



Original research article

# Who cares about Norway's energy transition? A survey experiment about citizen associations and petroleum

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## ABSTRACT

Experts and academics think, write, and talk extensively about energy transition, but can the same be said about the public? A comprehensive move from fossil to renewable energy implies significant structural changes and social consequences, for example linked to employment, mobility, and individual consumption patterns. Consequently, public acceptance of such an energy transition is needed for its success in democracies. However, the extent to which the concept of energy transition is familiar to the public remains poorly understood, and existing methods to gauge public opinion may overestimate the public's familiarity with energy transition pathways. Here we invite randomly selected citizens to write down the words they associate with one of the following: "oil and gas", "energy," and "transition," notably not asking about "energy transition" itself. We collect 3232 textual responses in Norway, a crucial case for both energy supply and transition due to its dominant petroleum industry and hydroelectric power capacity. Overall, topics related to energy transition are not prevalent. Notably, "transition" responses center on reorganization in the workplace and government centralization, while few links are found between transition and energy. Furthermore, we find that associations with the word "transition" in the context of jobs are negative more than positive, suggesting risks related to using the same word for the movement from fossil to renewable energy in public communication. Our findings indicate that the issue of energy transition appears distant for the general public to engage in, compared to the concerns of everyday life and notably concerns connected to employment.

## 1. Introduction

The energy transition required to prevent dangerous human-made global warming is substantial. Notably, fossil fuel consumption needs to decline toward zero this century to retain a reasonable probability of maintaining global average temperatures no more than two degrees above the pre-industrial mean [1]. The necessary energy transitions are, however, likely to affect different groups in different ways and to generate losers as well as winners [2]. In democracies, support by or at least acceptance from key segments of the public is necessary for such large changes to be successfully executed [3]. This holds for both passing and implementing legislation and for citizens' own changes in their energy-related behavior. Nevertheless, the current literature contains very few studies where large population samples express themselves specifically about their views on energy transitions, and to our knowledge no studies where respondents express themselves in their own words. Here we ask to what extent the public is familiar with the concept of energy transition. While energy transition constitutes a topic often discussed by policymakers, industrialists, bureaucrats, and academics, we ask whether it is a topic also recognized and used by citizens.

The aim of our paper is to provide descriptive evidence that may facilitate theory development in sustainability transition research

regarding the social acceptance of energy transition. This field of research has arguably developed into a discipline of its own right over the past fifteen years as the numbers of publications and citations have exploded and an overarching theme has emerged: explaining radical change in socio-technical systems such as heating, buildings, mobility, and food production [4]. The majority of the literature consists of qualitative case studies that highlight features of successful transitions such as niche innovations, weakening of existing systems, and strengthening of exogenous pressures [4,5,6]. It remains unclear, however, whether it is feasible to implement such success factors in systems that are currently not undergoing radical change.

Social acceptability is often mentioned as a potential barrier to sustainability transitions, as policymakers in democracies need popular support in order to gain and maintain legislative power and because it is politically demanding to implement policies that are not acceptable to the public. Yet there is little empirical data on the social acceptance of energy transitions. Our paper contributes to filling this research gap, but we do not ask directly whether Norwegians accept energy transition. We believe that it is appropriate first to ask whether energy transition is something people think about at all, and if so, what their thoughts about energy transition are. Public perceptions may be multi-dimensional, and we want to get the full picture before potentially constructing a one-dimensional scale, e.g., one ranging from low to

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high acceptance.

The study by Ziegler [7] represents one of the few existing quantitative examinations of public opinion directly related to the topic of energy transition. This study finds that acceptance of six policies to promote energy transition in Germany correlates strongly with political identification and environmental values, whereas concerns about cost are relatively weak. Although few other scholars have examined public perceptions of energy transition, there are numerous studies of public perceptions of energy [8,9], energy security [10], and global warming mitigation options [11,12,13,14,15]. Böhm et al. [16] is to our knowledge the study most similar to ours, as they find that Norwegian and German students have only vague knowledge about energy transition pathways, but that they associate affective evaluations with the various elements of energy transition, mostly positive (walking, renewable power) but also sometimes negative (nuclear power, flying less).

Case studies in energy transitions research typically identify factors other than public perception that can encourage or discourage transitions to alternative energy production and consumption. Several studies argue that successful energy transitions rely on policies that support niche actors and generate an electoral basis for broader pro-transitional energy policies [17,18,19,20,21]. Diffusion of technology is mentioned as another important initiator of energy transitions, and development beyond initial stages of transitions is typically described as a path-dependent process [2,18,22]. The political and institutional context may also matter, as scholars find positive correlations between political competition (i.e., the turnover rate in government), bureaucratic policy design, and indicators of energy transition [23,24].

In environmental sociology and psychology, scholars debate the causes of pro-environmental behavior, and point to values, beliefs, norms, and identities that may underpin such behavior [25,26,27,28]. However, it is insufficient to know the levels of acceptance of individual policies, or who prefers what policies, when the task is to identify factors that may increase the overall level of policy acceptance. In order to reach that aim, one must also understand how much attention people devote to energy transitions, their perceptions and imagination related to energy, and how they may (if at all) reason about various energy policy options.

Here we report on a study to map and analyze public associations with or images of three interrelated concepts: Fossil fuels, energy, and the general concept of transition. Specifically, we field a representative survey of 3232 respondents in Norway, asking respondents to write down what comes to mind when they hear or read the words “oil and gas,” “energy,” and “transition.” We avoid asking directly about energy transition as that might lead the respondents to think about an issue that might not come to mind naturally outside the survey setting. We consider Norway as a *most likely case* to study because the country combines an economy dominated by a petroleum sector in projected long-term decline with a renewable electricity sector and a high profile in international environmental cooperation. We base our reasoning on the fact that if energy transition should be on people's minds in any country, it should be so in Norway. The next sections elaborate on the case selection and survey method. In brief, however, we believe that the design is appropriate because it optimizes our chances for getting useful and nuanced responses related to the concept of energy transition, insofar as this topic is present in the minds of Norwegian citizens.

We organize the remaining paper in four sections. First, we expand on our decision to interpret Norway as a most likely case and present the theoretical expectations of our study. Second, we describe the data collection and the methods used in our analyses. Third, we present the results of word counts, structural topic modeling, regression analysis, and sentiment analysis. Finally, we offer recommendations for further research and suggestions for policymakers.

### 1.1. Norway as a most likely case

Previous research has suggested a dualism between the economic and environmental effects of Norway's large oil and gas production (Norgaard, 2006). This dualism is similarly manifested in Norwegian policy where different political parties promote different arguments to move forward in climate mitigation matters. Next to its fossil fuel industry, Norway also has a virtually fossil-free electricity sector, dominated by hydroelectric power. Starting in 2014, a dramatic fall in the international oil price led to a crisis in the petroleum sector, with high unemployment in the regions where the industry is concentrated – notably the west coast. The public debate has subsequently seen an upswing in discussions about transitions away from oil and gas and toward other opportunities for industry and employment. We thus argue that a public understanding of interrelations between fossil fuels, energy and transitions should be present in Norway, if anywhere. This background justifies the selected three words/phrases constituting the main object of investigation in the present study.

