What is Important for Swiss Stakeholders regarding the Acceleration of Renewable Energy Deployment within the Domestic Energy Supply Subsystem?

(A Case Study with Topic Modelling)

MASTER'S THESIS

Faculty of Science

University of Bern

Presented by:

MEIXI ZHANG

2021

SUPERVISOR: PROF. DR. RALPH WINKLER

Climate Economics: Energy, Technological Change and International Cooperation, University of Bern

CO-SUPERVISOR: DR. PANOS EVANGELOS

Energy Economics Group, Laboratory of Energy Systems Analysis, Paul Scherrer Institute

田径赛马。

Abstract

With Switzerland's ratification of its Long-term Climate Strategy 2050, it has committed itself to achieve net-zero in Green House Gas emissions within this timeline. Renewable energy transition emerges as one of the most crucial pillars for decarbonization. Policies targeting the energy supply sector to promote renewable energy penetration has comprehensive implications that require not only the support of the population but also the stakeholders. This thesis investigates the important drivers for Swiss stakeholders regarding the acceleration of renewable energy deployment domestically.

Topic modelling, as a Natural Language Processing tool, is employed to analyse the stakeholders' position papers and uncover the keywords that define stakeholders' opinions towards the political instruments proposed in the Revision of Energy Law 2020. A top-level modelling is performed, followed by second-level and type-specific modelling. Insights are discovered through the highly-weighted words and clustering of the stakeholders from topic modelling, revealing the key factors stakeholders concern themselves with, based on the energy technology they are involved in or the type of stakeholder they belong to. By considering these fundamental drivers of the stakeholders, policymaking can potentially become more feasible, accepted, and efficient. The novelty and implications of using topic modelling on position papers in stakeholder analysis is discusses for future research.

Acknowledgments

This thesis is performed as part of the project “Swiss Decarbonization Pathways towards Zero CO2 Emissions”—POLIZERO, financed by the Swiss Federal Office of Energy (Research Grant: SI/502149-01).

The contribution made by this thesis is the result of the consistent and excellent supervision of Prof. Dr. Ralph Winkler. His authentic enthusiasm and creative thinking have led the thesis to its fruitful results. It was an absolute delight working with a supervisor with such understanding, empathy and creativity.

I want to thank Dr. Panos Evangelis for his trust and confidence in me. His guidance and expertise helped build the foundation of the thesis and inspired me to further my academic journey in Energy Economics and Politics. His curiosity and passion for different disciplines were nothing but encouraging for me as a student pursuing an interdisciplinary approach in research.

Finally, I am grateful for all my friends and family, who were there to drag me out my room for a coffee, to cook me dinner and to support me through these six months— thank you.

Content

List of Figures

List of Tables

List of Abbreviations

ACF	**A**dvocacy **C**oalition **F**ramework
BAU	**B**usiness **A**s **U**sual
DSV	**D**achverband **S**chweizer **V**erteilnetzbetrieber
ewb	**E**nergie **W**asser **B**ern
GHG	**G**reen **H**ouse **G**as
IGEB	**I**nteressen**g**emeinschaft **E**nergieintensive **B**ranche
JASM	**J**oint **A**ctivity **S**cenarios and **M**odelling
KHR	**K**raftwerk **H**inte**r**rhein AG
kWh	**K**ilo**w**att-**h**our
KWO	**K**raft**w**erke **O**berhasli AG
LDA	**L**atent **D**irichlet **A**llocation
MCMC	Markov Chain Monte Carlo
NLP	**N**atural **L**anguage **P**rocessing
PC	**P**rincipal **C**omponent
PCA	**P**rincipal **C**omponent **A**nalysis
PoS	**P**art-**o**f-**S**peech
PMF	**P**robability **M**ass **F**unction
pLSI	**P**robabilistic **L**atent **S**emantic **I**ndexing
RE	**R**enewable **E**nergy
SES	**S**chweizerische **E**nergie-**S**tiftung
SGS	**S**chweizerische **G**ernia **S**tiftung
STEM	**S**wiss **T**IMES **E**nergy **S**ystem **M**odel
SVP	**S**chweizerische **V**olks**p**artei
SWV	**S**chweizerischer **W**asserwirtschaft**v**erband
SAC	**S**wiss **A**lpine **C**lub
SCCER	**S**wiss **C**ompetence **C**entre for **E**nergy **R**esearch
TGB	**T**echnische **G**emeindebetrieb **B**ischofszell
VUE	**U**mweltgerechte **E**nergie
VSG	**V**erband der **S**chweizerischen **G**asindustrie
VFAS	**V**erband **F**reier **A**utohandel **S**chweiz
VSE	**V**erband **S**chweizerischer **E**lektrizitätsunternehmen
VCS	**V**erkehrs **C**lub der **S**chweiz

1. Introduction

The rejection of the CO2 Law referendum (Bundesgesetz über die Reduktion der CO2-Emissionen) in June 2021 (Bundesamt für Umwelt, 2021) was a major drawback in Switzerland's effort to decarbonize. As a relatively "clean", environmentally progressive, and wealthy country, whose federal council had just passed its Long-term Climate Strategy 2050 for the Paris Agreement on Climate Change in August 2019 (Bundesamt für Umwelt , 2021), the issue of climate change can be tackled comprehensively. The Energy revision law draft (Energiegesetz, 2020) is another legal pillar facilitating Swiss decarbonization. As the CO_2 Law undergoes further revision for a revote, the Energy revision law draft, which determines the future of Swiss renewable energy (RE) promotion instruments from 2030 onwards, is still ongoing, calling for further understanding of the current stance of the issue and perspective of Swiss Decarbonization.

1.1 Relevance of Swiss Stakeholders in the Energy Transition

As part of the Paris Agreement, Switzerland vowed to achieve net zero for Green House Gas (GHG) emissions by 2050. A possible CO_2 emissions trajectory to achieve this commitment is shown in Figure 1, a net-zero long-term scenario quantification with the Swiss TIMES Energy System Model (STEM) within the context of the Swiss Competence Centre for Energy Research (SCCER) Joint Activity Scenarios and Modelling (JASM) project (Panos et al., 2021).

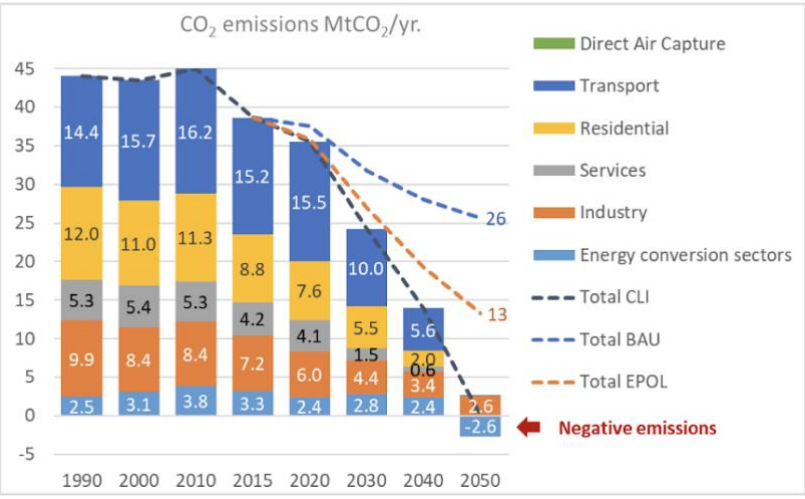

Figure 1. CO2 emissions scenarios from fuel combustion and industrial processes (excluding international aviation) for various sectors with CLI pathway as target pathway

According to the modelling results, all sectors in the core net-zero scenario of STEM must reduce their emissions drastically, with the residential, transport, and service sectors reaching carbon neutrality by 2050. The residual emissions from industry require the deployment of carbon negative technologies to abate them, due to carbon-intensive industrial processes that are difficult to find carbon-neutral substitutes. To achieve the drastic drop in emissions for all energy sectors within 29 years, instruments, such as heavier carbon tax and emission trading implemented in the CO_2 law would not suffice; a fundamental transition in the type of energy that powers our economy is necessary. A cornerstone in the transition is also the deployment of renewable energy in electricity supply (to partially compensate of the gradual phase out of existing nuclear power) and in energy demand sectors.

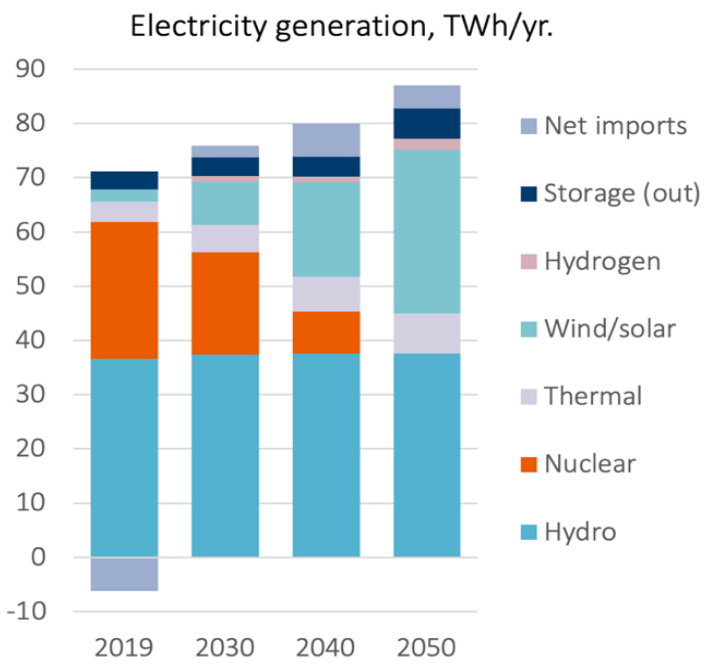

Figure 2. Progression of various energy technologies' electricity generation to achieve net zero by 2050

More specifically, the degree and timeline of the various renewable energy technology expansion is also quantified in the JASM results based on the 2050 net zero goal. Figure 2 indicates an increase of around 96% of renewable energy production by 2050 compared to the current level of existing renewables (Panos et al., 2021). At the same time, nuclear energy production will not be promoted to serve the energy transition, instead it will be fully phased-out according to the 2017 referendum results (albeit with a 42% voter turnout). The gradual phase-out in nuclear energy will demand for further renewable energies' expansion, predominantly in solar and wind energy, to fill the gap.

Such a drastic energy transition calls for the implementation of urgent and sweeping measures. Policies have become a stronger force than ever to facilitate decarbonization pathways, Business As Usual (BAU) is no longer an option. For a policy to be implemented in Switzerland, a

legislative process is in place before the final draft is subject to a popular vote, or a referendum if the law concerns the constitution. An important step during the legislation process, before the proposed law is discussed in the Parliament and the Federal Council, is the consultation phase ("Vernehmlassung"). The consultation phase within the pre-parliamentary process allows the integration of not only the political parties', interest groups' and cantons' opinions into the legislative process, but also any other entity wishing to express themselves. All these opinions are officially written down as position papers ("Stellungnahme") to be considered and to some extent incorporated into the draft, which is later presented to the Parliament and Federal Council. It is worth stressing that the opinions of the participants do not remain symbolic, because they can always mobilize a referendum challenge or rejection of popular vote if no satisfactory compromise during the consultation phase was made at all (Linder et al., 2010). The consultation phase is highlighted in Figure 3 as a key reflection of one of the defining pillars of Swiss consensus democracy— power-sharing (Wolf & Müller, 2010). Power-sharing refers to the distribution of political decisional power to not only the political elite, such as politicians but other entities as well.

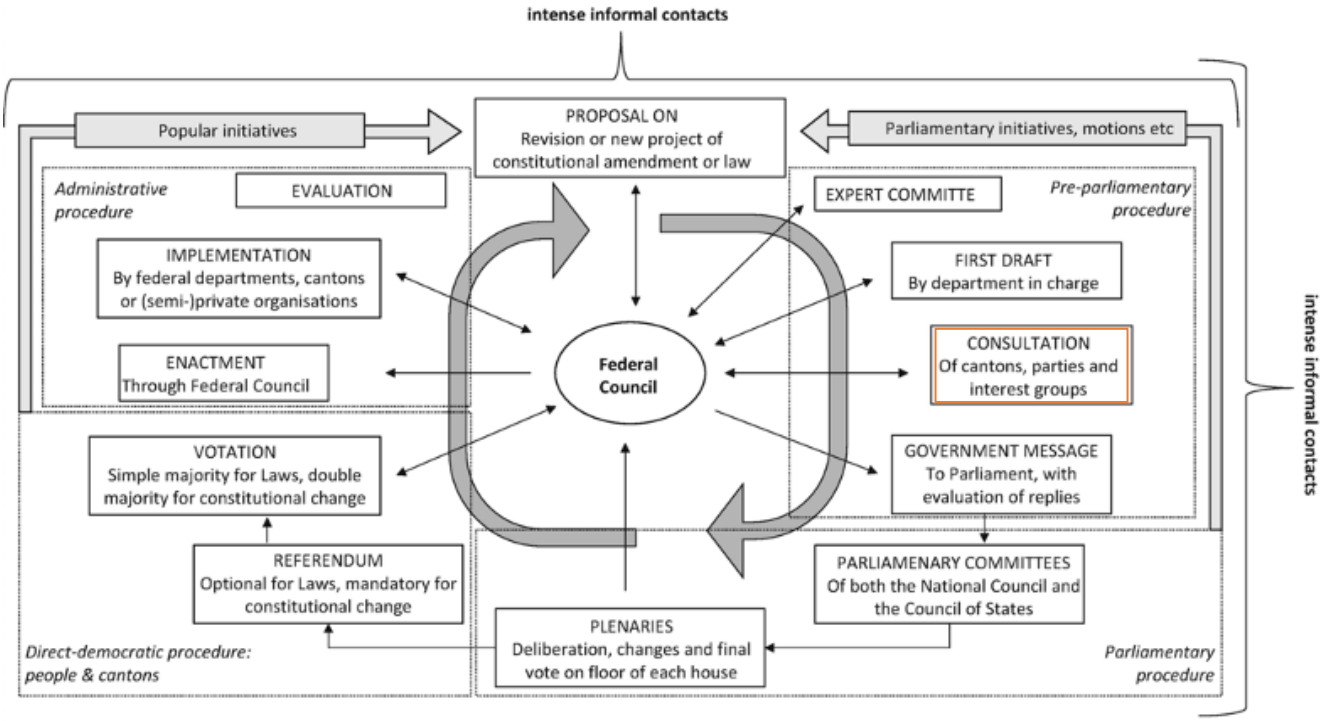

Figure 3. Swiss legislative process and policy cycle, (Wolf & Müller, 2010)

The influential position of these stakeholders during the political decision-making process necessitates a deeper examination of their views and positions to facilitate broadly acceptable policy solutions promoting RE, for Switzerland, by the society. Hence, this thesis seeks to find

the factors which are important to these stakeholders regarding renewable energy promotion policies, leading to the following research question;

What is Important for Swiss Stakeholders regarding the Acceleration of Renewable Energy Deployment in the Domestic Energy Supply Subsystem?

Stakeholders, in this research question, refers to the participants during the consultation phase. Similar to the concept of "elites" defined by Hartmann (2017), stakeholder here is understood as "a social group who as a result of their institutional position or their resources, is able to influence the course of the society or take decisions that are crucial for its development at the national level". Furthermore, stakeholders can be dissected into 3 aspects of being reputational, decisional, or positional (Pappi & Henning, 1998). Though all stakeholders qualify under the criteria of decisional due to their participation in the consultation phase, which is an integral step of policy decision-making; they may differ in significance depending on the extent of reputational influence and the positional power in voting. Subsystem in the research question follows the concept of Sabatier (1998) as "a sort of domain that consists of actors from a variety of public and private organizations who are actively concerned with a policy problem or issue and who regularly seek to influence public policy in that domain."

