, 政治 government, 第3極 a third pole Common: 選挙 elections Yomiuri: 候補 candidate, 衆院選 lower house elections, 新 new, 選挙区 electoral district, 立候補 candidacy, 層 layer, 小選挙区 single-seat constituency, 有権者 electorate, 候補者 voter, 1区 1 st district, 2区 2 nd district, 擁立 support	Yomiuri: 政策 policy, アベノミクス Abeconomics, 安倍政権 Abe administration, 政治 government Common: 参院選 House of Councillors election Yomiuri: 候補 candidate, 新 new, 議席 legislative seat, 新人 new candidate, 現 current, 現職 incumbent, 立候補 candidacy, 改選 re-election, 擁立 support, 無党派層 independent, 元 ex-, 選挙戦 election campaign, 公示 public notice	Yomiuri: アベノミクス Abeconomics, 政策 policy, 安倍政権 Abe administration, 政治 government Common: 候補 candidate Yomiuri: 衆院選 General elections, 都知事選 Governor elections, 選挙 (選) elections, 新 new, 立候補 candidacy, 選挙区 election district, 小選挙区 single-seat constituency, 候補者 voter, 無党派層 nonaligned voters
Elections		Yomiuri: 街頭演説 street speech, 支持層 supporting layer, 支持 support	Yomiuri: 街頭演説 street speech, 支持層 supporting layer, 支持 support	Yomiuri: 街頭演説 street speech, 支持層 supporting layer, 支持 support, 出馬 run campaign, 陣営 camp
Campaign	Yomiuri: 退陣 resignation	Common: TPP Yomiuri: 消費増税 consumption tax increase	Common: TPP	Twitter: 集団の自衛権 right of collective self-defence
Other political issues				

Groups	Twitter: 派 faction/group, 原発推進 nuclear supporters, 反対派 opposition faction Twitter: 東電 TEPCO Yomiuri: 東京電力 TEPCO, 電力会社 electric company	Twitter: 派 fraction, 原発推進 NPP promotion Twitter: 関電 KEPCO, 東電 TEPCO	Twitter: 派 group, 原発推進 nuclear promotion Twitter: 東電 TEPCO	Twitter: 派 group, 原発推進 nuclear promotion Twitter: 東電 TEPCO, 電力会社 electric company
Company	Twitter: 推進 promotion Common: エネルギー energy, 電力 electricity Yomiuri: 依存 depend, 発電 generate	Twitter: 推進 promotion, 原発推進 nuclear promotion Common: 電力 electricity Yomiuri: 経済 economy	Twitter: 推進 promotion, 原発推進 nuclear promotion Common: 電力 electricity Yomiuri: エネルギー energy	Twitter: 原発推進 nuclear promotion Yomiuri: 電力 electricity
Ideology	Common: 原発 NPP, 原子力 nuclear energy, 英国原発 Hamaoka NPP Yomiuri: 発電 generation Twitter: # 原発 (#genpatsu) NPP, もんじゅ Monju, 福島原発 Fukushima NPP	Common: 原発 Twitter: #GENPATSU, # 原発) NPP, 大飯原発 ŌiNPP, 原子力 nuclear energy	Common: 原発 NPP Twitter: # 原発 NPP	Common: 原発 NPP Twitter: # 原発 NPP
Economy	Common: 再生可能エネルギー renewable energy, 自然エネルギー natural energy Yomiuri: 国 country Twitter: 日本 Japan, ドイツ Germany, 福島 Fukushima	Twitter: 日本 Japan, 福島 Fukushima	Twitter: 日本 Japan, 福島 Fukushima	Twitter: 福島 Fukushima
Nuclear energy	Common: 事故 accident, 原発事故 nuclear accident Yomiuri: 福島第一原発 Fukushima Daiichi NPP Twitter: 放射能 radiation	Twitter: 放射能 (# 放射能) radioactivity, 福島 Fukushima	Twitter: 汚染水 contaminated water, 被曝 elimination, 放射能 radiation, 原発事故 nuclear accident	
Renewable energy	Yomiuri: 安全性 safety, 安全 safety, 安全対策 safety measures, 立地 siting Common: 国民 citizens	Common: 国民 citizens		Twitter: 噴火 eruption
Country, region	Common: 原発 anti-nuclear, 原発 要求 demand, 原発 demo, 原発 署名 anti-nuclear demo, 署名 signature, 集会 gathering	Twitter: 反原発 anti-nuclear, # 反原発 anti-nuclear, # 原発 demo, 抗議 protest, 原発 -demo, 反原発 anti-nuclear, 反原発 運動 movement, 集会 meeting, 運動 movement, 官邸 official residence, 首相官邸 office of Prime Minister, 福島 Fukushima	Twitter: 反原発 anti-nuclear, # 反原発 anti-nuclear, # 原発 demo, 抗議 demo, 反原発 運動 movement, 国会 diet, 原発停止 stop NPP, 官邸 Prime Minister office, 福島 Fukushima	Twitter: #nonukes, 反原発 (# 反原発) anti-nuclear, 抗議 demo, 原発 demo, 福島 Fukushima
Consequences	Common: 反対 against Twitter: 反対 against	Common: 反対 opposite Twitter: 反対 anti-	Common: 反対 against Twitter: 反対 anti-	Common: 反対 against Twitter: 反対 anti-
Natural disaster				
Safety				
People				
Actions				
Objection				