One of the reasons for examining the citizens' perceptions of energy transition is that it appears to be a popular concept among politicians and scientists. We want to find out if there is a similar tendency among the public, and we want to know if the public perceives the concept in a similar way as experts and leaders. This paper emphasizes public perceptions, but we also present a simple media analysis to motivate and contextualize our analyses. Such an analysis produces evidence of a lively discussion of themes related to energy and transitions in the Norwegian public sphere. Based on data from the Atekst/Retriever media depository, the Norwegian word for transition, *omstilling*, has grown in use in Norwegian print and online media from fewer than 1000 annually in the 1990s to a peak of almost 15,000 in 2016, at the height of the employment crisis, and back to about 10,000 in 2018. The more specific word *energiomstilling* (“energy transition”) was less frequently used, but saw its highest frequency to date at 206 in 2018.<sup>1</sup> A corpus based on the articles in the largest national broadsheet, *Aftenposten*, in 2016, yielded 374 articles containing at least one form of the word “transition.” In these articles, various forms of the word “oil” occurred 1076 times, versions of “energy” 155 times, and various forms of “climate” 326 times.<sup>2</sup>

Furthermore, Sjøvaag et al. [29] estimate a Latent Dirichlet Allocation (LDA) topic model comprising all digital news articles published by 180 of the largest media outlets in Norway (periods: October-December 2015, 2016, and 2017). Their analysis produces 200 topics, of which “energy transition” is the 98th most prominent, with an average prominence score just below the mean. These various analyses reveal an active discussion of energy transitions in the Norwegian public sphere. What is less clear, however, is the extent to which this discussion also engages the public at large. Political communication research suggests a positive effect of media content on public opinion, in terms of topic prevalence [30,31], and we therefore expect “energy transition” to be a prevalent topic in the minds of Norwegian citizens.

At the same time, the compound “energy transition” (*energiomstilling*) does not appear in the Norwegian government's 2016 white paper on energy policies (*Kraft til endring, Meld. St. 25 2015–2016*). There are 30 occurrences of “transition”; the majority of them are related to energy in one way or another, such as in “transition to a low-emission society” and “transition to a more sustainable energy system”, but none in the direct combination “energy transition”.

<sup>1</sup> Search term: “energiomstil\*”. Sources: Norwegian print media, radio, TV, and online media.

<sup>2</sup> The Antconc software [32] was used, with auxiliary analysis in R. Search terms were “olje\*”, “energi\*”, and “klima\*”.

## 1.2. Expected sub-group variation

As explained in the previous section, we expect Norwegian citizens to report a substantial number of textual responses from all three questions to touch on topics related to energy transition, such as transitions from fossil fuels (notably Norway's oil and gas) to renewable energy (such as hydro, wind, and solar). We also expect answers mentioning issues related to work in the petroleum sector and conflicts between nature conservation and new renewable energy.

Second, we expect variation in sub-topic prevalence to vary according to attitudinal and demographic factors. Overall, we expect respondents with higher education to write more about topics related to energy transition, all else equal, given the complexity of many topics related to energy transition, and given that transition processes are often managed by people with higher education. Respondents who worry more about climate change are also more likely to bring up energy transition when asked about their associations with the three concepts, all else equal.

Relatedly, we expect respondents working in the oil and gas sector to emphasize the negative aspects of energy transition, including the 2014 oil price drop and subsequent fall in employment (cf. [15]). Conversely, we expect respondents who worry about natural preservation to bring up the conflict between petroleum and fisheries, and potentially between wind power and wildlife.

Gender effects could take two directions. On the one hand, women tend to be more concerned about climate change, and may thus be more prone to volunteer energy transition topics in their textual responses. On the other hand, earlier research indicates that women display less trust in technological responses to climate change, all else equal [33]. This leads us to expect that women might bring up topics related to energy transition less often than men, particularly when controlling for concern about climate change.

Finally, we expect variation in the sentiment of textual responses regarding “transition”, as this concept can have negative and positive implications for individuals in different groups of society and along short and long timescales. This expectation is particularly strong for our Norwegian sample because the term “transition” (“*omstilling*”) is used frequently in a variety of contexts in the Norwegian language, describing not only radical change in socio-technical systems, but also firm-level rebuilding, workplace reorganization, and public sector reform. The Norwegian word “*omstilling*” may thus potentially produce connotations that imply more wide-ranging and intrusive changes than the English word “transition.”

The discussion so far leads to the following research questions (RQs):

RQ<sub>1</sub>: To what extent is “energy transition” a prevalent topic in Norwegian citizens’ associations with “oil and gas,” “energy,” and “transition”?

RQ<sub>2</sub>: Is employment in the petroleum industry negatively associated with the prevalence of topics concerning energy transition?

RQ<sub>3</sub>: Is support for policies to increase oil and gas drilling negatively associated with the prevalence of topics concerning energy transition?

RQ<sub>4</sub>: Is higher education positively associated with the prevalence of topics concerning energy transition?

RQ<sub>5</sub>: Is female gender negatively associated with the prevalence of topics concerning energy transition?

RQ<sub>6</sub>: To what extent is “transition” perceived as a positive or negative concept?

## 2. Data and methods

External validity is a potential problem in survey research, and notably in survey research on topics that may not be salient on average in the population. Asking questions such as “How worried are you about climate change?” prompts respondents to think of an issue (in this case “climate change”) that may not otherwise occupy their minds [34]. Consequently, respondents may report strong opinions about

climate change that would not emerge outside the survey setting. Studies of issue salience seek to avoid this problem by asking “issue neutral” questions such as “What do you think is the most important problem facing this country today?” [35]. A potential challenge with this approach in our case is that relatively few people would report energy transition as (one of) the most important political issue for them personally, which limits the potential for analysis.

Our primary objective of the research reported in this paper is to assess the extent to which the idea of energy transition is present in people's minds, and to characterize and explain the content of their expressions related to energy transition. Given the challenges related to external validity, we cannot ask directly whether people are in favor of energy transition or not, or what they associate with the words “energy transition.” Such questions would run the risk of inflating the salience of energy transition in our results.

To address these potential methodological problems, we chose an alternative approach, asking the respondents to report their associations with three concepts that we consider integral to, but not necessarily or uniquely linked to energy transition in Norway: petroleum (“oil and gas”), “energy”, and finally “transition” on its own. Thus, when reading these words, we expect the respondents to express associations with “energy transition” if this issue is salient in their minds.

To examine the implications of our survey design, we consider a final research question, alluding to the policy salience of worrying about climate change:

RQ<sub>7</sub>: To what extent is worry about climate change positively associated with the prevalence of topics concerning energy transition?

### 2.1. Open-ended questions in online survey

To find out the degree of public engagement with energy transition debates, we rely principally on three open-ended survey questions, which invite respondents to freely formulate their answers, both in form and length. This is a choice justified by the fact that when respondents can express their views in their own words, their answers provide richer and more nuanced data than with fixed-response questions, adding great value to knowledge about people's opinion about energy questions [36,37,38,39].

Compared to the use of fixed-response questions, where response alternatives are selected and defined by the researchers designing the surveys, the use of open-ended questions may provide more detailed knowledge about the matter in question [40]. In addition, in their freely formulated answers, respondents can express what is important to them. Thus, we get access to what citizens prioritize to mention, indirectly measuring their issue priorities.