1.2 Previous Literature and Thesis Novelty

There is an abundance of studies on voters acceptance regarding the Swiss energy transition, ranging from citizen perspectives in terms of policy instrument acceptance (Ingold et al., 2018), consumer attitudes towards the energy transition (Motz, 2021), and tolocal residential perceptions towards wind energy projects (Walter, 2014). However, the voters and individuals, who did not participate in the consultation, do not belong under the stakeholder definition in this thesis, as they are positioned near the end of the legislative cycle—left with only the option of accept or reject and not in the position to influence the legislation during the pre-parliamentary phase.

Recent research has expanded onto stakeholder views as well, yet our understanding towards their views and interests remains relatively limited compared to voters' opinions, despite the vital role the stakeholders play. Conventionally, the investigation of stakeholders utilizes survey data to gain insights into their position about a proposed law. Such a method requires

substantial administrative effort in contacting the right stakeholders and is subject to risk of low response rates often due to stakeholders' institutional barriers when expressing their views. Due to these mentioned drawbacks, surveys are often conducted by pre-selecting the stakeholders to reduce sample sizes for data collection. Moreover, to achieve good response rates, the stakeholders participating in surveys often have trusted relationships with the research teams performing the survey — further limiting the size of the sample. The study of stakeholders' belief towards specific energy policy instruments by Kammermann & Ingold (2019) managed to have a high response rate of around 70%, however, all the stakeholders are from only 3 cantons— Bern, Lucerne, Thurgau. The pre-selection, albeit often justified, reduces the information gained and its research value-added. In Duygan et al (2022)'s study, only 364 stakeholders responded from the targeted 680 organisations. Duygan et al. (2022) also confirms the lack of research on stakeholders due to the limited data and sources on the stakeholders' view provided other than through survey data.

Thus, in this thesis, we adopt a complementary, to some extent alternative, approach in which position papers for the Energiegesetz (EnG) 2020 will be used, instead of survey data, as a source for the stakeholder opinions towards a proposed law. Regarding data on stakeholder views, Switzerland is in an advantageous position due to its consultation phase, which publicizes the stakeholders' official and formal views on a particular piece of proposed law. The particular focus on EnG 2020 is because of the thesis' interest in knowing the most current stances towards renewable energy promotion policies. EnG 2020 mainly substituted feed-in-tariffs for numerous RE technologies with one-time subsidy payments, therefore the opinions specifically towards such a policy shift is concerned of and not the previous energy laws which we know have been accepted. Though position papers is potentially a direct and reliable source of data, they have been rarely used for stakeholder analysis, largely due to its sheer amount of text, which is disproportionately labour-intensive and time-consuming to be processed by humans. In this case, topic modelling, a Natural Language Processing (NLP) methodology using machine learning approaches (Blei et al., 2001) emerges as a suitable technique to process large number of documents in a computationally efficient way and extract insights from them (i.e. the topics the documents contain).

Despite the formal and official nature of the position papers, their validity to reflect stakeholders' opinions and attitudes has come under evaluation. Often interest groups dramatize and exaggerate their sentiments, hardening their stances or even push for more extreme measurements than they deem necessary so that the outcome of the consultation would

still be within their acceptance after being neutralized by opposing views. Ingold et al. touch upon the validity of position papers (2019). The paper discovered clear evidence of differences between the opinions expressed in surveys after the results of the vote and the opinions stated in the position papers during the consultation phase. The paper argued that the differences can be explained either by the instability of policy beliefs as theorized under the Advocacy Coalition Framework (AFC) (Sabatier, 1998) or the stakeholders' active adjustment of their opinions due to social desirability. Stakeholders who did not have their opinions incorporated during the consultation phase or rejected during popular vote, the "losers" as termed by Ingold et al., tend to modify their opinions during the survey to not appear as having been totally defeated. Under the social desirability framework, the position papers remain a reliable source, as the opinions expressed during the surveys can be seen as a reaction towards voting results, while the original position papers are views uninfluenced by social desirability (Ingold et al., 2019). The possibility of policy positions to be not as stable under various frameworks will not be explored as this thesis only focuses on the energy subsystem for the next decade instead of a longer horizon, in which the concept of belief stability would be involved.

Topic modeling has been commonly applied on huge compilation of textual data for clustering and understanding of the themes for published scientific papers (Yau et al., 2014). Yet, its field of application has been expanding and proven versatile; in the marketing field, topic models offer the ability to process large amounts of consumer feedback and comments in order to improve the products. As topic modeling is embryonic in the marketing field (Amado et al., 2018), its adoption in political sciences is also relatively recent, albeit with impressive works conducted; whether it is the detection of political orientation through tweets (Cohen & Ruths, 2021) or political tension over time in the United States Senate (105^{th} to 108^{th}) through plenary speech (Chen et al., 2010), the ability for topic modeling based on Latent Dirichlet Allocation (LDA) (Blei et al., 2001) to uncover the hidden structure and find topical patterns behind massive amounts of textual data is highlighted among all the literature. The application of topic modelling in the Swiss-specific context using position papers to investigate insights of the stakeholders, as this thesis does, has yet to be explored.

By applying topic modeling[1] on the latest Revision of the Energy Law draft[2] in 2020 for all 212 stakeholders' position papers, restriction on the size of stakeholders and the subject of

[1] See section 2 for more details on topic modelling and Latent Dirichlet Allocation (LDA)
[2] https://fedlex.data.admin.ch/filestore/fedlex.data.admin.ch/eli/dl/proj/6020/14/cons_1/doc_1/de/pdf-a/fedlex-data-admin-ch-eli-dl-proj-6020-14-cons_1-doc_1-de-pdf-a.pdf

stakeholder opinions can be lifted. As a Natural Language Processing (NLP) tool, not only can topic modeling process large amounts of textual data more efficiently, the algorithm extracts a combination of the most weighted words that constitute the topics. These words are interpreted as significant drivers that influence the positions of the stakeholders, so as to evaluate the drivers behind the feasibility of successful policies to be implemented in Switzerland. The novelty of this thesis lays on the technique used, as topic modelling for analyzing politics and policy is explored for first time in Switzerland at this scale (under of course time and resource limitations related to a Master Thesis). However, we demonstrate the methodology and highlight the insights that could be gained from it, using the energy law revision draft in 2020 as proof of concept, to inspire further research on the domain of applying machine learning algorithms in better understanding the views and positions of key stakeholders during the legislation process. The proposed methodology has a handful of advantages; the potential to substitute or at least complement survey data and stakeholder meetings by using readily available textual data, the possibility to serve as an alternative clustering method to hierarchical clustering; and the prospect to reduce sample sizes for further research by grouping stakeholders around common topics and selecting representative stakeholder(s) within a group.

We find that stakeholders share some common drivers - security of supply, tenders/auctions, sliding market-premium, self-consumption and costs. By further elaborating in the derived topics additional insights for types of stakeholders are obtained too. For instance, wood-based, waste incineration stakeholders, the farmer associations and the conventionally named Umweltallianz are the most cohesive in their opinions. On the other hand, other energy-based stakeholders have niche frationings, for example, a portion of the solar-based stakeholders targets more on the solar energy production in the building sector and household consumption, and the other group concerns themselves more with the set up of the electricity market model. Wind-based stakeholders and energy utility and production companies are often clustered in the same top-level group but in different subgroups, indicating the niche fractioning. Finally, political parties and cantons are the two types of stakeholders that are scattered in all subgroups without interpretable bases. Complementing these findings with qualitative support, political parties can be understood as a dichotomy between liberal parties and left-wing parties, where the former is fixated on network surcharges and the later focuses on environmentalism in general. The results from cantons and communes are less straight-foward but with the supplement of qualitative research, insights could be drawn such as their strong hold on large-

scale hydropower, call for incentives specifically for winter energy production and the openness to further exploit solar energy.

A handful of methodological and policy implications are derived from this thesis. Topic modelling accompanied with qualitative research can highlight the fundamental drivers of Swiss stakeholders in the current domestic renewable promotion scene. The results help plough through the rhetoric of politics and identify the factors stakeholders deem as important. The clustering of the stakeholders, based on the topics they belong to, provides an alternative model to the hierarchical clustering that is usually used in political science (Kammermann & Ingold, 2019). Based on the clustering, samples sizes can be reduced based by selecting the most representative stakeholder within each subgroup. Nevertheless, there are several points to be conscious of regarding topic modelling, such as the necessity of qualitative research support topic coherence, and human interpretability.

As not all stakeholder needs can be satisfied at the same time, these results assist political compromises by ensuring that the most fundamental points of concern are satisfied from most of the stakeholders.

1.3 Thesis Outline

After the significance of the research question in the context of current literature has been demonstrated, I give the outline of how this question will be approached and the answer unfolded. In the following section, Section 2, topic modelling will be explained as an overall concept initially and dug deeper algorithmically. Its implementation in Python will also be noted on along with the utilization of qualitative research to complement topic modelling results with additional insights (especially related to the sentiment of stakeholders' views towards the identified topics).

The methodology of how topic modelling is adopted in this thesis is also showcased; a top-level topic modeling by using the position papers of all stakeholders is performed first in which stakeholders are also assigned to the identified topics; a second-level topic modeling is followed by applying exclusively to each stakeholder groups produced from top-level modelling individually; resulting in subgroups. A second-level topic modeling is necessary to further accentuate stakeholder drivers on a more granular level as in total 210 stakeholders participated

in the consultation phase for EnG. Complementary to this approach, also topic modeling is performed by focusing on a certain type of stakeholders to understand the drivers behind their expressed positions, particularly for political parties and cantons. The reason for an exclusive topic modeling on political parties and cantons is because they encompass all three aspects of a stakeholder- reputational, positional and decisional; additionally they are more scattered in different subgroups compared to other types of stakeholders. Hence, these significant stakeholders are selected to perform topic-modeling to zoom in on their drivers.

The results from the methodology will be displayed in Section 3 with preliminary comments. These results would be discussed more in depth in Section 4, focusing on the methodological implication of topic modelling as a tool to assess Swiss stakeholder opinions. In Section 5, a conclusion is drawn from the results to synthesis the insights gained and the importance of these insights, in terms of policy implication. Finally, in the last section, Section 6, the outlook of topic modelling in political science is highlighted, particularly in the ways topic modelling can be further used in corpus expansion, other subsystem's analysis, and time series analysis.

2. Topic Modelling as Methodology

To unpack the methodology used, the data chosen will be presented, justified and shown how it is to be pre-processed, followed an illustratation of topic modelling conceptually under the thesis' context. A summary of the algorithmic background of the Latent Dirichlet Allocation (LDA) (Blei et al., 2001) for the comprehension of the necessary hyperparameters involved in this thesis' topic modelling is also provided. The implementation of the modelling in Python is also given in terms of libraries and packages. And finally, the role and importance of complementary qualitative research support is explained.

2.1 Textual Data For Topic Modelling

Position papers from the consultation phase related to the latest Revision of the Energy Law draft in 2020 are used as textual data. These positions are officially compiled, publicized and legally obliged to be made available on Fedlex:Die Publikationsplattform des Bundesrechts (https://www.fedlex.admin.ch/de/consultation-procedures/ongoing). During each consultation phase, the template of the revision draft ("Vorlage"), the explanatory report ("Erläuternder Bericht") and a cover letter are given to the invited stakeholders. The position papers are the most direct source of information on the opinions of the interest groups. Though news outlets and social media could also have constituted a source of information, the position papers contain the most comprehensive and specified opinion on the proposed political instruments. Figure 5 provides an overview of the length of position papers submitted related to the revision of EnG. The median of the number of words in the stakeholder positions is around 1,248 words, the shortest position paper at 18 words, which can be speculated as an abstention, and the longest position paper are at 8,221 words, which is around 17 pages single-spaced. The standard deviation of the position papers length is 1,696 words. The number of words in the position papers potentially reflects the extent of importance the law in question is to a stakeholder.

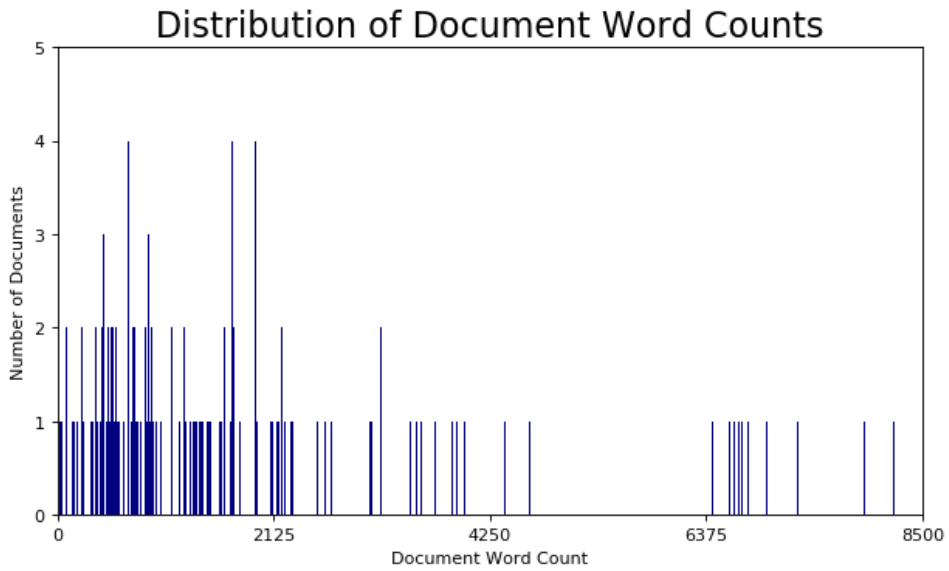

Figure 4. Histogram of document word counts showcasing how many documents have how many words for the EnG position papers

2.1.1 Data Pre-processing

The purpose of data pre-processing is to eliminate parts of text that bring no information under topic modelling, i.e. they should not be considered when the algorithm identifies topics for the assessed documents. This process of elimination involves predominantly the deletion of words that occur with high frequency but reveal little to no information. These words are deemed as stop words. Cleaning out stop words helps reduce modelling "noises" as the high frequency stop words would interfere less with the topics identified by the algorithm producing highly weighted keywords that reveal insights about the "actual" topics discussed in the documents.

Before elaborating further on stop words, basic, and common punctuations are erased, such as:

.	,	*	-	(	)	[	]	<<	>>	;	:	+	/	&	%	?

Additionally, depending on the text, special character combinations are also cleaned. Typically, these only emerge after processing the textual data. Further character and symbol combinations were removed such as:

i.\t	.\t	a/.	±

Capitalization is also removed, and German umlauts are transformed into respective non-umlaut combinations to standardize all the words for the convenience of stop words removal.

With all special characters eliminated, together with invalid combinations of them that could induce difficulties in the identification of whole words, stop words can be treated and removed from the documents. Words such as pronouns, prepositions, conjunctions, and interjections are terms which are generally deemed as stop words. Following the definition of stop words, words and phrases that are specific to EnG or common across all position papers of the stakeholders are also eliminated, such as “sehr geehrte”, “Vorlage”, “Massnahmen” and “Energiewende”. Furthermore, as all the position papers revolve around the same topic— renewable energy promotion policies, it was not surprising that after the first run of the algorithm, there was a handful of overlapping words. In particular, various names of energy technologies emerged, such as biomass, hydropower, photovoltaik, wind energy. These words are not typical stopwords because they bring context and implication towards the topic. However, knowing that all position papers are commenting on the same subject, which are these energy technologies, they no longer bring much value and are therefore eliminated.

The full list of stop words eliminated during pre-processing is displayed in Appendix B, 74,591 words remain in the corpus after removing these stop words.

The 74,591 words are normalized using lemmatization and stemming. The process of normalization is a necessary step in data pre-processing for topic modelling as it helps transform words with the same meaning to become more uniform when they are used by the LDA algorithm in identifying topics, hence refining its results. Lemmatization normalizes the text by reducing inflicted words into their base grammatical forms to be treated as the same word. The accuracy of lemmatization is enhanced by implementing Part-Of-Speech (POS) tagging, which takes into consideration which part of speech the word belongs to, based on its context, and lemmatize respectively. On the other hand, stemming reduces the words to their root grammatical form by merely cutting off the suffixes. Lemmatization is preferred over stemming in this thesis as stemming is a relatively crude and heuristic, while lemmatization considers the morphology of the words based on their part-of-speech.

Finally, synonyms were identified and replaced as one word. Primarily, most terms containing a type of energy technology is substituted by the name of the energy technology, for example, “biomass plants” is replaced by “biomass”. Considering that the topic modelling algorithm applied in the thesis is based on probabilistic approaches for word treatment, words with the

same meaning should be treated as the same for a more accurate weighting of them in the identification of topics. Hence, manual refinement of the position texts using substitution of synonyms is employed.

2.1.2 *Typology of Stakeholders Analysed*

The typology of stakeholders also constitutes an important piece of data in this thesis. The understanding of the characteristics and qualities of stakeholders assists our interpretation of the results. Figure 6 shows that associations as the dominant type of stakeholders that expressed their positions for EnG with at least twice as much of them participating in the consultation process compared to other types of stakeholders.

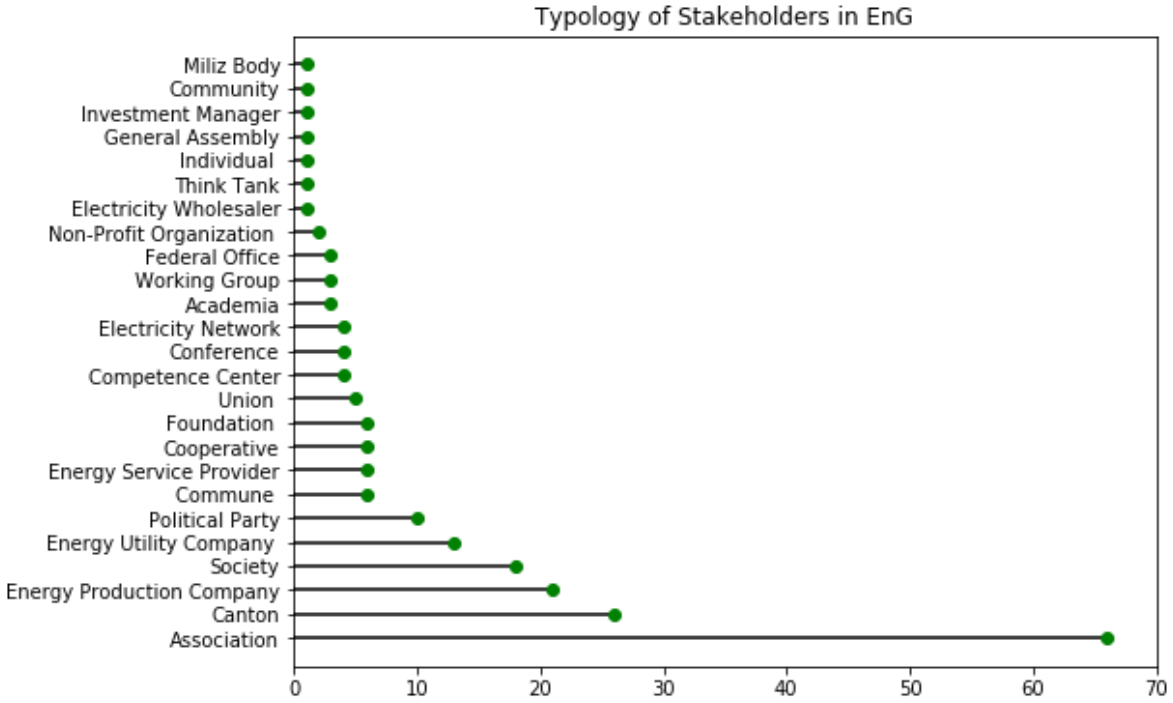

Figure 5. A typology of stakeholders and the extent of their presence for the consultation phase of EnG

Although the 66 associations ("Verbände")[3] are treated as a same type of stakeholder in

Figure 5, they have heterogeneous focuses. Figure 7 displays the various themes these associations concern themselves with; most associations (18% of the total associations assessed) revolve around the overarching theme of energy, climate and landscape; others take specific

[3] see corresponding German terms in Appendix A

interest in a certain energy technology such as waste (9%), hydropower (5%), wood (5%), wind(3%), gas (3%), district heating (3%) and geothermal (2%); some belong to a specific sector such as mobility (9%), building (8%), electricity supply (8%) and industry (6%). Finally, farmer associations (8%) and Chamber of Commerce (8%) have a relatively higher participation compared to the public sector (5%), political consulting (2%) and distribution network operator (2%) associations. The various associations strive to promote their ideologies or interests through different mediums. Energy-based associations, for example, manifest their commitments through promoting a certain energy technology, whether it is through information campaigns, publicity events or political involvement, many also provide technical consulting services on the suitable implementation of this technology for organizations and individuals alike.

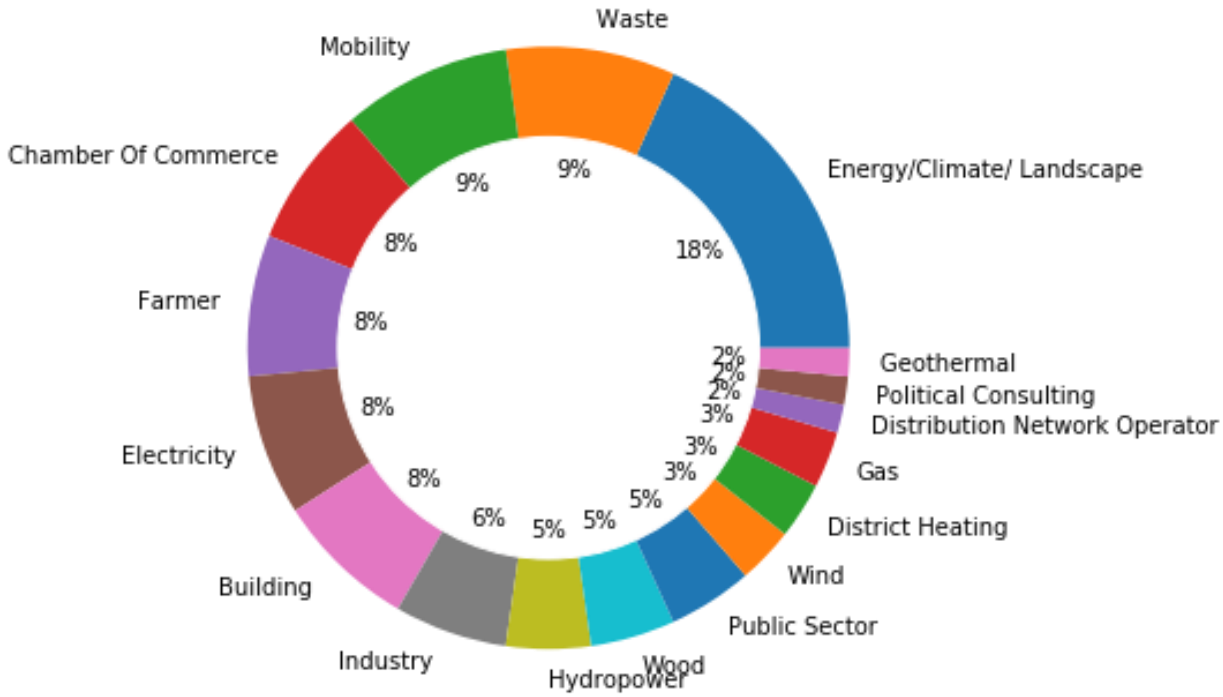

Figure 6. Associations' different interests and focuses in percentage

Societies ("Vereine")[4] are similar to associations in their purpose of promoting certain subjects; whether it is a technology or ideology. With 18 societies involved in the consultation phase of EnG, these stakeholders are defined under Swiss law Art. 60 ZGBt in that they are treated as a legal entity, which can open bank accounts and own its P.O. boxes (Schweizerisches

4 see corresponding German terms in Appendix A

Zivilgesetzbuch, 2017). Though societies and associations both have ideological pursuits, associations can (but not must) have members that are not natural persons but a legal entity, such as a canton or another organization.

All 26 cantons' opinions are included in this consultation, enabling a comprehensive analysis on the cantonal level. Also, six communes participated in voicing their positions. Furthermore, energy production companies constitute a substantial number of consultation participants right after the associations, along with 13 energy utility companies that provide both energy production and services, such as Alqip, Axpo, and BKW.

2.3 Overall Concept of the Topic Modelling Approach

With the textual data prepared, topic modelling is applied to discover the hidden topical patterns behind large collections of documents. As illustrated in Figure 7, through applying topic modelling algorithm on the collection of text documents, several topics are returned. However, the number of topics needs to be predetermined (in the top-right of the figure). The identified distinct topics are clusters of word combinations, which are also returned by the process. In the bottom right-hand corner of Figure 4, clusters of documents by topic is displayed, with each colour representing a different topic and each dot a separate document. The coloured bars represented the documents being classified as under a certain topic while the thickness of the bar indicates the number of documents belong to a certain topic; the thicker the bar the more documents classified under that topic.

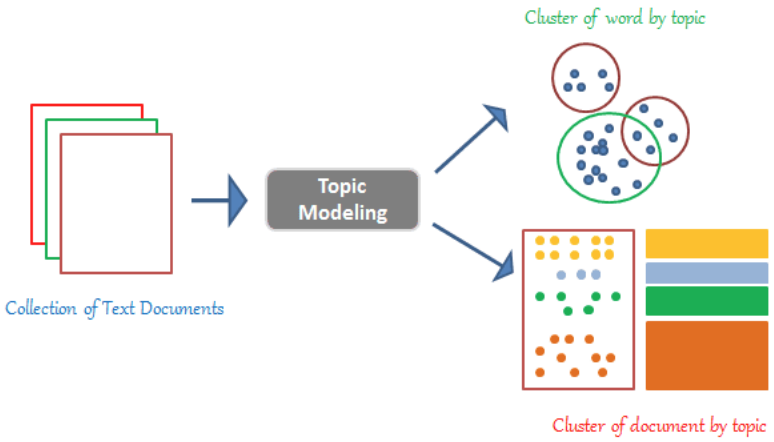

Figure 7. The mechanism of topic modelling in generating words that constitute topics and classification of documents based on the topics (Ma & Chen, 2019)

In the context of the research question of this Master thesis, topic modelling can be ideally utilized by interpreting the words that define a topic as drivers that influence that group of stakeholders, the clusters of position papers, which represents the stakeholders, further reflects stakeholders' interrelations. Unlike in conventional topic modelling where a one-word topic or theme is concluded from the clusters of words in the end to label the documents, for our research a definitive label is of secondary concern. The words under each topic are on their own insightful, as they are treated as individual factors of importance for the stakeholders and not the means to the end goal of labelling.

Topic modelling based on the Latent Dirichlet Allocation (LDA) algorithm (Blei et al., 2001) is chosen to uncover the insights in the position papers of the stakeholders .In the field of information retrieval (IR), there are also a handful of other methodologies such as the popular tf-idf (Gerard & McGill, 1983), latent semantic indexing (Deerwester, Dumais, Furnas, Landauer, & Harshman, 1990) and probabilistic latent semantic indexing (pLSI) modelling developed by the end of 20th century (Hofmann, 1999). However, there are shortcomings of the widely-used tf-idf, such as insufficient description reduction and document structure revelation; on the other hand pLSI has a linear increase of parameters with the increase of the size of corpus and most importantly the probability distribution's applicability on new data sets is weak (Blei et al., 2001). Hence, this paper decides to utilize the generative model nature of Latent Distribution Allocation (LDA) as proposed by Biel et al. to explore the topics of position papers (Blei et al., 2001).

2.4 Algorithmic Overview of Latent Dirichlet Allocation

2.4.1 Basis Assumptions of LDA

Before diving into the formal notations and equations, the basic assumptions of LDA are stated. LDA assumes that documents, in this case position papers, have multiple topics. Each topic is a distribution over a fixed vocabulary. Topic modelling with LDA is a non-supervised topic classification method, which implies that there is no pre-set of manually annotated topics. The topics are generated from the corpus. Nevertheless, the number of topics must be specified beforehand. LDA assumes that similar topics contain a similar group of words.

In a nutshell, the LDA algorithm can be described as follows (Rabindranath, 2021), provided that the Dirichlet distribution is used, and the number of topics has been already specified.

- Step 1: Initialise the algorithm by randomly assigning a topic to each word in each document (in this step the counts of topics in each document (i.e. *topic frequency*) and the counts of words in each topic (i.e., *words frequency*) are calculated)
- Step 2: Update the topic assignment for a single word in a single document:
    - Choose a word in the document
    - Un-assign its assigned topic which was initially used during Step 1
    - Re-assign a topic to word conditional upon all other topic assignments for all other words in all documents by considering:
        - The popularity of each topic in the document (topic frequency) and a Dirichlet-generated multinomial distribution over topics in a document
        - The popularity of each word in a topic (word frequency) and a Dirichlet-generated multinomial distribution over words for each topic
    - Multiply the above popularities to get the conditional probability of the chosen word for each topic
    - Assign to the word the topic with the highest conditional probability
- Step 3: Repeat Step 2 for all words in all documents
- Step 4: Iterate as words gravitate towards “good” topics to approximate

With each iteration of the entire LDA algorithm the relative counts amongst words and topics are used to calculate probabilities of words belonging in topics and for topics belonging in documents. These probabilities are updated with each iteration (step 4). With each update the words in topics, and the topics in documents, move together in a way that produces more

probable groupings based on the calculations of the algorithm. Thus, with more iterations, words gravitate towards each other to form topic and word mixes that are increasingly likely. The resulting topics represent in the end the most likely combinations given the number of iterations, the underlying set of documents and the parametrisation of the LDA algorithm by the author. In practice, the more iterations the better the results. However, a balance needs to be maintained between solution quality and computational cost.

Below insights on Dirichlet Distribution and Gibbs Sampling, which are the mathematical tools behind LDA, are given.

2.4.2 Dirichlet Distribution

A Dirichlet distribution $Dir(\alpha)$ is a way to model Probability Mass Function (PMF). As stated above, in topic modelling with LDA, there are two random variables following the Dirichlet distribution necessary,

1. θ_d: topic proportions for document d (i.e. *topic frequency*)
2. $\beta_{W,k}$: proportion of word w appearing in topic k (i.e. *word frequency*)

These proportions are calculated by assigning randomly a word w within each document to a topic k. After all words have been assigned to a topic, the proportion of a word w being assigned to a topic k, $\varphi_{W,k}$, can also be calculated and put into a word-to-topic count matrix. The total topic occurrences of all the words in a document can also be calculated and put into a document-to-topic count matrix, examples of each are given in Table 1 and Table 2 for better comprehension

Word	Topic 1	Topic 2
Sector Coupling (S.C)	0	1
Biodiversity (B)	1	3
…	…	…

Table 1. Word-to-topic count matrix with random numbers, only for illustration purposes

Document	Topic 1 Count	Topic 2 Count
1	2	2
2	4	3

Table 2. Document-to-topic count matrix with random numbers, only for illustration purposes

The Dirichlet parameters, α and η, determine the distribution of words for topics and the distribution of topics for words. As seen in Figure 8, the coloured points indicate the words while each of the three corners represents one of the three topics. It can be observed that the higher the α value is, the more topics the words belong to. For example, with a symmetric distribution of α =5 across the three topics, the points are aggregated in the center (top-right chart in Figure 8), implying that these words could be distributed to one topic as much as to the other. On the other hand, the smaller the α, the more exclusive the words are to one topic; thus, they tend to aggregate more towards the corners. The value of η determines how many topics a word should belong to; the smaller the η, the less topics a word can be assigned to and vice versa.