The survey questions were fielded using the Norwegian Citizen Panel (NCP) in its seventh wave, with fielding dates from November 1 to December 1, 2016. The NCP is an online, probability-sample survey platform with participants drawn at random from the Norwegian population registry. Participants are invited to take part in studies two or three times per year. Studies relate to academic research only. The questions relevant to the current study were:

What comes to mind when you hear [the words “oil and gas”]/[the word “energy”]/[the word “transition”]? Please write down the first thing that comes to mind. We welcome all types of answers.<sup>3</sup>

Original wording: *Hva tenker du når du hører eller leser [ordene “olje og gass”]/[ordet “energi”]/[ordet «omstilling»]? Vennligst skriv ned det første du kommer på. Vi ønsker alle typer svar.*

We designed the study so that each respondent received one of the

<sup>3</sup> Question codes are r7km1a, r7km1b, and r7km1c, for the three wording types. The randomization variable has the code r7ran1.

three versions of the question above selected at random. We did so for two reasons: First, we did not want the thought process started in the course of a response to one open-ended question to influence the content of the next open-ended question (see [41], for a discussion of context effects). Second, open-ended questions are demanding on the respondents, who take part in the survey voluntarily, and we did not want to burden them unnecessarily. Thus, rather than posing three questions to each of 1000 individuals, we gave approximately 3000 individuals one question each.

For the analysis, we kept answers with at least three characters, discarding shorter ones. This leaves 3232 textual responses. To ensure respondent anonymity, potentially identifying words or phrases were deleted.

Our survey abides by Sovacool et al. ([42], p. 25) codes of practice for survey data collection since: (1) nearly all Norwegian citizens have Internet access and the Norwegian population registry provides a near-perfect sampling frame; (2) our sample size is close to 1000 (or larger) for each sub-group; (3, 5) we conduct robustness tests using weights based demographic register data; (4) the survey items were exposed to internal peer review in the Norwegian Citizen Panel. Moreover, we answer their call for triangulation of different methods as we use quantitative methods to analyze open-ended textual responses, which are qualitative data.

## 2.2. Fixed-response survey questions

To evaluate our hypotheses related to the role of demographic and attitudinal data, we rely on three additional questions drawn from the Norwegian Citizen Panel.

- *Worry about climate change*: “How worried are you about climate change?”
- *Support for oil industry expansion*: “Consider the statements below. To what extent do you agree or disagree with them: ... We should not allow oil and gas extraction in the area around [the] Lofoten and Vesterålen [archipelago].”<sup>4</sup>
- *Work in the petroleum industry*: “Is your workplace in the oil and gas sector, or closely related to it?”

The response scale for the “worry about climate change” question has five options (very worried – worried – somewhat worried – not particularly worried – not at all worried). The question on oil industry expansion around the Lofoten and Vesterålen archipelago has seven response options (strongly agree – agree – somewhat agree – neither agree nor disagree – somewhat disagree – disagree – strongly disagree), so that high values indicate stronger support for expansion. Finally, the petroleum employment question has three response options (“yes, I work in the oil and gas industry”, “yes, my work is closely related to the oil and gas industry”, and “no”). We recode the petroleum employment responses into a binary variable where the two positive alternatives take on the same value.<sup>5</sup>

<sup>4</sup> Three other statements were included in this battery survey item, and they did not concern climate change.

<sup>5</sup> Question codes are r7dvh\_1 (Lofoten oil/gas drilling), r8bekym (worry about climate change) and a compound of the variables w01\_k24, w03\_r3k24, r4k24, r5km11, r9k24a, r9k24\_1\_1, r6k34\_20, r7k34\_20, r8k34\_20, r9k34\_20 (work in the petroleum sector). Note that not all the petroleum work variables are identically worded, and that in some cases general questions about employment sector are used, see Ivarsflaten et al. [44] for question wordings. The question about worry was given in the wave after the open-ended questions, due to constraints on the number of questions posed to each sub-sample in each wave. We assume that the responses to the question reveal stable attitudes, and thus adopt this variable for our analyses. The correlation between the identically worded questions on worry about climate change in Wave 7 and Wave 8 is .78 (significant at the 99% level), which agrees with our assumption of opinion stability on this question.

## 2.3. Quantitative text analysis: structural topic modeling

To conduct the quantitative text analyses, we make use of word frequency counts and structural topic modeling (STM), a semi-automated quantitative text analysis technique [43]. Instead of relying solely on human coding of the open-ended answers, we base our analysis on recent developments in machine learning based on analysis of textual data allowing for an inductive search for distinct topics in the text corpus. As such, it “allows the researcher to discover topics from the data, rather than assume them” ([43]: 1066).

STM takes documents and data associated with each document – metadata – as input. In our case, each individual textual response is the document and the metadata include a marker of which version of the question was asked (“oil and gas” “energy,” or “transition”) plus demographic and attitudinal data. Based on these inputs, STM suggests topics, presented as clusters of words, based on analysis of which words tend to appear together in a document and which words do not tend to appear together.

STM does not categorize documents into discrete groups, but rather permits multiple membership so that each document can be a member of several topics to varying degrees. Thus, in a model with three topics, a given document may be 75% member of Topic 1, 20% member of Topic 2, and 5% member of Topic 3. The extent to which a document takes part in a topic is called topic proportion or topic prevalence, thus the prevalence of Topic 1 in the present example would be 0.75.

To analyze topic prevalence, we extract the estimated prevalence of each induced topic from the chosen STM model. Using the variables provided as metadata in the estimation as covariates (i.e., question wording (“oil and gas”, “energy”, or “transition”), demographic variables, employment sector and attitudinal variables) we perform regression analyses to uncover patterns in topic prevalence across strata.<sup>6</sup>

## 2.4. Qualitative and quantitative text analysis: sentiment analysis

Based on the outputs of the STM model, we select one topic most clearly related to “transition” and analyze the 100 most representative statements, given the chosen STM model, qualitatively. Three coders then independently classify these according to their content. Four categories are used: positive, negative, positive and negative, and neither positive nor negative. We then produce average scores to generate a picture of the overall sentiment linked to the word “transition.”

## 3. Results

We start by presenting the word frequencies of the responses to each of the three questions as well as the total word frequencies. Then we display the results of our STM model and discuss patterns in topic prevalence in general as well as for three specific topics chosen for their potential significance as bridges between our three open-ended questions. Finally, we present the results of our sentiment analysis.

### 3.1. Word frequencies

The ten most frequent terms across all questions are, in descending

<sup>6</sup> Our topic model processes the original responses in a series of steps including: A) removing generic stop words (such as pronouns, prepositions, copula verbs, and conjunctions) as well as domain-specific stop words given by the question wording (“oil”, “gas”, “transition”, “energy”); and B) removing the least frequent mentioned stubs (frequency below 4). Furthermore, although the STM estimator is not designed to handle survey weights, we can use weights to adjust the topic proportions, regression analyses and word counts. It can be shown that adding weights only leads to minor changes in topic proportions, regression coefficients and word counts. Additional information about text processing in STM is available at <https://www.rdocumentation.org/packages/stm/versions/1.3.3/topics/textProcessor>.



order, “Norway,” “energy,” “change,” “oil,” “must,” “electricity,” “think,” “money,” “new,” and “economy.” When considering the frequency by question, we find that people use different words to describe their associations with “oil and gas”, “energy”, and “transition”. Besides mentioning synonyms for the words in question, which is very common, the respondents refer to economic performance and the environment when associating with “oil and gas”; labor-related terms when associating with “transition”; and renewables or the environment when associating with “energy”.

Among the ten most frequent words in the responses to the **petroleum** question, four relate to the economy: “money,” “economy,” “job,” and “income.” Two relate to the country of Norway, whereas two relate to the environment: “pollute” and “environment.”

For the question about **transition**, some of the most frequent words relate to employment: “job” and “working life.” In 13th place, the first term at least somewhat related to energy appears: “shift” (“skifte”), used in 35 responses, which tends to appear alongside the word “green” (“grønn”), forming the expression “grønt skifte” or “green transition.”<sup>7</sup> The frequency is relatively low, however, at 35 for the word “shift” and 21 for the expression “green transition” in its various forms. This amounts to only two to three percent of the responses to this question.

To what extent do the various key words in each question – oil/gas, energy and transition – appear in the responses across question versions? Table 1 shows that respondents quite frequently return the words used in the question: “energy” is mentioned in 264 or about one-quarter of responses to the question where respondents are asked to produce their associations with “energy.” By contrast, only three respondents mention “transition” in the context of energy, and only seven mention “energy” when asked to associate with “transition.” A somewhat higher number - 54, or about one in twenty - mention “oil” when asked what comes to mind when they hear the word “transition.” This contrasts with only 10 respondents mentioning “transition” when asked to associate with “oil.” In a similar manner, respondents receiving the question about energy are much more likely to write the word “oil” in their responses (175 cases) than the inverse situation where those asked about oil write the word “energy” (70 cases).

### 3.2. STM results

We ran STM on the full sample of texts to discover latent topics in the material. Based on multiple model runs and close reading of representative responses, we found that a selection of nine topics produced the best trade-off between coverage across topic and within-topic coherence. The seven most representative terms, using the frequency-exclusivity (FREX) metric, are given in Table 2, together with suggested labels and topic proportions. We base the labels on the top ten FREX words and the three most representative responses for each topic. An overview of the most representative responses by topic in English translation and Norwegian original is available in Supplementary Table S1.

The most prevalent topics are the ones capturing synonyms with the words in the question: *Energy sources* (variations on “energy”, e.g., “power”) and *Work life changes* (variations on “transition,” e.g., “change,” plus labor-related terms). Moreover, several topics concern the fossil-fueled Norwegian economy (with varying degrees of optimism and pessimism): *Crisis*, *End of an Era*, and *Dependence*. The topic *Alternatives to oil* captures responses suggesting that Norway should seek to become less dependent on oil production, whereas *Fossil-renewable* relates directly to the notion of energy transition in suggesting that Norway should dismantle or change the fossil fuel industry in favor of renewable energy production. The *Lofoten* topic captures responses concerned with a fragile coastal area in Northern Norway, centered on the Lofoten and Vesterålen archipelago, where oil extraction has been

<sup>7</sup> The term “grønt skifte” in Norwegian relates closely to the German “Energiewende” or “energy transition.”

**Table 1**

Key words across responses to each question version.

Question version		Word mentioned in response				Total responses
		oil	gas	energy	transition	
	Oil/gas	201	95	70	10	1110
	Energy	175	3	264	3	1087
	Transition	54	3	7	143	1035

The table lists the occurrence of each word in textual responses to each question version. The total number of responses is 3232.

proposed but not (yet) permitted, and where some of the world’s richest fisheries are located [45]. Finally, the topic *Political/economic changes* captures responses dealing with societal development in general. These results cohere with the word counts presented in Fig. 1.

Fig. 2 illustrates how the topic proportions co-vary with the wording of the question. Topics located in the corners of the triangle capture responses that are predominantly given to specific questions (i.e., “oil and gas”, “energy” or “transition”), whereas topics located closer to the middle capture responses from more than one of the questions. The plot identifies two question-specific topics, *Work life changes* and *Energy sources*, which almost exclusively capture responses to the questions about “transition” and “energy,” respectively. Furthermore, the *Crisis* topic relates mainly to the “oil and gas” question. One can think of these topics as the product of responses by respondents who have very specific associations or images in mind. Perhaps more likely, this relative lack of overlap in responses to the three questions suggests that “oil and gas,” “energy,” and “transition” are independent concepts in the minds of most respondents. That is, the idea of an energy transition rarely emerges spontaneously when people hear about petroleum, energy, or transition. This suggests that much work still needs to be done if one wants to make energy transition a salient concept in Norway.

### 3.3. Exploring prevalence of selected topics

We will here seek to examine to what extent there are specific groups of citizens who are more likely to bring up the three topics that arguably relate the most closely to the concept of energy transition. These are *Crisis*, *Alternatives to oil* and *Fossil-renewable*. The two aims of this analysis are: (1) to examine if topic prevalence varies between different segments of the population, and (2) to examine the correlation between topic prevalence and environmental attitudes. The results we present for non-randomized variables (all variables except Treatment 1–3) should not be interpreted as causal relationships, as we lack measures of potentially influential variables. The presented models are estimated with ordinary least squares (OLS) regression.<sup>8</sup>

Table 3 presents the results of our regression analyses. All predictors except petroleum work and worry are included in the NCP data set for Wave 7 (see footnote 6 for a discussion). Gender, birth year, and region are taken from the Norwegian population registry, whereas the treatment variables, urban/rural residence and education are ordinary survey items in the NCP. Descriptive statistics are available in our supplementary materials (Table S3).<sup>9</sup>

The first three coefficients in each row coincide with the results illustrated in our triangle plot: “Alternatives to oil” is not associated with the transition question, “crisis” is primarily associated with oil and gas,