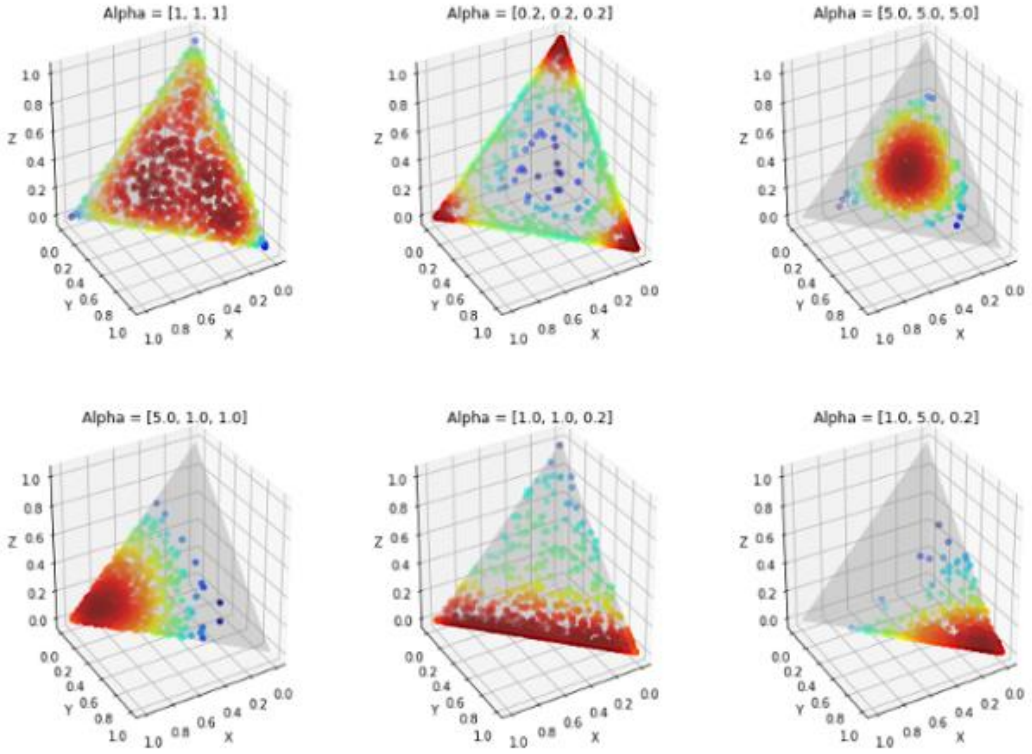

Figure 8. Geometric representation of the impact of hyperparameter adjustments with regards to α (Ganegedara, 2018)

2.4.3 Mechanism of Latent Dirichlet Allocation

As illustrated algorithmically, for LDA, "the basic idea is that documents are represented as random mixtures over latent topics, where each topic is characterized by a distribution over

words." (Blei et al., 2003). Figure 9 provides an overview of how the Dirichlet distribution and parameters are connected to build up the model and in turn, using Gibbs sampling to infer the latent variables.

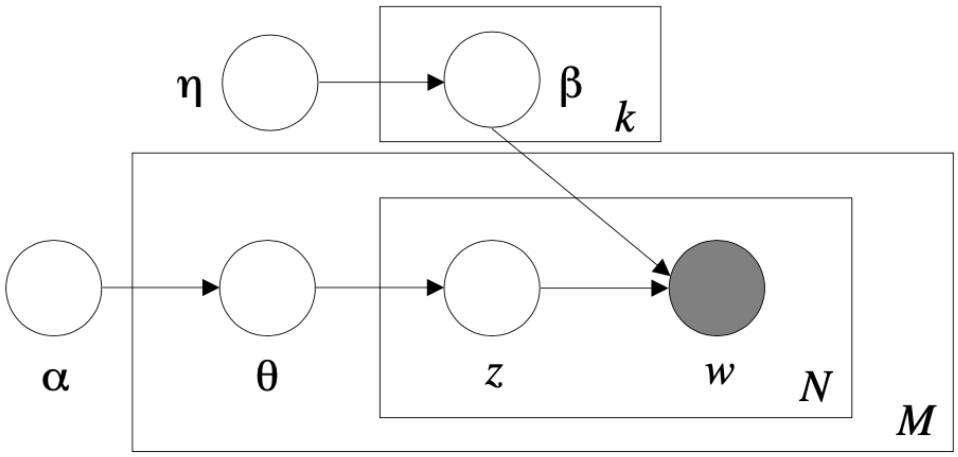

Figure 9. Graphical model representation of LDA

Let us define the nodes in Figure 9:

- M: the number of documents
- N: the number of words in a given document m
- Node α: Dirichlet prior determining per-document topic distributions
- Node η: Dirichlet prior determining the per-topic word distribution
- Node $\theta \rightarrow \theta_i \sim Dir(\alpha), i \in \{1, \dots, M\}$: represents the document-topic proportions based on a Dirichlet distribution with a symmetric parameter α,
- Node $\beta \rightarrow \beta_k \sim Dir(\eta), j \in \{1, \dots, K\}$: represents the topic-word proportions based on a Dirichlet distribution with parameter η
- Node z $\rightarrow Z_{d,i} \sim Multinominal\ (\theta_i)$: multinominal distribution of the topic of the i-th word in document d, essentially per-word topic assignment
- Node w $\rightarrow w_{d,i} \sim Multinominal\ (\beta_{zn,i})$: multinominal distribution of the i-th word in document d, essentially the observed word

The graphical representation of LDA in Figure 9 can be represented as a joint conditional probability function,

$$p(\beta,\theta,\mathbf{z},\mathbf{w}) = \left(\prod_{i=1}^{K} p(\beta_i|\eta)\left(\prod_{d=1}^{D} p(\theta_d|\alpha)\prod_{i=1}^{I} p(z_{d,i}|\theta_d)p(w_{d,i}|\beta_{1:k}, z_{d,i})\right)\right)$$

Equation (1). Formal definition of LDA Model

To infer to posterior distribution $p(w_{d,i}|\beta_{1:k}, z_{d,i})$, collapsed Gibbs sampling is used to approximate this latent variable that represents the word probabilities for each topic.

2.4.4 Collapsed Gibbs Sampling

Collapsed Gibbs sampling is used for iteration to calculate the optimum results. Gibbs Sampling belongs to Markov Chain Monte Carlo (MCMC) approaches. When sampling across multiple random variables (or joint probability distributions), the Gibbs Sampling samples from each random variable one at a time by keeping the current values of the other variables fixed.

In the context of LDA, Gibbs Sampling is used for successively sampling the conditional assignments of words to topics to identify the "correct" (posterior) probabilities of the assignments. Gibbs sampling is used to improve the topic representations of all documents and word distributions of all topics, during LDA's reassignments of topics to words (i.e. in step 2 described above).

Let us denote:

- W: total number of unique words
- T: total number of topics
- z_i: is the topic assigned to the i-th unique word
- j: is a topic
- d_i: is the document containing i-th unique word
- w_i: is the word type of the i-th unique
- z_{-i}: is the set of topics of all other unique words except for the i-th word
- $C^{WT}_{w_i,j}$: matrix of word-topic counts
- $C^{DT}_{d_i,j}$: matrix of document-topic count
- $\sum_{w=1}^{W} C^{WT}_{w_i,j}$: the count of words assigned under topic T within the corpus
- $\sum_{t=1}^{T} C^{DT}_{d_i,j}$: the total count of all topics occurring within document D

Using the equation of Gibbs Sampling shown below, the topic t's probability for a word w for document d can be calculated.

$$P(z_i = j|\boldsymbol{z}_{-i}, w_i, d_i, a,\eta)=\frac{C_{w_i,j}^{WT}+\eta}{\sum_{w=1}^{W} C_{w_i,j}^{WT}+W\times\eta} \times \frac{C_{d_i,j}^{DT}+\alpha}{\sum_{t=1}^{T} C_{d_i,j}^{DT}+T\times\alpha}$$

Equation (2). Collapsed Gibbs Sampling Formula

In the given example, $\sum_{W=1}^{W} C_{w,j}^{WT}$ would be the sum of Table 1's individual columns, $\sum_{W=1}^{T} C_{d,j}^{DT}$ would be the sum of Table 2's individual rows.

Based on the highest probability of the topics assigned for a word under the document, the final topic will be given. This process is repeated during the iteration by assigning topics onto words randomly. The result of the final iteration is chosen.

Document	Word	Previous Iteration Topic	Probability for Topic 1	Probability for Topic 2	Final Topic based on max. probability
1	S.C	Topic 2	0.0161222781	0.0156191487	Topic 1
2	B	Topic 1	0.0161222781	0.0312226938	Topic 2

Table 3. Final probabilities for a topic belonging to a word in a certain document, with random numbers, only for illustration purposes

As Gibbs sampling is Markov chain Monte Carlo (MCMC) algorithm, the iteration is to converge to more accurate predictions. Such samplers asymptotically achieve to generate samples from a distribution with the specified conditional probabilities as displayed in Table 3. Thus, we use the results from Gibbs sampling, as shown in column 4 and 5 in Table 3, as the optimized approximation of the posterior distribution $p(w_{d,i}|\beta_{1:k}, z_{d,i})$ in the LDA Model.

2.5 Determination of K Number of Topics

The number of topics is determined before the implementation of LDA. To find the optimal number of topics, usually a handful of candidate models are ran with varying number of topics (Maier et al., 2018). In this thesis, instead of typical internal and external validation criteria such as perplexity and topic coherence, a combination of visualization and calibration with common understanding of reality is employed. The visualization algorithm developed by Sievert & Shirley (2014) using multidimensional scaling, whose centres are determined by computing the Jensen–Shannon divergence that measures similarity between two probability distributions, produces an inter-topic distance map (Sievert & Shirley, 2014). The inter-topic distance map

reduces the K dimensions (that correspond to topics) from LDA to a 2-Dimensional (2D) Principal Component Analysis (PCA) plane (Sievert & Shirley, 2014). Intuitively, this visualization indicates how different the topics are, as each topic is represented by a circle and positioned on the 2D plane (distance among topics based on calculating the 2D Euclidean distance of the centres of the circles); the further away the circles/topics are from each other, the larger the semantic differences they have. If two topics have (a subset of) words that are the same between them, they are more similar to each other than topics that have no word shared between the two. The benefit of such a visualization is the straight-fowardness of detecting whether there are topics that are too similar that should be combined as one. Overlapping circles suggest that these topics are highly similar and could be set as one topic instead. Hence, based on the criteria of least overlapping with most information displayed, the number of topics can be set.

However, the two-dimensional plane, resembling a Principle Component Analysis (PCA) graph with Principle Component 1 (PC1) as the horizontal axis and Principle Component 2 (PC2) as the vertical axis cannot be used to comment on whether, similar to a PCA, the differences among the topics on PC1 would represent larger differences compared topics on PC2. Thus, our interpretation cannot go beyond noting on the distances among the circles and the size of the circles (Sievert & Shirley, 2014). The size of the circles (i.e. circle diameters) reflects the prevalence of the terms within a topic. Prevalence is defined as the percentage of these words under a certain topic in the overall documents.

Based on this approach of visualising the distances of topics and focusing on maximizing distances among topics, the “optimal” number of topics in the case of the top-level topic modelling (i.e. across all stakeholders’ position papers) performed in this thesis was chosen.

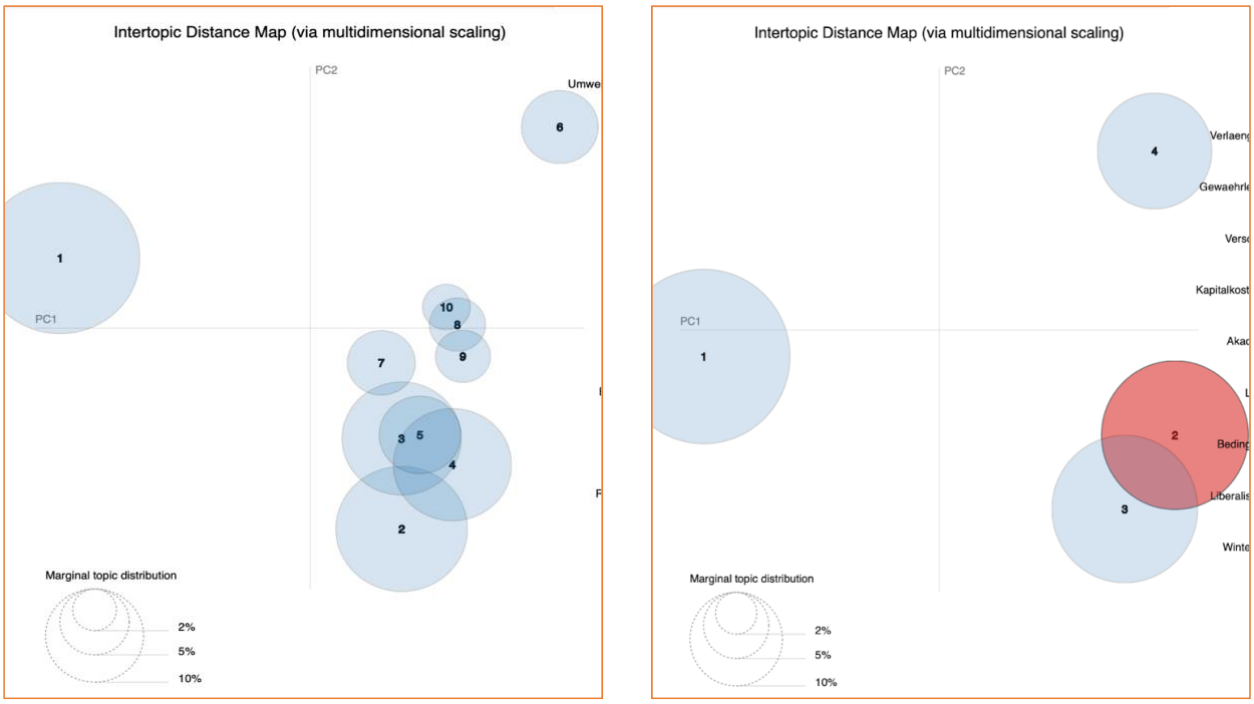

Figure 10. (left) total of 10 topics with strong overlapping of circles indicating many similar topics (right) total of 4 topics with minimal overlapping and stronger differences among the topics- more unique topics

Figure 10 is a demonstration of the calibration of the number of topics. The inter-topic distance map provides a compact overview of the topic differences, assisting the determination of optimal topic numbers. As observed on the left-hand side of Figure 10, ten topics have been set, which resulted with a cluster of small topics in the bottom right corner. There is significant overlapping among these topics, suggesting that the topics share similar words, and they are not as distinct from each other as they could be. On the other hand, if k is reduced to four, the results have minimal overlapping. The previous cluster of circles seem to be combined into only two separate circles. A portion of words under previous cluster of topics have been distributed to topic 1 and 4 after the reduction of the topics. It can be argued that k should be reduced to three, instead of four, considering the circles on the bottom right-hand side are still overlapping. However, the circles retain their own differences as there are areas that are not overlapping, indicating words that differ from each other from the two topics. By combining circle two and circle three, these differences would be overseen. Therefore, for the top-level topic modelling the optimal number of topics was set to 4.

The words considered during the topic modelling in this visualization differ slightly from the assignment of words into topics displayed in Figure 13 in the results section. Figure 13 shows foremost the topic and term results from the application of the LDA algorithm accompanied by information on simple word count in the corpus and word frequency within the topic. For this

visualization, the notion of "relevance" is applied additionally, to balance the mere frequency of a term with the exclusivity of the term. This consideration of "relevancy" proposed by Bischof et al. (2012) was achieved through adding a "lift" factor, which is defined as "the ratio of a term's probability within a topic to its marginal probability across the corpus" (Sievert & Shirley, 2014). The equation for the relevance *r*, is given below:

$$r(w, k \mid \lambda) = \lambda \log(\phi_{kw}) + (1 - \lambda) \log\left(\frac{\phi_{kw}}{p_w}\right)$$

Equation (3). Equation for "relevance" in terms of "lift"

In the above equation, we denote:

- λ: weight parameter
- ϕ_{kw}: probability of term w ∈ {1,...,V} for topic k ∈ {1,...,K} (V is the number of terms in the vocabulary)
- p_w: probability of term w in the corpus.
- $\log\left(\frac{\phi_{kw}}{p_w}\right)$: "lift" factor

By changing the value λ, the balance between displaying words that are common in terms of their frequency and the rare terms occurring under a single topic can be adjusted. By setting λ = 0, relevance of the words would only depend on the «lift», displaying words that are more topic-unique than highly weighted in the topic. In this thesis, λ is set at 0.6, the "optimal value" produced by Sievert & Shirley (2014) through their callibrations. In their paper, setting λ as 0.6 returns a relatively balanced set of results between topic-uniqueness and topic-representation. Nevertheless, it is important to note that, "as with other unsupervised methods, the received wisdom is that there is no "correct number" as this is an application and context-dependent issue" (Matthews, 2019). Nevertheless, other λ values were experimented to test the suitability of λ=0.6 in this thesis. With a λ value lower than 0.6, obscure words emerged with little insights provided or possibility for interpretation; these words were difficult to be treated as cohesive words under the same topic. With a λ value higher than 0.6, more words overlapping the groups occurred, increasing the difficulty to distinguish among the topics. Hence, the λ value follows 0.6 as noted in Sievert & Shirley (2014).