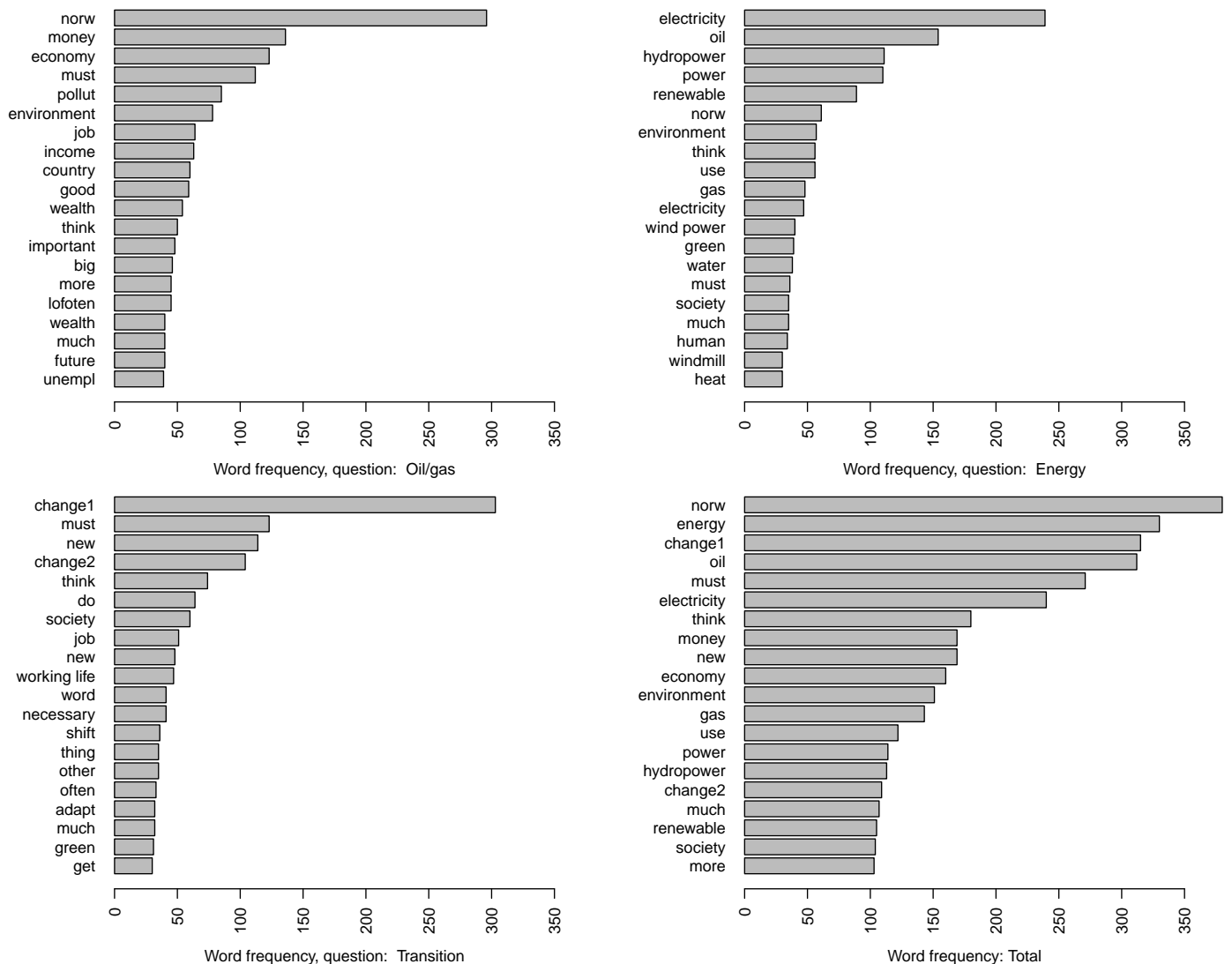
<sup>8</sup> Analyses with survey weights produce highly similar results. Analyses that incorporate “topic uncertainty” (i.e., estimateEffects in R) produce slightly higher standard errors, but the main findings are still similar. These results are available upon request.

<sup>9</sup> The question codes for gender, birth year, region, urban area and education are: r7P1, r7P5\_1, r7P2, r7municipalSize and r7P4\_1, respectively. Notice that our variable ‘urban area’ is a recoded version of r7municipalSize, which treats all municipalities with 60,000 or more inhabitants as “urban”.

**Table 2**  
Topic with suggested labels, proportions, and the most frequent and exclusive terms.

Label	Topic proportion	Most frequent and exclusive (FREX) terms
Work life changes	22.0%	change1, change2, working life, adapt, downsizing, cuts, always <i>endr, forandr, arbeidsliv, tilpass, nedbeman, nedskjær, alltid</i>
Energy sources	18.6%	electricity, power, hydropower, electricity, sun, wind power, water <i>strøm, kraft, vannkraft, elektrisitet, sol, vindkraft, vann</i>
Crisis	10.6%	economy, money, job, wealth, unemployment, welfare, high standard of living <i>økonomi, peng, arbeidsplass, rikdom, arbeidsledig, velferd, velstand</i>
Political/economic changes	10.0%	develop, find, policy, lose, think, see, job <i>utvikl, finn, politikk, mist, mene, sett, jobb</i>
Dependence	9.4%	Norway, important, future, source of income, had, forward, today <i>norg, viktig, framtid, inntektskild, hatt, fremov, idag</i>
End of era	7.4%	country, resource, production, end, take, fund, last <i>land, ressur, produksjon, slutt, tar, fondet, sist</i>
Lofoten	7.3%	pollution, Lofoten [archipelago], Vesterålen [archipelago], exploit, time, sustainable, view <i>foruren, lofoten, vesterålen, utbyg, tide, bærekraftig, sikt</i>
Fossil-renewable	7.3%	consumption, fossil, shall, fuel, should, fuel, car <i>forbruk, fossil, bør, drivstoff, burd, brennstoff, bil</i>
Alternatives to oil	7.2%	environment, extract, alternative, price, Norwegian, use, natural resource <i>miljø, utvin, alternativ, pris, norsk, bruk, naturressur</i>

Results based on the chosen structural topic model with nine topics. Two different Norwegian words for “change” are given: “*ending*” (1) and “*forandring*” (2).



**Fig. 1.** Word frequency by question version. The 20 most frequent words are shown. Stop words and keywords used in the individual questions (“oil”, “gas”, “energy”, “transition”) removed. Note that the figure shows two different Norwegian words for “change”: “*ending*” (1) and “*forandring*” (2). Original Norwegian words are given in Fig. S1.