2.6 Implementation of the LDA algorithm in Python

Several packages are used for the implementation of topic modelling with LDA in Python, as listed in Table 4. The package used for the elimination of stop words started with the basic German stop word package *de_core_news_sm*, the lemmatization and tokenization of the words uses, *Germmalemma* and *nltk.tokenize.WhitespaceTokenize* from *the nltk* library. *CountVectorizer* from the *sklearn.feature_extraction.text* library is used for the vectorization of the normalized text as preparation for modeling,. Finally, the package *gensim.models.LdaMulticore* from *genism* library is chosen for LDA modeling as it has more options for parameter adjustments. The input parameters are α and β set as 0.25 as convention (Fan, et al., 2007), and value λ set as 0.6 (Sievert & Shirley, 2014).

Package Name	**Functionality Description**
de_core_news_sm	Basic German Stop words package
nltk.tokenize.WhitespaceTokenize	Tokenization tool
Germmalemma	Lemmatization tool for German words
CountVectorizer	Vectorization of the normalized text
gensim.models.LdaMulticore	LDA model with possibility of parameter adjustments
pyLDAvis.gensim	LDA visualization tool for the determination of K

Table 4. The Python packages used in LDA implementation with their respective functionalities

2.7 Supplementary Qualitative Research

Supplementary qualitative research is built upon the Natural Language Processing (NLP) tool to compensate the shortcomings in topic modelling. Eickhoff et al. (2018) notes on these "drawbacks", which resonate in this thesis as well, such as the potential lack of "context" and "meaningfulness" in the topics generated. In these cases, a reading of the stakeholders under these uninterpretable topics is performed for an improved understanding of the words under the topics, and in turn comprehend the important drivers. Furthermore, though the thesis seeks for only influential factors of the stakeholders, when stakeholders who are unlikely to be grouped together occur under the same topic, qualitative research can attest whether such stakeholders do share the same drivers but with complete opposite sentiment, or the grouping needs adjustment due to noises.

3. Results

With the corpus cleaned and normalized, the parameters set, we finally run the LDA algorithm using the *LDAMulticore* Python package on all stakeholders for EnG. The goal is to find the distinct drivers among them without having too many groups resulting in too many overlapping similarities. With a total of 210 stakeholders expressed positions related to the revision EnG, it was necessary to apply a second-level of topic modeling to further accentuate drivers on a more granular level. To achieve a deeper dive into the drivers on the second level, stopwords would be added specifically for that group, which are the keywords that define that topic on the top-level to avoid repetitios and overlaps.

3.1 "Optimal" Numbers of Topics through Visualization

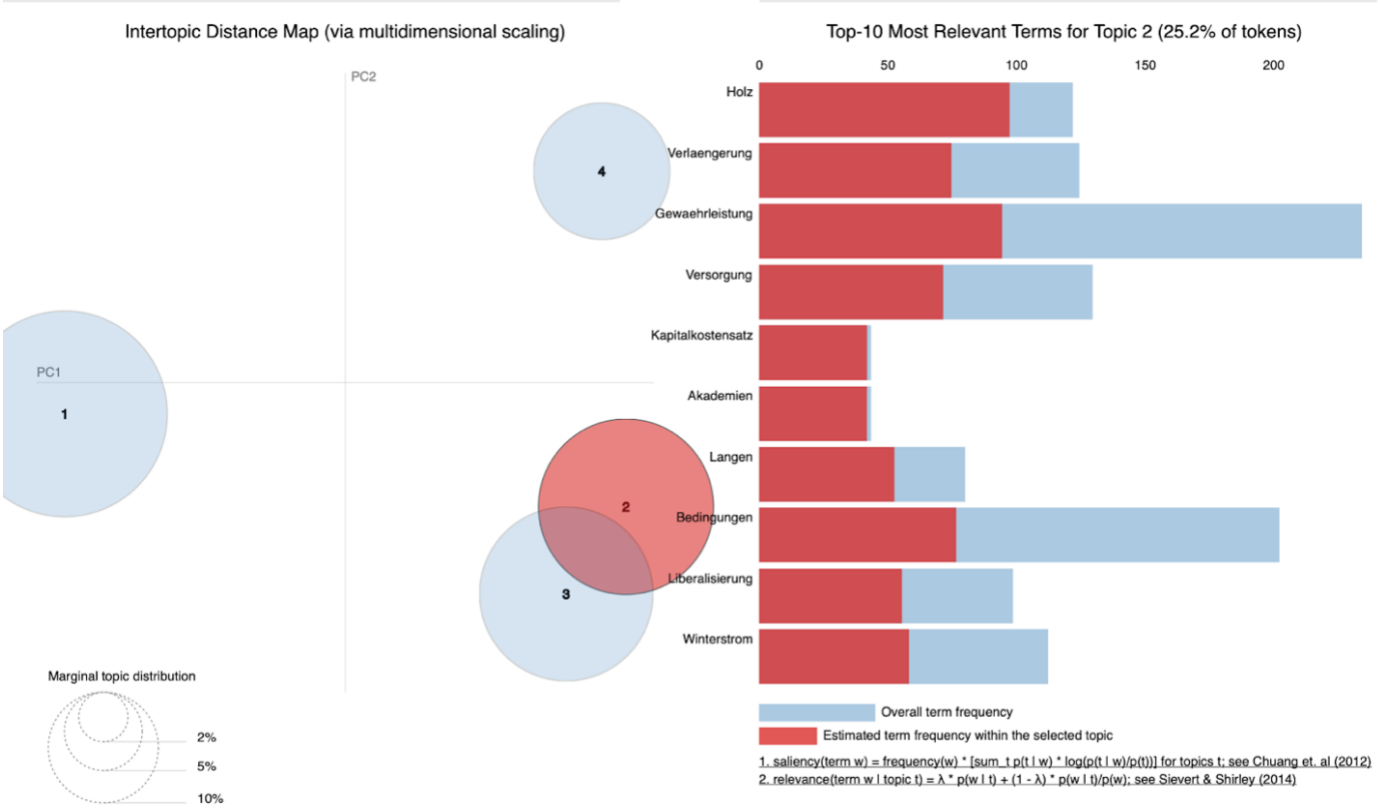

Figure 11. Visualization results with optimal numbers of topics

Figure 11 displays the full information provided through the visualization. On the right hand side, the horizontal blue bars represent the corpus-wide frequency of the given term,while the red bars represent topic-specific frequency of the term. In Figure 11, topic 2 is selected to

elaborate on the information the bars provide, hence, the red color on circle 2. Circle 2 contains 25.2% percent of the tokens. And in this case, the term wood ("Holz") occurred in the corpus almost 125 times (corpus-wide frequency) according to the blue bar and almost 100 times (topic-specific frequency) according to the red bar. The longer the red bar the more likely that the word is being used in this topic. On the other hand, the word guarantee ("Gewaehrleistung") occurred significantly often more in the overall corpus than in the documents classified under topic 2.

3.2 Topic Modeling Analysis in Two Levels

In this section, two types of results are presented: the top-level topic modelling and the second-level modelling results. Top-level modelling refers to topic modelling across all stakeholders without explicitly accounting for their type and interests; the important drivers shared by the majority of stakeholders were identified as they are words common to all groups. Moreover, four groups emerged, classifying all stakeholders based on the topic they are defined under. The second-level topic modelling applied the same mechanism as the top-level modelling, except individually on one of these four overarching grouped produced by the top-level modelling. The results from the second level also produces various subgroups and drivers specific to the stakeholders of that subgroup.

3.2.1 Common Keywords Across all Top-level Groups

Common words, such as security of supply ("Versorgungssicherheit"), auctions ("Auktionen"), sliding market-premium ("Gleitende Marktprämien") and cost ("Kosten"), as compiled in Figure 12, were topic-defining words dominating all four top-level groups.

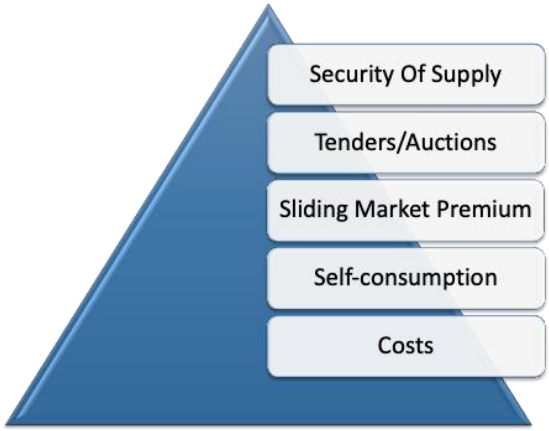

Figure 11. Hierarchical representation of the stakeholders' common concerns

Security of Supply is identified as the highest concern across all stakeholders. Such a finding can be attributed to three main reasons. First, the discontinuation of nuclear power, if not substituted by other technologies will reduce the existing capacity of "clean energy" and create an electricity supply gap in the future. Second, as the goal of decarbonization is pursued, electrification of the mobility and building sector will also accelerate, in turn increase demand for electricity. Lastly, the increased electricity demand needs to be met by RE to be compatible with the climate targets, yet a concrete solution against the intermittency nature of RE and battery capacity is still lacking.

Words such as auctions, tenders and sliding feed-in-premium, as some of the most common words, imply a general acceptance to a subsidy regime that is consistent and long-term, yet market-oriented.

The word self-consumption reveals the stakeholders' interest utilizing this scheme as one of the approaches to promote REs. The regulation can be either to financially incentivize more self-consumption or to restrain further self-consumption schemes due to the concern of non-optimized rooftop and surface utilization.

Finally, energy supply cost remains as the fundamental concern for all stakeholders.

3.2.2 Observations of Top-level Groupings

Figure 13 displays the top ten keywords from each of the four overarching topics of the top-level topic modelling. For each keyword in the topic, the weight and word count are also indicated to distinguish between the corpus frequency and the relative occurrence of the word under the respective topic. The word count is indicated by the lighter shade of pastel colours; while the weight, which suggests the relative frequency and significance within the group of documents assigned to the each topic, is in dark-shaded colours. The comparison of word count and relative frequency uncover whether a word is only considered important because it has a high overall word count or it does have a high relative frequency within the specific topic.

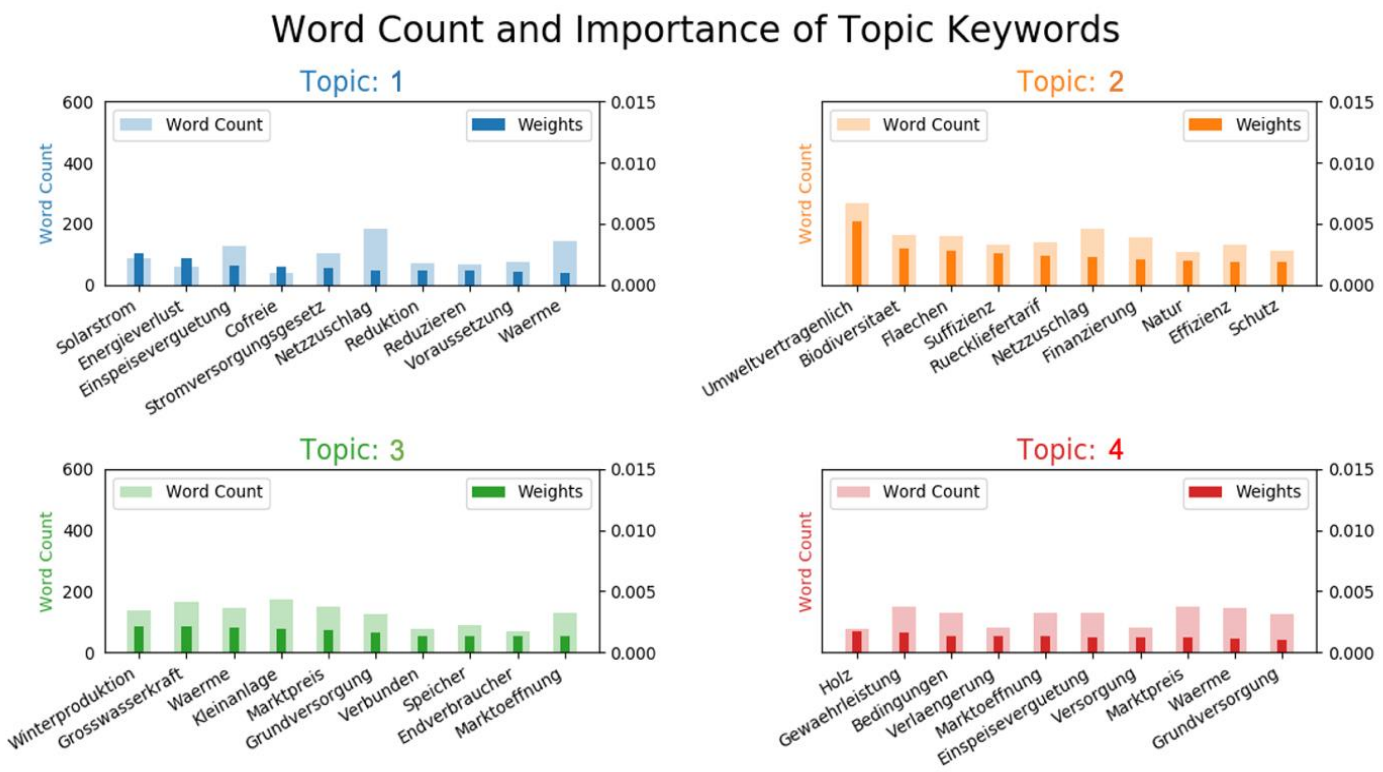

Figure 12. Word Count and Weights of the topics' terms for topic-specificity comparison

Words with a much higher word count than weights are often eliminated as they do not contribute to providing unique terms defining a topic. Though the two criteria (word count and weight) are in different units, they can still be compared in terms of their individual relativity. For example, the word network surcharge ("Netzzuschlag") has the highest word count for topic 1, yet its weight ranks among the lowest ones. These relative discrepancies help distinguish whether the words, which define a topic are important because of their ability to constitute a topic as unique or because they overflood the whole corpus. Though a higher word count correlates to a higher probability of overlapping among topics, the two qualities are not the same. Figure 13 shows that words such as small-scale power plants ("Kleinanlage"), basic supply ("Grundversorgung"), conditions ("Bedingungen") or network surcharge ("Netzzuschlag") have a perceptibly higher word count than weight, yet these words are not eliminated because they do not dominate all groups of documents. Thus, they still constitute as defining terms particular to the topic.

It can be observed that in Figure 13 each topic contains words suggesting a combination of energy technologies and indicative political instruments. Topic 1 is defined by solar electricity,

attention to energy losses with a particular emphasis on the Electricity Supply Law and network surcharges, as well as consideration of feed-in-tariffs. Topic 2 is composed of environmental, biodiversity, nature, and protection considerations with a general concern about energy efficiency, a specific focus on network surcharge and redelivery tariffs. Topic 3 is characterized by winter production concerns, large-scale hydropower, and heat, with a concentration on market prices alignment, storage, and market liberalization. In topic 4, wood (specifically wood-based heat) is represented with the notion of guarantee, framework conditions, market liberalization and feed-in-tariff. To synthesize these observations, topic 1 relates to renewable electricity and impacts on grids, topic 2 concerns itself with environment and protection, topic 3 focuses on security of supply in winter and lastly, topic 4 caters around renewable heating.

3.3 Second-level Topic Modeling Results

The analysis from top-level topic modelling provides the overall drivers common to all stakeholders. The initial dissection of the stakeholders showcases the different fields the stakeholders focus on. With the second-level topic modelling, the aim is to identify more specific drivers. The same process is done for the second-level topic modelling as for the top-level, except that the algorithm is applied individually to the stakeholders/position papers for each top-level group.

3.3.1 Subgroups for Topic 1: Renewable Eelectricity and Impacts on Grids

Figure 13. Topic 1 subgroups with a total of 50 stakeholders

The first cluster under Topic 1 (Figure 14), contains mainly stakeholders related to biomass, such as Holzindustrie Schweiz, Holzenergie, Task-Force Wald+Holz+Energie, and Wald Schweiz. This suggests the alignment of stakeholders based on the same energy technology. These wood-relevant associations and production companies are focused on feed-in-tariff as a support mechanism due to the investment planning security it provides. Furthermore, the Cemsuisse also being included with these biomass stakeholders implies a solidarity with these groups. This can be explained by the utilization of biomass as cement industries' main tool of lowering their carbon emissions.

The second cluster is characterised by solar electricity, the Schweizerische Gernia Stiftung (SGS) and Solar Agentur appeal for more incentives for self-consumption in the building sector.

The third group focuses more on the overview of the electricity market model, its redelivery tariffs, electricity prices, and network surcharges. This group includes PV2Grid and the Verband Unabhängiger Energieerzeuger (VUE), which explains the particular concern of access to the electricity grid and market. Unlike the solar-relevant stakeholders in the previous sub-group, the Schweizerische Vereinigung für Sonnenenergie (SSES), being included in this sub-group, is concerned less of self-consumption of solar electricity in the building sector and more of the general elecitricy market design.

3.3.2 Subgroups for Topic 2: Environment and Protection

Figure 14. Topic 2 subgroups with a total of 53 stakeholders

The first cluster under Topic 2 (Figure 15) is defined by environmentalism, biodiversity, nature, protection and habitat. This cluster includes all the Umweltallianz members such as WWF Switzerland, Greenpeace, Pro Natura, Naturfreude, Schweizerische Energie-Stiftung, Birdlife and Swiss Alps Club. Additionally, biodiversity organizations such as Aqua Viva and Schweizerische Fischerei-Verband; stakeholders from the mobility sector— Verkehrs Club der Schweiz (VCS); from the building sector— Gebäudehülle Switzerland also aligned with the drivers of Umweltallianz. Among the political parties, the Green Party, the Social Democratic Party, and the Evangelical Peoples' Party share the same drivers with these associations. The Youth Session of Switzerland, representing the political orientation of the youth, also stand in solidarity with green party. This cluster's drivers are to be achieved through network surcharges and more financial support to renewable electricity and heat.

The second cluster contains predominantly of waste incineration plants and associations; such as Infrawatt, and wastewater treatment plants; such as Worbental, Lenzburg, Alternhein, and Morgenthal wastewater treatment plants. These stakeholders are focused on the potential of biogas from waste incineration plants and waste water treatment plants. The keyword "large-scale hydropower" could explain the presence of stakeholders such as Credit Suisse Energy Infrastructure Partners AG, the Energie Genossenschaft Schweiz, Pronovo, the Hauseigentuemerverband and the Swiss Peoples' Party. These stakeholders cannot be displayed in Figure 15 due to space limitation, however, they are included in the full list of groupings shown in Appendix C.

The last cluster specifies a differentiation of installation sizes regarding the financing model for renewable energy. The cluster appeals to direct marketing of the energy produced, storage capacity, production capacity and redelivery remuneration. These are the central keywords of Biomass Suisse, Holzbau Schweiz, Verein für Umweltgerechte Energie (VUE) and AEE. This group concerns itself on gas production from biomass.

3.3.3 *Subgroups for Topic 3: Security of Supply for Winter*

Figure 15. Topic 3 subgroups with a total of 50 stakeholders

The first cluster under Topic 3 (Figure 16) is characterized by wind energy, which is closely linked to the concepts of national and local energy production. In order to accelerate the deployment of wind energy in Switzerland, these stakeholders value guarantees (in terms of long-term and stable financial support), cantonal construction permits and investment security. The oldest association for the promotion of wind energy, Suisse Éole, is included in this group that representswind energy; along with renewable energy companies, such as the Vento Ludens Suisse GmbH, which is a family-owned international group of companies.

The second cluster under Topic 3 is led by Alpiq Holding AG accompanied by major electricity network associations, such as Verband Schweizerischer Elektrizitätsunternehmen (VSE) and Dachverband Schweizer Verteilnetzbetrieber (DSV). Alpiq is selected as the «leading» stakeholder due to its sheer size in company employees, level of profit and involvement in energy trading and investments. The Alpiq-led coalition includes not only electricity network associations but also energy producers, such as Technische Gemeindebetrieb Bischofszell (TGB). These stakeholders are concerned with winter production of electricity and energy, end consumers, and the electricity supply law. Such concerns can be alleviated through tenders and investment incentives to technologies that can secure electricity supply also in winter. An overarching interest for them is large-scale hydropower. There are more diverse types of stakeholders in this subgroup than in other subgroups, with the energy companies but also

political parties, such as the Christian Democratic Peoples' Party and Economic Association; Swiss Cleantech (listed in the full list of groupings in Appendix C).

Though the third cluster is also largely composed of energy utility companies and powerplants, they are not in the same subgroup. Axpo is chosen as the coalition «leader» along the same criteria as Alpiq. Though both the Alpiq-led coalition and Axpo-led coalition are concerned with large-scale hydropower, Alpiq-coalition seems to target more aspects of the electricity market and law, while Axpo-coalition tend more towards a specific focus on sector coupling, the issue of winter energy production and notion of storage technology solutions. Therefore, included with Axpo are gas-relevant groups such as Verband der Schweizerischen Gasindustrie (VSG), Gaz Energie, Gaznat SA. However, not only gas-relevant companies are present in the group, a handful of regional electricity companies also emerged as well, such as Swiss Power (competence center for 22 Municipality Electricity works and regional companies), Regio Energie Solothurn, Energie Wasser Bern, ENIWA AG, and BKW. The association of regional electricity companies with gas-related stakeholders hint towards the interest of these regional companies in the development of gas. Similar logic follows for the electricity network, the inclusion of the federal electricity stakeholders, such as the Federal Elecitricity Commission and SwissGrid; indicates an interest in the development and potential of gas power in Switzerland.

3.3.4 Subgroups for Topic 4: Renewable Heating

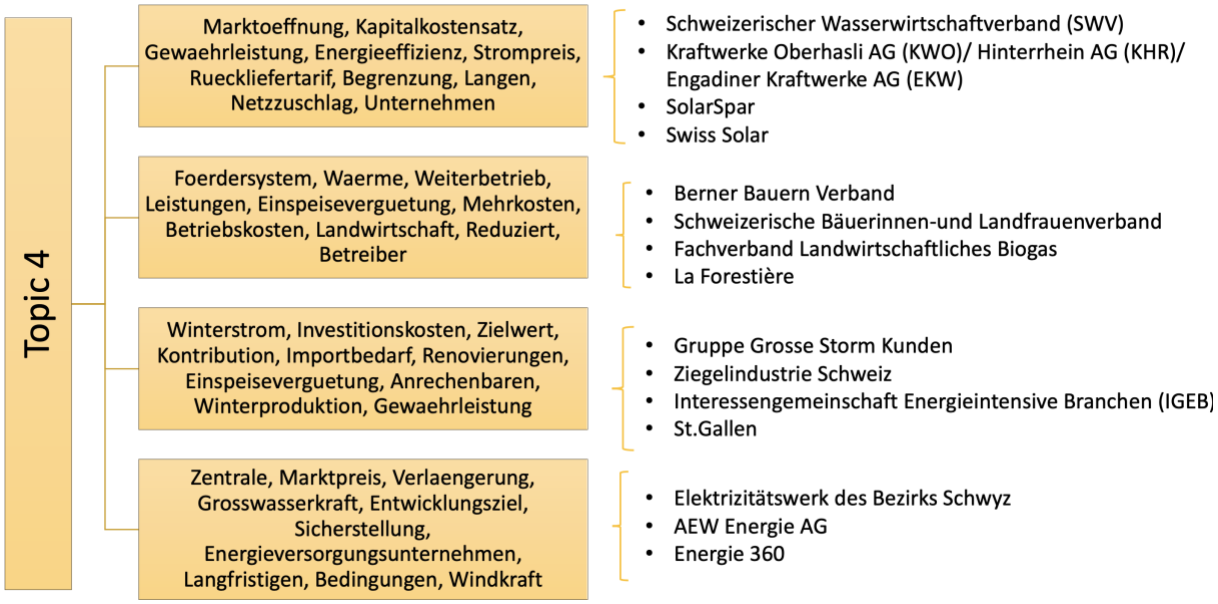

Figure 16. Topic 4 subgroups with a total of 56 stakeholders

The last top-level group, unlike the previous ones, is divided into four subgroup clusters (Figure 17). It is also the largest group with the most stakeholders of 56. The first subgroups' opinions are influenced by policies on market mechanisms such as the process of electricity market liberalization, the level of electricity prices, redelivery tariffs, network surcharges and capital costs. Stakeholders defined by these keywords are led by the Schweizerischer Wasserwirtschaftverband (SWV), which represents the interests of hydropower plants and powers 90% of Swiss hydroelectricity. Power plants such as Kraftwerke Oberhasli AG (KWO), Kraftwerk Hinterrhein AG (KHR), and Engadiner Kraftwerke AG (EKW) can be understood to be following SWV's focuses as more regional electricity producers engaging in hydropower. Furthermore, solar-based associations such as SolarSpar and SwissSolar included in this subgroup also align themselves with the focus on electricity market instruments.

The second cluster under Topic 4 emerges predominantly as a coalition among the farmer associations, biomass association and the biogas association. The Berner Bauern Verband, Schweizerische Bäuerinnen-und Landfrauenverband hand in hand with the Fachverband Landwirtschaftliches Biogas and La Forestière, emphasize on the role of heating and a promotion scheme that takes additional costs and operational costs into account. Feed-in-tariff could be one of the preferred instruments for these stakeholders to enable investments in renewable energy technologies.

The third cluster contains primarily actors in industry, with Gruppe Grosse Strom Kunden, Ziegelindustrie Schweiz and Interessengemeinschaft Energieintensive Branchen (IGEB). Such actors highlight the security of electricity supply in winter, the level of investment costs and import needs. Though feed-in-tariff is mentioned here, this industry alliance is not in favor of it but the abandonment of it to avoid distortions in the market competition.

Finally, the last cluster of the last topic is characterized by large-scale hydropower, the electricity market prices, the interests of energy utility companies and the long-term conditions. This subgroup notes on security and financial support extension. With such mixed keywords, this group is also more heterogenous than the others, ranging from political parties, cantons, farmer associations, energy utility and production companies to building sector associations.

	Alignment	Niche Fractioning	Scattered
Energy-based	Wood-based Associations and Companies	Solar-based Associations and Companies	Cantons and political parties
	Wastewater and waste incineration plants	Wind-based Associations and Companies	
Typology-based	Farmers Associations	Energy Utility andProduction Companies	
Ideology-based	*Umweltallianz*	/	

Table 5. Observation and interpretation of the second-level modelling results

Table 5 provides a summary of the second-level modelling results to show the extent of political alignment based on the type of energy, stakeholder typology or ideology. Though most stakeholders can be clustered based on the energy technology that they support, the type of stakeholder they belong to or the ideology they follow; political parties and cantons are rather scattered among different clusters. The implication of such scattering is that the important words from these documents could be overflood by other stakeholders in the same group that are more dominant. Hence, to accentuate the important drivers of these scattered groups, type-specific topic modelling is employed as the next step. The results from the type-specific modelling are presented and discussed in the next section.

3.4 Type-specific Topic Modelling

In this subsection the results of type-specific topic modelling are presented. As mentioned in the methodology section, the type-specific modelling refers to the application of topic modelling on the position papers solely from the same typology. In this case, they are political parties and cantons and municipalities. These types of stakeholders have been identified in the previous sections to be scattered across the different clusters, necessitating individual assessment with topic modelling. The results are presented and discussed below.

3.4.1 Political Parties

The grouping and key drivers for each group for political parties shown in Figure . As there are not as many stakeholders for this model, all the political parties under the groups are displayed.

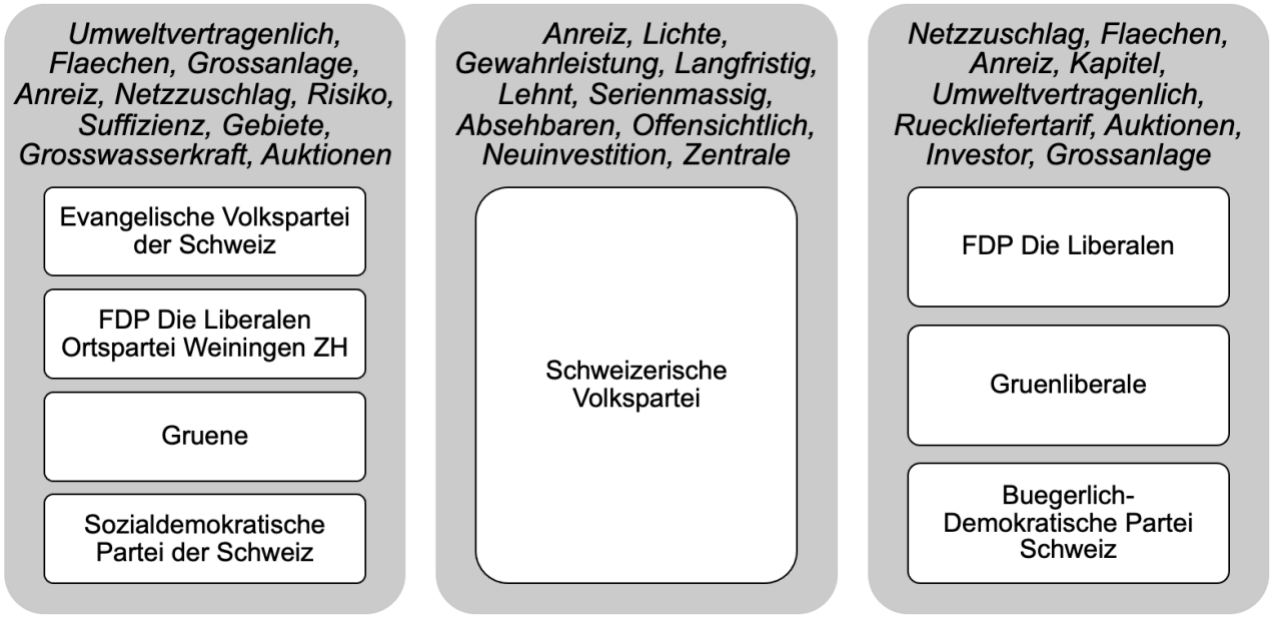

Figure 18. Overview of political parties' grouping and the respective topic words

The People's Party of Switzerland (SVP) distinctively stands out as on its own, while the other two groups are to be discerned as relatively left-wing or liberal. Many key drivers for the political parties overlap with each other, especially for the groups in the first and third column. Words such as incentives ("Anreiz"), network surcharges ("Netzzuschlag"), surfaces ("Flaechen"), and auctions ("Auktionen") are shared among all parties. To interpret these findings also qualitative analysis is employed. Additionally, it is important to keep in mind that the order of the keywords is an indication of the differences in weight. The list of the keywords are in descending order of their importance. Hence for the first group, being environmental is top priority; for the second, specifically and exclusively the SVP, incentive is overpowering, perhaps due to the will against further financial incentivization; for the last group, the network surcharge is most valued. Being environmental, though a general concept, is logical to be set as the most relevant for left-wing parties. On the other hand, the liberal parties have a peculiar focus on network surcharges. Considering the increase of network surcharge from 1,5 Rappen/kWh to 2,3 Rappen/kWh through the previous Energy Law[5] that came into effect in 2018, the emphasis on network

[5] https://www.fedlex.admin.ch/eli/cc/2017/762/de

surcharge from the liberal parties implies a reluctance to accept further imposition of surcharge rate rises.