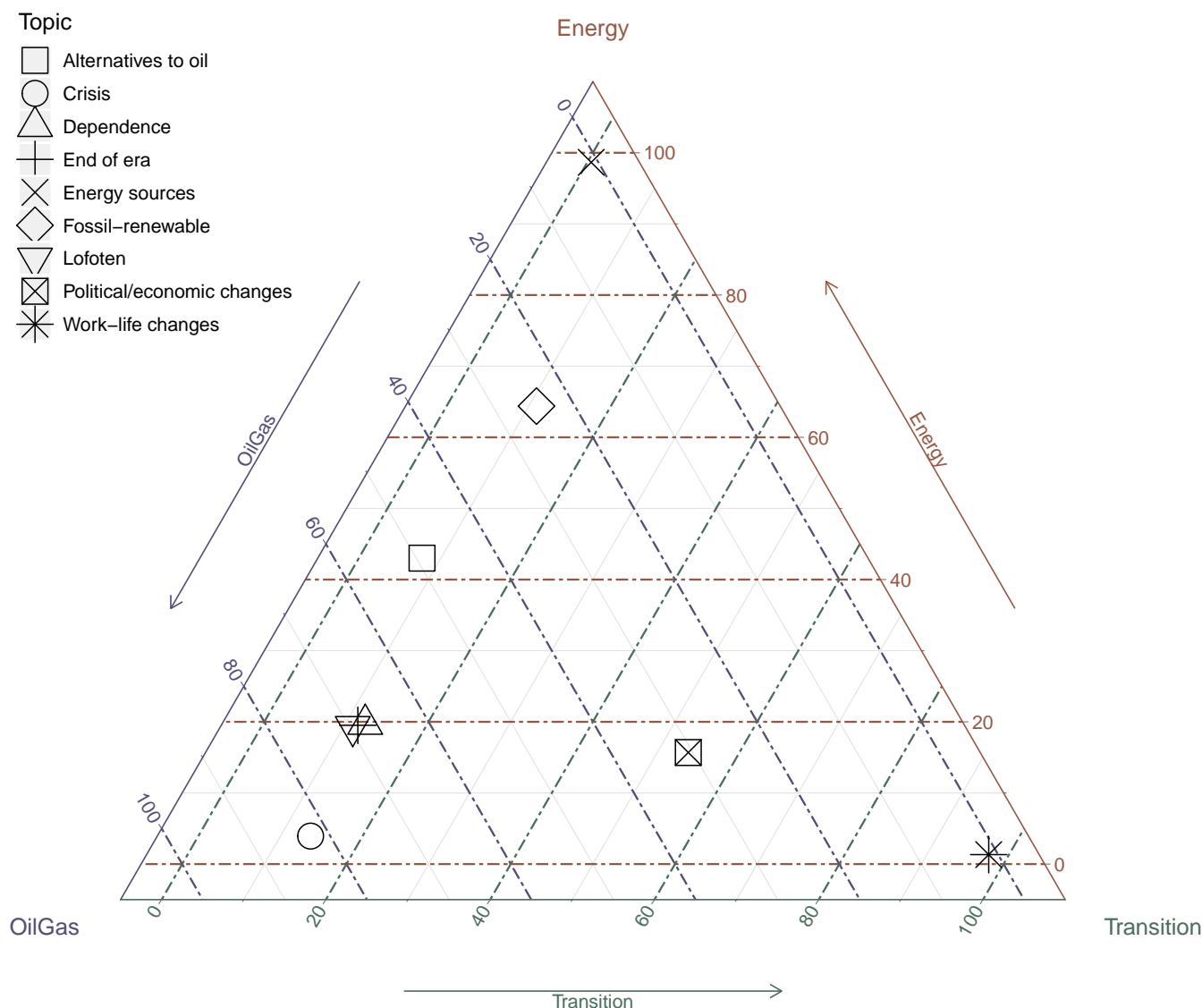


Fig. 2. Triangle plot of topic frequency by question. The numbers derive from the chosen structural topic model run, and are available in Supplementary Table S2. The partially overlapping symbols near the lower left Oil/Gas corner represent the topics Dependence, End of era, and Lofoten.

and “fossil-renewable” is primarily associated with the energy question.

As emerges from Models 1 and 2, younger respondents and those who live in urban areas, mention “Alternatives to oil” more frequently. Conversely, respondents in the oil-rich region of Western Norway, and to some extent petroleum-sector workers, are less likely to offer responses associated with this topic.

The “Crisis” topic is emphasized relatively more by people living in Western Norway, by men, and by individuals in the higher age categories. In Model 4, where environmental attitudes and petroleum work are controlled for, there is also a positive effect of higher education (significant at the 10% level). This result is not very robust, however, as Model 3 shows no such relationship with a higher number of observations (2946 against 1459).

It can be shown that individuals who support petroleum industry expansion into the Lofoten archipelago also show a significantly higher prevalence of the “Crisis” topic (see Model 5 in Table S4). This effect disappears in Model 4, Table 3, possibly because the petroleum work variable has many missing observations and thus lower numbers of observations due to listwise deletion. It can also be shown that individuals who want to protect the Lofoten area are more likely to bring up the “Lofoten” topic, all else equal (Models 11–12 in Table S4).

The third topic of interest, “Fossil-renewable,” is used more frequently by respondents who live outside western Norway, by men, and by rural residents (Models 5 and 6). This topic is also brought up significantly more by individuals who worry more about climate change.

Methodologically speaking, it is reassuring to find a significant relationship between worry about climate change and one of the topics related more directly to energy transition. It is also reassuring that numerical values on the scale item concerning the Lofoten archipelago relate statistically to the prevalence of the induced Lofoten topic. Yet the sizes of the coefficients are relatively small. Moving four points from the lowest to the highest value of the worry variable only increases the prevalence of the “Fossil-renewable” topic by 1.2 percentage points, which is approximately one-sixth of the total prevalence of the “Fossil-renewable” topic (7.3%, see Table 2). Similarly, moving six points from the lowest to the highest value of support for Lofoten drilling only increases the prevalence of the “Lofoten” topic by 1.3 percentage points, which less than one-sixth of the total prevalence (7.3%).

**Table 3**  
Regression analysis of prevalence of selected topics.

	Dependent variable:					
	Alternatives to oil (1)	Alternatives to oil (2)	Crisis (3)	Crisis (4)	Fossil-renewable (5)	Fossil-renewable (6)
Treatment: Oil & gas	9.60*** (0.20)	9.92*** (0.48)	25.80*** (0.42)	26.44*** (0.99)	6.72*** (0.34)	5.16*** (0.82)
Treatment: Energy	8.25*** (0.20)	8.35*** (0.48)	1.79*** (0.43)	1.16 (1.00)	15.58*** (0.35)	14.56*** (0.83)
Treatment: Transition	0.65*** (0.20)	0.77 (0.48)	4.74*** (0.43)	4.09*** (1.00)	3.70*** (0.35)	2.57*** (0.83)
Lofoten: support oil drilling		0.0004 (0.04)		0.12 (0.09)		-0.06 (0.07)
Worry about climate change		-0.07 (0.09)		-0.16 (0.18)		0.31** (0.15)
Work in petroleum		-0.45* (0.25)		0.56 (0.53)		0.16 (0.44)
Gender (1 = woman)	0.04 (0.11)	0.02 (0.15)	-1.22*** (0.23)	-0.91*** (0.32)	-1.67*** (0.18)	-1.56*** (0.26)
Birth year (categorized)	0.25*** (0.03)	0.30*** (0.06)	-0.13* (0.07)	-0.02 (0.13)	0.08 (0.06)	0.15 (0.11)
Education (1 = university/college)	0.09 (0.11)	0.005 (0.17)	0.37 (0.23)	0.63* (0.35)	-0.15 (0.19)	-0.13 (0.29)
Region (1 = west)	-1.41*** (0.12)	-1.35*** (0.17)	1.54*** (0.25)	1.34*** (0.35)	-0.57*** (0.21)	-0.57** (0.29)
Urban area	0.64*** (0.11)	0.50*** (0.15)	-0.13 (0.23)	-0.37 (0.32)	-1.33*** (0.19)	-1.50*** (0.27)
Observations	2946	1459	2946	1459	2946	1459
R <sup>2</sup>	0.90	0.90	0.86	0.88	0.77	0.78
Adjusted R <sup>2</sup>	0.90	0.90	0.86	0.88	0.77	0.78
Residual Std. Error	2.84 (df = 2938)	2.80 (df = 1448)	6.11 (df = 2938)	5.81 (df = 1448)	4.94 (df = 2938)	4.83 (df = 1448)
F Statistic	3163.53*** (df = 8; 2938)	2283.33*** (df = 8; 2938)	968.64*** (df = 11; 1448)	1210.49*** (df = 8; 2938)	464.70*** (df = 11; 1448)	

Note:

\*  $p < 0.1$ .

\*\*  $p < 0.05$ .

\*\*\*  $p < 0.01$ .

### 3.4. Sentiment analysis

We selected the largest topic, *Work-life changes*, for sentiment analysis. Overall, the three coders agreed in 76 of the 100 cases. We found that on average, ten responses revealed a positive sentiment (minimum 7; maximum 13). The top example in this category, judging by prevalence of the *Work-life changes* topic, was “Change something. Make a change from something bad to something better.”<sup>10</sup>

Conversely, 27 statements (min. 23; max. 30) were coded as negative, the highest ranked example being “Negatively charged word, where one has to change something good to something slightly less good.” A majority of these negative responses mention cutbacks or downsizing directly.

Nine responses were coded as both positive and negative on average (min. 6; max. 11), e.g., “A difficult change that needs to be done so that things can get better.” Finally, a majority of 54 statements (min. 51/ max. 57) were classified as neither positive nor negative, as for example the single-word response “change.” Thus, associations with the *Work-life changes* topic are generally more negative than positive.

## 4. Discussion and conclusion

We have used open-ended questions and quantitative text analysis to elicit and map people's conceptions of energy transition. Our analysis provides five key findings.

First, Norwegians rarely use the concept of energy transition when

<sup>10</sup> This response has the highest topic prevalence for the statements that all the coders interpreted as positive.

asked to write down their associations with “oil and gas,” “energy” or “transition.” This finding is robust across the demographic segments of our sample.

Second, there is little crossover between associations with the three terms offered in our questions. That is, responses to each question overlap only to a limited extent content-wise. Responses to the “energy” and “transition” questions are topically the furthest apart. “Oil and gas” responses contain elements related to both energy and transition, but not to a large extent.

Third, and relatedly, Norwegians are more likely to mention “oil” when asked to offer associations with “transition” than the other way around. This suggests that the concept of transition is narrower while oil produces a greater diversity of associations.

Fourth, energy transition is more prevalent but still not strongly present in the minds of individuals who have reported strong worries about climate change. Similarly, the topic of Lofoten oil drilling is significantly more present, but still not very prevalent, in the minds of those who express opposition to petroleum exploration in this area. These findings imply that it is inappropriate to interpret opinions about specific issues as expressions of salience, but we do not have enough evidence to make a decisive conclusion. Future research should go more deeply into analyzing the relationship between respondents' preferences for policy initiatives and their associations with the subject of the policy (e.g., the correlation between support for carbon taxes and the propensity to associate public policy on climate change with carbon taxes).

Fifth, the word “transition” largely evokes associations with the workplace and changes there. These associations are more negative than positive and often include references to cutbacks and downsizing.

We expected to find more responses concerning energy transition, as



there is a substantial amount of attention to this topic in public debates in Norway. However, our findings suggest that the lively discussion of energy transitions seen in Norwegian media and policy documents has limited reach among most citizens. Rather, the concept of energy transition seems to be shared mainly among experts. Other ways of discussing changes in the energy sector seem more prevalent, involving themes such as future alternatives to oil (topic 2) and the idea of a crisis related to employment and the economy (topic 3).

Our findings have implications for future research and for policy. Future research should pay attention to whether and how statements by policymakers, industrialists, bureaucrats, and academics regarding energy transitions are picked up and reused among citizens. For example, does the discussion of energy transitions contain specific characteristics or display a specific style? If so, how do such characteristics affect the effectiveness of communication between citizens, policymakers, and experts? Are certain strata of citizens more likely to adopt transition-related cues by certain specialists, given a certain style of discourse? It may also be useful to examine the relationship between stated preferences and associations in further detail. Controlling for the prevalence of associations with relevant policies or weighting regressions by the estimated relationship between policy preferences and prevalence of associations might improve survey research on political attitudes. In other words, textual responses may indicate salience or priority, which may usefully be added to models of policy acceptance and preferences.

As regards policy implications, the clearest recommendation to be drawn from our results is that the concept of transition (“*omstilling*”) may be an unfortunate choice for public communication about energy sector changes in the Norwegian context. Specifically, negative associations clearly outnumber positive ones in our sentiment analysis, and these negative associations are strongly tied to people's employment situation and thus a major factor in their daily lives. Accordingly, while the concept of “energy transition” may so far have served its purpose for communication among experts, a better term might be sought for the purposes of communicating with the public.

More generally, this finding suggests further research opportunities related to the responsiveness of democracies in environmental and energy policy. The aim of our paper has been to provide descriptive evidence that may facilitate theory development in sustainability transition research regarding the social acceptance of energy transition. A common language – and similar understanding of core concepts among decision-makers, experts, and the public – is important for policy responsiveness. Future research could therefore apply the research questions and methods in this paper to other key concepts in energy policy debates, such as energy efficiency and decarbonization.

#### Data availability

The data and code used in this study are available at the Harvard Dataverse, DOI: 10.7910/DVN/N3WF2P

The data used in this study are also available from the Norwegian Centre for Research Data, DOI: 10.18712/NSD-NSD2606-V1.

#### Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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#### Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.erss.2019.101357](https://doi.org/10.1016/j.erss.2019.101357).