3.4.2 Cantons and Municipalities

The outcomes of topic modelling on the position papers of Cantons and Municipalities only are shown in Figure 17.

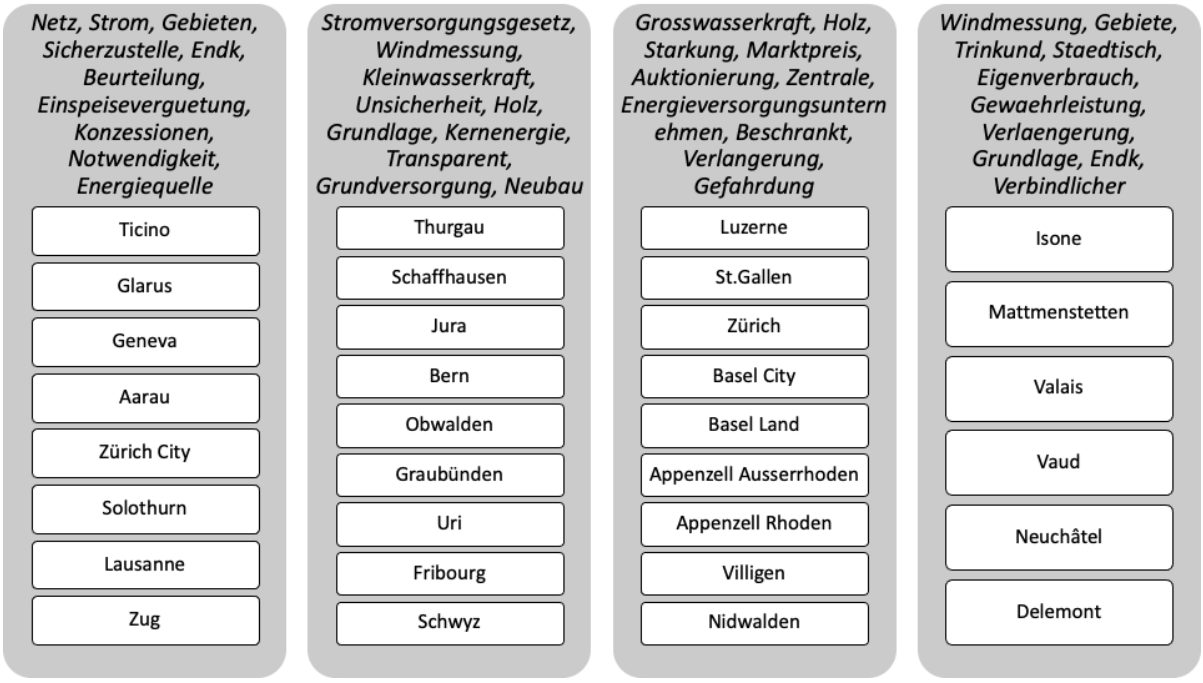

Figure 17. Overview of cantons' and municipalities' grouping and the respective topic words

Many compelling keywords occurred during the modeling for exclusively cantons and communes, such as concessions ("Konzessionen"), transparency ("transparent") and wind measurement ("Windmessung"). However, unlike the results from the two-level modeling, there is no conspicuous factor such as the type of the stakeholder or the energy technology the stakeholder is concerned of. The geographical factor does not seem to play a role in orienting the cantons and municipalities into clusters. Thus, the interpretation of the keywords also becomes arbitrary without the supporting information of common characteristics of the stakeholders in the same group. Further qualitative research is therefore necessary to facilitate an understanding of the keywords and extract insights.

With the complimentary qualitative support of reading the positions papers, combined with the key words, it can be understood that maintenance of large-scale hydropower in terms of concessions and renewal subsidies is of prominence. Further exploitation of solar energy

potential on top of auctioning of large-scale solar installations is often noted on and finally support instrument targeting specifically winter energy production is called for.

4. Discussion

4.1 Methodological Implications

Stakeholder position analysis through topic modelling has numerous unique novel benefits; insights of stakeholder drivers are provided through the words defining the topics and through the clustering of stakeholders, common characteristics of the stakeholders in the same top-level group or second-level subgroup can be extracted to further our understanding of the underlying factors orienting their positions.

However, there are 3 crucial aspects to keep in mind when performing topic modeling for this purpose. First, topic-specific and unique words are relatively difficult to capture when the documents are fundamentally related to the same theme, in this case the revision of EnG; second, topic modeling does not provide the sentiment towards the keywords; and finally, human interpretability could be argued to be subjective. Nevertheless, these drawbacks are outweighed by the benefits of topic modelling, which will be explained in the following subsections.

4.2 A Corpora Directed towards the revision of EnG

Though the topics could be distinguished from each other, there is an observable amount of words overlapping, which can be attributed to the fact that all documents are commenting directly towards the proposed policy instruments. Through inspection of the proposed draft for the revision of EnG, as synthesized in Table 2, it was sensible to set all the energy technology terms as stop words, because all documents are referring to these terms. By eliminating words with such high word count, more illuminating words such as wood and large-scale hydropower plants emerged.

Law	Technology	Conditions	Policy
Art.25	Photovoltaic	Construction and expansion	Investment contribution of max. 30%
Art.25	Photovoltaic	Construction "above certain capacity" with complete Feed-in	Investment contribution of max. 60%
Art.25a	Photovoltaic	Construction "above certain capacity"	Auction investment contribution
Art.25a2	Photovoltaic	Construction "above certain capacity" with self-consumption (Art.16)	Separate auctioning
Art.25a3	Photovoltaic	Installations participating in auctions	Renumeration criteria based on kilowatt per output
Art.26	Hydropower	Construction (<10MW and >1MW)	Investment contribution of max. 60%
Art.26	Hydropower	Construction (>10MW)	Investment contribution of max. 40%
Art.26	Hydropower	Expansion (>300kw)	Investment contribution of max. 60%
Art.26	Hydropower	Renewal (<5MW and >300kW)	Investment contribution of max. 40%
Art.27(2)	Biomass	Construction and expansion	Investment contribution of max. 60%
Art.27(3)a	Biomass	Construction and expansion	Excludes MSWI, WWTP
Art.27(3)b	Biomass	Construction and expansion	Excludes SSI, SGI
Art.27(3)c	Biomass	Construction and expansion	Excludes installations partial fossil-fuel based
Art.27a(2)	Wind	Construction (>10MW)	Investment contribution of max. 60%
Art.27a(3)	Wind	Measurement	Investment contribution of max. 40%
Art.27b(2)	Geothermal	Prospection, development, and construction	Investment contribution of max. 60%
Art.27b(3)	Geothermal	Project planning	Investment contribution of max. 40%

*MSWI: Municipal Waste Incineration, WWTP: Wastewater Treatment Plant, SSI: Sludge Sewage Incineration, SGI: Sewage Gas Incineration

Table 6. List of renewable energy technology promotion instruments

Such necessary eliminations reveal potential shortcomings in topic modeling considering the effort of determining and adding stopwords. As seen in Table 2 in Appendix B, in total there are 1256 stopwords, while the initial stopword packages for german 'de_core_news_sm', containing the basic stopwords, consists of 15 words. The necessity to increase by 8373% in stopwords compilation can be seen as a deterrent to implement this method under the condition that the documents are commenting on the same theme. With the larger manual selection of the stopwords, the risk of increased human subjectivity also rises. Nevertheless, the elimination of stop words in comparison to the readings of all textual data, proved to be more efficient.

Moreover, though the process of manually adding stop words is seen as inherently subjective, all the criteria of additional stop words are justified under context and transparent for the readers. Most importantly, topic modelling revealed insights that are overseen by manual processing of large number of documents.

4.3 Topic interpretability and Coherence

As seen in Figure 13 displaying word counts against weights for the keywords, the absolute criteria of eliminating words that have a substantially higher word count is not followed. Thus, the leniency in stopword criteria becomes a tangency of subjectivity. Though this could be argued as a point of human bias and subjectivity, the comparison in the thesis was better served as an understanding of the keywords' weights than a strict threshold to follow. Eliminating keywords based on the criteria and higher weights than word count undermines the possibility for human interpretation, as these words can serves cohesion words as well for the overall interpretation of the topic.

Often, humans eliminate word intrusions when they do not recognize the connection of the intrusion word to the others, in some cases it could be that the person does not have the expertise and overview to see the connection. In Arnold (2016)'s experiment concerning topic evaluation and human interpretability, primary care physicians outperformed medical students in both identifying words that do not belong under a certain topic and assessing the different models' level of representation of the documents. The results of this experiment reinforces the possibility of necessary prior knowledge in the specific field when the majority of the documents are concerned with a specialized and distinct field. In other words, due to the final step of human involvement for topic interpretation, certain prior human judgment is also necessary to produce results that are interpretable. With a mixed approach, which this thesis has employed, qualitative support facilitated and consolidated more accurate comprehension and interpretability by referring to the original document.

4.4 Necessity of Qualitative Research Supplement

In this thesis, qualitative research has been utilized to determine sentiment when necessary. For example, wind measurements, as one of the areas for investment contribution according to Figure 19 also occurred as keywords for the Cantons and communes. The appearance of wind measurement as a keyword only indicates a frequent notion on this policy instrument from this group, it is not however, precise on whether investment contribution for wind measurement is supported, renounced or anything in between. Hence, in case of such ambiguity and necessity to understand the sentiment, qualitative research can be of assistance.

It could be argued that a sentiment analysis would be more efficient and productive than qualitative research when the knowledge of the sentiment is necessary. Though sentiment analysis is more efficient in the sense that it is faster to compute than pure reading, it provides an overall sentiment of the document, or the position paper of the individual stakeholder. Hence, the results from sentiment analysis do not solve the issue of understanding the orientation regarding a specific keyword but the overall view towards the entire energy revision law draft. It is possible to extrapolate the sentiment for the overall document to the specific words that constitute the topic the document is allocated to, however, such extrapolation pales in front of the certain and concrete results from qualitative research.

Again, though the sentiment can be useful and deepen our understanding of the stakeholders, this thesis seeks mainly to find the determinants of stakeholders' orientations; which keywords are valued the most by certain stakeholders, in which changes within the field of those keywords would alter the position of the stakeholder towards the whole revision draft. Having this aim in mind, the overall sentiment does not add much more value against topic modeling with selective qualitative research support.

5. Conclusion

5.1 Insight to Stakeholders' drivers

Using topic modelling, a Natural Language Processing (NLP) tool that mines the underlying hidden topical patterns, insights could be gained on the drivers that are important to the stakeholders with influence on them. Overarching focuses emerged from the majority of stakeholders. The highest concern is the security of supply, especially during the winter. The frequent occurrence of keywords such as auctions and sliding market-premium indicates an openness for market-competitive support mechanisms that reduce distortions. Additionally, regulation on self-consumption was dominant in the discourse and energy supply costs remain one of the fundamental considerations during policy acceptance.

Furthermore, we observe through the clusterings, that types of stakeholders such as wastewater treatment plants and waste incineration plants, wood-relevant stakeholders, farmers' associations and wind-relevant stakeholders are highly aligned among themselves, their positions are coherent among each other. Wastewater treatment plants and waste incineration plants require investment planning security and a subsidy regime that takes into consideration the fees they pay for the waste. They advocate for inclusion of heat energy into the support scheme. Wood-relevant stakeholders also notes on the inclusion of renewable heat and feed-in-tariff. The cement industry clustered within the same subgroup as the wood industry indicates its grip on biomass as their primary tool for reducing emissions in industry. The farmers' association not only notes on the inclusion of heat but also the additional investment costs, operational costs and self-consumption for rural buildings. Wind-relevant stakeholders largely deem themselves as a source of local, national and domestic basic energy supply, which could also provide electricity during winter, and requires investment security. For wind-relevant stakeholders the construction permit procedure remains as a fundamental concern, along with the role of the cantons as enablers in the licensing procedures.

Types of stakeholders that are relatively clustered together but have niche fractioning and differences are solar-based stakeholders and large energy utility and production companies. The division among solar-based stakeholders lays on the different target areas for solar technology expansion; one group promotes its utilization in the building sector with incentivization and self-consumption, while the other focuses on electricity market models favouring solar energy; in terms of network surcharges, redelivery tariffs, market price, electricity price and investment

security. The energy utility and production companies can be characterized into an Alpiq-led coalition and Axpo-led coalition. The major difference between the two coalitions is that Alpiq-led coalition centers around aspects of the electricity market, such as the electricity supply law, winter production, auctioning, end consumers and investment incentives; on the other hand, Axpo-led coalition takes on storage and sector coupling. Nevertheless, both acknowledges the role of large-scale hydropower plants.

The final category of stakeholders are classified as scattered, which implies that their positions are not based on the energy technology they are associated with or the type of stakeholders they belong to. They are observed to be sprinkled in all the different subgroups. In this case they are political parties, cantons and municipalities. With further complimentary qualitative research support, we can conclude that for cantons and municipalities, the maintenance of large-scale hydropower in terms of licensing and renewal subsidies remains key, further exploitation of solar energy potential on top of auctioning of large-scale solar installations should be considered, and support instrument targeting winter energy production should be called for. Regarding political parties, there is an overall concern for planning security and risk cushioning for energy technology investments. Furthermore, a relatively clear divide between the liberal and left-wing parties emerges. Liberal parties intent to expand auctions to further technologies (wind, biomass…), while left-wing parties notion to emphasize on energy efficiency and sufficiency along with urban spatial regulations.

5.2 Policy Implications

The conclusions drawn from our results have policy implications on RE technologies' deployment. The current stakeholder opinions can be characterized into three strains; the ones promoting a more market-competitive, stable, and consistent framework with "sliding market premium", "auctions" and "tenders, the ones who are do not fundamentally oppose to such a framework but concerns themselves with the source of funding because long-term support mechanism would require a larger funding pool than the current rate of network surcharges, and finally, the ones that are opposed of any type of subsidies as they are considered market distortive. Noting on the conflicting nature of these major strains, policymaking for the promotion of RE in Switzerland remains challenging.

Results from topic modelling are valuable in identifying the most fundamental and primary drivers, instead of the orientation and mentality of the stakeholders that are reflected from the

three strains through qualitative research. Though most wind-relevant stakeholders propose the hybrid-model of investment contribution based on sliding market premium, their key issues boil down to the acceleration of "construction permit" processes, the role of "cantons" in assessing its environmental impact on the "local" level and generally, "investment" security. Improvements along these lines would be not only welcomed but also impactful as they would solve the root causes of the stagnation in wind energy uptake in Switzerland. At the same time, such changes would not be in direct conflict with the others. For solar-relevant stakeholders, the niche fractioning highlights the stakeholders two priorities at this stage; strengthening of solar energy in the building sector and a re-evaluation of the electricity model in favour of solar electricity, such as having a centralized uniform "redelivery tariff" for solar plants that also "self-consume". For wood-relevant stakeholders, the discontinuation of "feed-in-tariff" for wood-fired power plants and wood-heat cogeneration plants is contentious as these stakeholders' require "planning security". Hence, regardless of which specific instrument is to be implemented for wood-based power plants, consistency and stability needs to be ensured. Finally, hydropower remains as the source of "basic supply", essential for "winter production" and deserving of further investment incentives".

These crucial findings based on energy technologies highlighted by topic modelling can assist in making more feasible policies in promotion of renewable energy and avoid the time-consuming process of multiple revisions due to rejection by the stakeholders or public. Furthermore, energy scenario modelling often require a prioritization of policies as only the policies potentially feasible and acceptable in a country would be considering to be implemented to evaluate their impact. In the POLIZERO project[6], the result of this thesis will be used to prioritize the potential policy instruments, which will be plugged into a large-scale energy systems model to further assess their impact and make policy recommendations (JRC-EU-TIMES, 2021).