#### References

- [1] M. Meinshausen, N. Meinshausen, W. Hare, S.C.B. Raper, K. Frieler, R. Knutti, ... M.R. Allen, Greenhouse-gas emission targets for limiting global warming to 2°C, *Nature* 458 (7242) (2009) 1158–1162 [https://www.nature.com/nature/journal/v458/n7242/supinfo/nature08017\\_S1.html](https://www.nature.com/nature/journal/v458/n7242/supinfo/nature08017_S1.html).
- [2] A. Cherp, V. Vinichenko, J. Jewell, M. Suzuki, M. Antal, Comparing electricity transitions: a historical analysis of nuclear, wind and solar power in Germany and Japan, *Energy Policy* 101 (2017) 612–628, <https://doi.org/10.1016/j.enpol.2016.10.044>.
- [3] E. Rhodes, J. Axsen, M. Jaccard, Does effective climate policy require well-informed citizen support? *Global Environ. Change* 29 (0) (2014) 92–104, <https://doi.org/10.1016/j.gloenvcha.2014.09.001>.
- [4] J. Köhler, F.W. Geels, F. Kern, J. Markard, E. Onsongo, A. Wieczorek, ... F. Boons, An agenda for sustainability transitions research: state of the art and future directions, *Environ. Innov. Soc. Trans.* 31 31 (2019) 1–32.
- [5] F.W. Geels, F. Berkhout, D.P. van Vuuren, Bridging analytical approaches for low-carbon transitions, *Nat. Clim. Chang.* 6 (6) (2016) 576.
- [6] F.W. Geels, B.K. Sovacool, T. Schwanen, S. Sorrell, Sociotechnical transitions for deep decarbonization, *Science* 357 (6357) (2017) 1242–1244.
- [7] A. Ziegler, "The relevance of attitudinal factors for the acceptance of energy policy measures: a micro-econometric analysis.", *Ecol. Econ.* 157 (2019) 129–140.
- [8] A. Engels, O. Hüther, M. Schäfer, H. Held, Public climate-change skepticism, energy preferences and political participation, *Global Environ. Change* 23 (5) (2013) 1018–1027, <https://doi.org/10.1016/j.gloenvcha.2013.05.008>.
- [9] Steentjes, K., Pidgeon, N.F., Poortinga, W., Corner, A.J., Arnold, A., Böhm, G., Mays, C., Poumadère, M., Ruddat, M., Scheer, D., Sonnberger, M. and Tvinnereim, E. (2017). European Perceptions of Climate Change (EPCC): topline findings of a survey conducted in four European countries in 2016.
- [10] C. Demski, W. Poortinga, L. Whitmarsh, G. Böhm, S. Fisher, L. Steg, R. Umit, P. Jokinen, P. Pohjolainen, National context is a key determinant of energy security concerns across Europe, *Nat. Energy* 3 (2018) 882–888, <https://doi.org/10.1038/s41560-018-0235-8>.
- [11] M.M. Bechtel, K.F. Scheve, Mass support for global climate agreements depends on institutional design, *Proc. Natl. Acad. Sci.* 110 (34) (2013) 13763.
- [12] T. Bernauer, R. Gampfer, How robust is public support for unilateral climate policy, *Environ. Sci. Policy* 54 (2015) 316–330, <https://doi.org/10.1016/j.envsci.2015.07.010>.
- [13] J.A. Krosnick, B. MacInnis, Does the American public support legislation to reduce greenhouse gas emissions? *Daedalus* 142 (1) (2013) 26–39, [https://doi.org/10.1162/DAED\\_a\\_00183](https://doi.org/10.1162/DAED_a_00183).
- [14] R. Shwom, D. Bidwell, A. Dan, T. Dietz, Understanding U.S. public support for domestic climate change policies, *Global Environ. Change* 20 (3) (2010) 472–482, <https://doi.org/10.1016/j.gloenvcha.2010.02.003>.
- [15] E. Tvinnereim, E. Ivarstlaten, Fossil fuels, employment, and support for climate policies, *Energy Policy* 96 (2016) 364–371, <https://doi.org/10.1016/j.enpol.2016.05.052>.
- [16] G. Böhm, R. Doran, Pfister, Laypeople's affective images of energy transition pathways, *Front. Psychol.* 9 (2018) 1904, <https://doi.org/10.3389/fpsyg.2018.0190>.
- [17] M. Huberty, *Energy Systems Transformation and the Political Economy of Climate Change*, University of California, Berkeley, 2013.
- [18] K. Levin, B. Cashore, S. Bernstein, G. Auld, Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change, *Policy Sci.* 45 (2) (2012) 123–152, <https://doi.org/10.1007/s11077-012-9151-0>.
- [19] J. Meckling, N. Kelsey, E. Biber, J. Zysman, Winning coalitions for climate policy, *Science* 349 (6253) (2015) 1170–1171, <https://doi.org/10.1126/science.aab1336>.
- [20] R. Raven, F. Kern, B. Verhees, A. Smith, Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases, *Environ. Innov. Soc. Trans.* 18 (2016) 164–180, <https://doi.org/10.1016/j.eist.2015.02.002>.
- [21] J. Zysman, M. Huberty, *Can Green Sustain Growth?: From the Religion to the Reality of Sustainable Prosperity*, Stanford University Press, 2013.
- [22] F.N. Laird, C. Stefes, The diverging paths of German and United States policies for renewable energy: sources of difference, *Energy Policy* 37 (7) (2009) 2619–2629, <https://doi.org/10.1016/j.enpol.2009.02.027>.
- [23] M. Aklın, J. Urpelainen, Political competition, path dependence, and the strategy of sustainable energy transitions, *Am. J. Pol. Sci.* 57 (3) (2013) 643–658.
- [24] J. Meckling, J. Nahm, The power of process: state capacity and climate policy, *Governance* (2018), <https://doi.org/10.1111/gove.12338> n/a-n/a.
- [25] D. Gadenne, B. Sharma, D. Kerr, T. Smith, The influence of consumers' environmental beliefs and attitudes on energy saving behaviours, *Energy Policy* 39 (12) (2011) 7684–7694, <https://doi.org/10.1016/j.enpol.2011.09.002>.
- [26] S.C. Jagers, J. Martinsson, S. Matti, The environmental psychology of the ecological citizen: comparing competing models of pro-environmental behavior, *Soc. Sci. Q.* 97 (5) (2016) 1005–1022, <https://doi.org/10.1111/ssqu.12313>.
- [27] J. Jansson, A. Marell, A. Nordlund, Exploring consumer adoption of a high involvement eco-innovation using value-belief-norm theory, *J. Consum. Behav.* 10 (1) (2011) 51–60, <https://doi.org/10.1002/cb.346>.

- [28] P.C. Stern, New environmental theories: toward a coherent theory of environmentally significant behavior, *J. Soc. Issues* 56 (3) (2000) 407–424, <https://doi.org/10.1111/0022-4537.00175>.
- [29] H. Sjøvaag, T.A. Pedersen, O.M. Læg Reid, Journalism and the political structure: the local media system in Norway, Unpublished manuscript. (2019).
- [30] C.A. Bail, L.P. Argyle, T.W. Brown, J.P. Bumpus, H. Chen, M.F. Hunzaker, ... A. Volfovsky, Exposure to opposing views on social media can increase political polarization, *Proc. Natl. Acad. Sci.* 115 (37) (2018) 9216–9221.
- [31] G. King, B. Schneer, A. White, How the news media activate public expression and influence national agendas, *Science* 358 (6364) (2017) 776–780.
- [32] L. Anthony, AntConc (Version 3.2.4w) (Computer Software), Waseda University, Tokyo, Japan, 2011.
- [33] D.J. Davidson, W.R. Freudenburg, Gender and environmental risk concerns, *Environ. Behav.* 28 (3) (1996) 302–339, <https://doi.org/10.1177/0013916596283003> Retrieved from.
- [34] R. Tourangeau, K.A. Rasinski, N. Bradburn, R. D'Andrade, Belief accessibility and context effects in attitude measurement, *J. Exp. Soc. Psychol.* 25 (5) (1989) 401–421 Retrieved from <http://www.sciencedirect.com/science/article/pii/0022103189900309> [https://doi.org/10.1016/0022-1031\(89\)90030-9](https://doi.org/10.1016/0022-1031(89)90030-9).
- [35] D.S. Yeager, S.B. Larson, J.A. Krosnick, T. Tompson, Measuring Americans' issue priorities a new version of the most important problem question reveals more concern about global warming and the environment, *Public Opin. Q.* 75 (1) (2011) 125–138.
- [36] A. Leiserowitz, American risk perceptions: is climate change dangerous? *Risk Anal.* 25 (2005) 1433–1442.
- [37] I. Lorenzoni, N. Pidgeon, Public views on climate change: European and USA perspectives, *Clim. Change* 77 (2006) 73–95.
- [38] N. Smith, A. Leiserowitz, The role of emotion in global warming policy support and opposition, *Risk Anal.* 34 (2014) 937–948.
- [39] E. Tvinnereim, K. Fløttum, Explaining topic prevalence in open-ended survey questions about climate change, *Nat. Clim. Chang* 5 (2015) 744–747, <https://doi.org/10.1038/nclimate2663>.
- [40] P. Stoneman, P. Sturgis, N. Allum, Exploring public discourses about emerging technologies through statistical clustering of open-ended survey questions, *Public Underst. Sci.* 22 (7) (2012) 850–868.
- [41] R. Mason, J.E. Carlson, R. Tourangeau, "Contrast effects and subtraction in part-whole questions.", *Public Opin. Q.* 58 (4) (1994) 569–578.
- [42] B.K. Sovacool, J. Axsen, S. Sorrell, Promoting novelty, rigor, and style in energy social science: towards codes of practice for appropriate methods and research design, *Energy Res. Soc. Sci.* (2018).
- [43] M.E. Roberts, B.M. Stewart, D. Tingley, et al., Structural topic models for open-ended survey responses, *Am. J. Pol. Sci.* (2014) 1064–1082.
- [44] E. Ivarsflaten, S. Arnesen, B. Folkestad, E. Tvinnereim, Å.D. Nordø, M.P. Johannesson, ... N. Serdarevic, Norwegian Citizen Panel 2016: Study Documentation, University of Bergen, Bergen, 2016.
- [45] K. Mohn, Arctic oil and public finance: Norway's Lofoten Region and Beyond, *Energy J.* 40 (3) (2019) 199–226.