[6] www.polizero.ch

6. Outlook

Though the thesis results, key drivers for the majority of the stakeholders were extracted, explaining also the clusterings, there are multiple directions the thesis can be built upon for further research; such as expanding the corpus, subsystem and time horizon.

6.1 Expansion of corpus

There are many other sources for textual data to further the understanding of stakeholders for research questions that do not have a targeted focus on current policies, as this thesis does. Further textual data could be sourced from tweets, facebook posts or any other form of social media. Social media information constitutes a ssubstantial starting point to have a grasp on the general public's perception on certain topics. It is worth noting, though many institutions in Switzerland have a social media account, many still do not or are inactive. Therefore, an analysis based solely from social media could have a reduced sample pool, however, as it could be a useful complimentary data source built upon other sources. If more comprehensive political opinions on the "elite" level are desired, textual data in Switzerland is not limited to just position papers but also Federal Council transcripts and reports. Similarly, parliamentary debates are also recorded in transcripts and reports. These legal documents could boost the corpus and further accentuate the keywords under the environment of a larger word count.

6.2 Expansion of Subsystem

The road to decarbonization involves not only the energy subsystem but also climate, biodiversity, agriculture, and water management subsystems. The position papers from other subsystems could also be taken into consideration to strengthen the understanding of the particular stakeholders. However, not all participants during the consultation phase would be involved in another consultation, therefore, there could be little stakeholders in common among the different subsystems.

6.3 Expansion of time horizon

Finally, positions from different time periods regarding the same piece of law from these stakeholders can be explored by developing a time series including previous positions papers. In doing so, concepts from the Advocacy Coalition Framework (ACF) can be more

comprehensively analyzed, by understanding the progression in “deep core beliefs”, “policy core beliefs” and “secondary policy beliefs” to further enhance our understand towards Swiss stakeholders (Sabatier, 1998).

References

Amado, A., Cortez, P., Rita, P., & Moro, S. (2018). Research trends on Big Data in Marketing: A text mining and topic modeling based literature analysis. *European Research on Management and Business Economics, Volume 24, Issue 1*, 1-7.

Arnold, C. W., Oh , A., Chen, S., & Speier, W. (2016, Febuary). Evaluating topic model interpretability from a primary care physician perspective. *Computer methods and programs in biomedicine, 124*, 67-75.

Bischof, J. M., & Airoldi, E. M. (2012). Summarizing topical content with word frequency and exclusivity. *Proceedings of the 29th International Conference on Machine Learning, ICML*, (pp. 201-208).

Blei, D., Ng, A., & Jordan, M. (2001). Latent Dirichlet Allocation. *Journal of Machine Learning Research*, 601-608.

Bundesamt für Umwelt . (2021, January 26). *Long-term climate strategy to 2050*. From Bundesamt für Umwelt BAFU: https://www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/emission-reduction/reduction-targets/2050-target/climate-strategy-2050.html

Bundesamt für Umwelt. (2021, July 13). *CO2-Gesetz und Klimaschutz*. From Bundes Amt für Umwelt BAFU: https://www.bafu.admin.ch/bafu/de/home/themen/klima/dossiers/klimaschutz-und-co2-gesetz.html

Chen, B., Zhu , L., Kifer, D., & Lee, D. (2010). What Is an Opinion About? Exploring Political Standpoints Using Opinion Scoring Model. In *Proceedings of the Twenty-Fourth (AAAI) Conference on Artificial Intelligence.* Atlanta.

Cohen , R., & Ruths, D. (2021). Classifying political orientation on Twitter: It's not easy! *Proceedings of the International AAAI Conference on Web and Social Media, 7(1)*, 91-99.

Deerwester, S., Dumais, S. T., Furnas, G. W., Landauer, T. K., & Harshman, R. (1990). Indexing by Latent Semantic Analysis. *Journal of the American Society for Information Science, 41*(6), 391-407.

Duygan, M., Kachi, A., Oeri, F., Oliveira, T. D., & Rinscheid, A. (2022). A Survey of Stakeholders' Views and Practices. In *Swiss Energy Governance* (pp. 369-394). Cham: Springer.

Eickhoff, M., & Wieneke, R. (2018). Understanding Topic Models in Context: A Mixed-Methods Approach to the Meaningful Analysis of Large Document Collections. *Hawaii International Conference on System Sciences.* Hawaii.

Energiegesetz Vorentwurf. (2020, April). From Fedlex: https://www.fedlex.admin.ch/filestore/fedlex.data.admin.ch/eli/dl/proj/6020/14/cons_1/doc_1/de/pdf-a/fedlex-data-admin-ch-eli-dl-proj-6020-14-cons_1-doc_1-de-pdf-a.pdf

Evangelos, Panos; Kober, Tom ; Ramachandran, Kannan ; Hirschberg, Stefan. (2021). *Long-term Energy Transformation Pathways.* Villigen: Paul Scherrer Institute.

Fan, T. J., Lemaitre , G., Grisel , O., Addepalli , S., Hug, N., Boisberranger , J. d., . . . Larsson, F. (2007). *scikit-learn*. From github: https://github.com/scikit-learn/scikit-learn/blob/0d378913b/sklearn/decomposition/_lda.py#L141

Ganegedara, T. (2018, August 23). *Intuitive Guide to Latent Dirichlet Allocation*. From towardsdatascience: https://towardsdatascience.com/light-on-math-machine-learning-intuitive-guide-to-latent-dirichlet-allocation-437c81220158

Gerard, S., & McGill, M. (1983). Introduction to Modern Information Retrieval.

Hartmann, M. (2007). *Eliten und Macht in Europa: ein internationaler Vergleich.* Frankfurt : Campus.

Hofmann, T. (1999). Probabilistic Latent Semantic Analysis. *Uncertainty in Artificial Intelligence.* Stockholm.

Ingold, K., Kammerer , M., & Metz, F. (2019). Are responses to official consultations and stakeholder surveys reliable guides to policy actors' positions? *Policy & Politics, 48*, 1-30.

Ingold, K., Stadelmann-Steffen, I., & Kammermann, L. (2018). The Acceptance of Instruments in Instrument mix Situations: Citizens' Perspective on Swiss Energy Transition. *Research Policy*.

JRC-EU-TIMES. (2021). From Polizero: https://polizero.ch/jrc-eu-times

Kammermann, L., & Ingold, K. (2019). Going beyond technocratic and democratic principles: Stakeholder acceptance of instruments in Swiss energy policy. *Policy Sciences*.

Ma, A., & Chen, P. (2019). *Trace Data Consulting Project: Topic Modeling - LDA.* From github: https://mandiema.github.io/tdconsulting/

Malik, U. (2019, April 13). *Python for NLP: Topic Modeling*. From StackAbuse: https://stackabuse.com/python-for-nlp-topic-modeling/

Matthews, P. (2019). Human-in-the-loop: Topic Modelling Assessing topic labelling and genre-topic relations with a movie plot summary corpus. *ISKO-UK Biennial Conference.* London.

Motz, A. (2021). Consumer acceptance of the energy transition in Switzerland: The role of attitudes explained through a hybrid discrete choice model. *Energy Policy Volume 151*.

Naskar, A. (2021). *Latent Dirichlet Allocation for Beginners: A high level overview.* From Think Infi: https://thinkinfi.com/latent-dirichlet-allocation-for-beginners-a-high-level-overview/

Pappi, F. U., & Henning, C. H. (1998). Policy Networks: More Than a Metaphor? *Journal of Theoretical Politics* .

Rabindranath, G. (2021, June 22). *Topic Modeling with LDA Explained: Applications and How It Works*. From high demand skills: https://highdemandskills.com/topic-modeling-intuitive/#h2-3

Sabatier, P. A. (1998). An Advocacy Coalition Framework of Policy Change and the Role of Policy-Oriented Learning Therein. *Policy Sciences* , 129-168 .

Schweizerisches Zivilgesetzbuch. (2017, January 1). From Fedlex: https://fedlex.data.admin.ch/filestore/fedlex.data.admin.ch/eli/cc/24/233_245_233/20170101/de/pdf-a/fedlex-data-admin-ch-eli-cc-24-233_245_233-20170101-de-pdf-a.pdf

Sievert, C., & Shirley, K. E. (2014). LDAvis: A method for visualizing and interpreting topics. *Workshop on Interactive Language Learning, Visualization, and Interfaces at the Association for Computational Linguistics.*

Visualising topics as distributions over words¶. (n.d.). From bl.ocks: http://bl.ocks.org/AlessandraSozzi/raw/ce1ace56e4aed6f2d614ae2243aab5a5/

Walter , G. (2014). Determining the local acceptance of wind energy projects in Switzerland: The importance of general attitudes and project characteristics. *Energy Research & Social Science*, 78-88.

Wolf, L., & Müller, S. (2010). *Swiss Democracy: Possible Solutions to Conflict in Multicultural Societies.* London: Palgrave Macmillan.

Yau, C.-K., Porter, A., Newman , N., & Suominen, A. (2014). Clustering scientific documents with topic modeling. *Scientometrics Volume 100*, 767–786 .

Appendix A

Table 1. Corresponding German words for the terms in the typology

Nature of Interest Groups	**Original Language (DE)**	**Numbers**
Association	Verband	66
Canton	Kanton	26
Energy Production Company	Energieerzeugungsunternehmen	21
Society	Verein	26
Energy Utility Company	Energieversorgungsunternehmen	13
Political Party	Politische Partei	10
Commune	Gemeinde	6
Energy Service Provider	Energiedienstleister	6
Cooperative	Genossenschaft	6
Foundation	Stiftung	6
Union	Vereinigung	5
Competence Center	Kompetenzzentrum	4
Conference	Konferenz	4
Electricity Network	/	4
Academia	Akademie	3
Working Group/Task Force/Technical Advisory Groups	Arbeitsgruppe	3
Federal Office	Bundesamt	3
Non-Governmental Organisations	Non-Profit-Organisation	2
Electricity wholesaler	Elektrizität Großhändler	1
Think Tank	Think Tank	1
Privat Individual	/	1

General Assembly	Generalversammlung	1
Investment Fund	/	
Community	Gemeinschaft	1
Miliz Body	Milizbehörde	1

Appendix B

Table 2. The list of Stop words

'dank', 'antrag', 'fur', 'sts', 'kuenftig', 'liegt', 'mwen', 'ener', 'richtw
ert', 'moeglich', 'siebenter', 'endken', 'einiger', 'vielen', 'kwp', 'á', 'o
ffentlichen', '-seen', 'allem', 'sie', 'unserem', 'anzupassen', 'ausbauzalte
n', 'genannten', 'sonst', 'mögen', 'beispielsweise', 'kam', 'darüber', 'soll
en', 'energiegesetzen', 'waere', 'geschaffen', '≈', 'zehn', 'wessen', 'eole
', 'ganzes', 'gegenüber', 'durchaus', 'ace', 'bisherigen', 'endkunde', 'der
', 'erzeugung', 'ihnen', 'frage', 'demgemäß', 'endkundinnen', 'manchem', 'nu
tzung', 'verfuegbaren', 'die', 'zusatzliche', 'rpkwh', 'bv', 'etwas', 'derma
ssen', 'tor', 'auch', 'den', 'projekte', 'strom', 'nahm', 'zwingend', 'ersch
eint', 'demselben', 'muessen', 'weniges', 'lang', 'beiden', 'daten', 'über',
 'alpiq', 'werdet', 'foerderungen', 'zwar', 'drittes', 'einmal', 'verguetung
', 'muessten', 'rechte', 'ist', 'geschweige', 'beruecksichtigung', 'rage', '
sagte', 'allen', 'währenddessen', 'mio', 'schon', 'großen', 'dementsprechend
', 'etwa', 'kleines', 'uns', 'darin', 'muess', 'unsere', 'muß', 'energiepers
pektive', 'dahinter', 'jemanden', 'fuer', 'dadurch', 'pro', 'for', 'ausbauzi
elen', 'unten', 'adressiert', 'beide', 'maien', 'veeng', 'anforderung', 'erf
olgende', 'erneuerbarern', 'besteht', 'ihm', 'solchem', 'getatigt', 'eicom',
 'rechtes', 'ausserdem', 'aktuellen', 'wichtige', 'o', 'trotzdem', 'meines',
 'gwhen', 'bis', 'ca', 'zwischen', 'klar', 'oben', 'gleitenden', 'strommarkt
', 'null', 'her', 'vierter', 'anderem', 'bemerkungen', 'neue', 'lene', '-',
'welche', 'kunden', 'und', 'wollen', 'wesentlichen', 'davon', 'muesste', 'dr
itten', 'also', 'wuerden', 'begrusst', 'gilt', 'bereichen', 'derjenigen', 'e
wz', 'andere', 'schweizweite', 'zusaetzlich', 'sechsten', 'dasselbe', 'sofer
nene', 'ara', 'wenig', 'https', 'eines', 'mehr', 'gen', 'peb', 'heute', 'ana
log', 'gegenueber', 'entwurf', 'gesamte', 'je', 'zweiten', 'sah', 'neu', 'fn
', 'hier', 'modelle', 'worden', 'kommen', 'araten', 'lange', 'Akademien', 'b
eruecksichtigen', 'zielwert', 'a', 'kva', 'gehen', 'dieselbe', 'strategie',
'problem', 'aten', 'deswegen', 'denn', 'gegen', 'duerfen', 'gas', 'dasein',
'kosten', 'Erneurbar', 'wenigstens', 'koennen', 'gwh', 'bzw', 'entwicklungsz
alten', 'darunter', 'produzierte', 'vorschlagen', 'investitionsbeitrag', 'ke
inem', 'wasserkraftwerke', 'grosser', 'coterie', 'fünftes', 'nach', 'jahr',
'jedermann', 'gesamten', 'ziel', 'ganze', 'genug', 'wind', 'wann', 'stellung
', 'schweizweit', 'am', 'wie', 'kurzfristig', 'e', 'bundesrat', 'trage', 'ma
n', 'speziell', 'generieren', 'hatte', 'ehehaften', 'gut', 'wollt', 'erloese
', 'zielwerten', 'ib', 'tage', 'dass', 'vorliegende', 'unterstuetzung', 'gsc
hg', 'genutzt', 'gross', 'bericht', 'überhaupt', 'windenergie', 'solches', '
einschließlich', 'so', 'branchen', 'erhalt', 'vorstehend', 'zukunfen', 'fünf
ter', 'noch', 'viele', 'fiiren', 'vorlage', 'ausgestaltung', 'außer', 'aktue
ll', 'weder', 'selbstverstaendlich', 'vom', 'forderung', 'hohe', 'mrd', 'vie
rte', 'gemacht', 'konnen', 'dazwischen', 'weiter', 'begrussen', 'hast', 'dan
eben', 'einander', 'schafft', 'besser', 'steigerung', 'zur', 'erstes', 'ausb
au', 'sechster', 'antragen', 'gruenden', 'da', 'eu', 'eng', 'jeder', 'verbra
ucheren', 'produktionsanlagen', 'wirklich', 'entsprechenden', 'neunten', 'gr
oße', 'elf', 'nachfrage', 'swisspower', 'grosses', 'nichts', 'welches', 'wir
d', 'zusaetzliche', 'erhebliche', 'noetig', 'fdp', 'alle', 'investitionsbeit
ragen', 'muss', 'demgemäss', 'lnvestitionen', 'akzeptanz', 'erheblichen', 'w
er', 'fmv', 'bunden', 'zusammen', 'dieselben', 'einen', 'einfuehrung', 'foer
dermittel', 'bezeichnung', 'dagegen', 'kleine', 'service', 'neun', 'dein', '
zusaetzlichen', 'beruecksichtigt', 'geht', 'von', 'energiestrategie', 'ihn',
 'soll', 'achtes', 'übrigens', 'jedoch', 'erster', 'im', 'bestehender', 'str
omversorgung', 'anreize', 'ersatz', 'lenen', 'diesen', 'sein', 'hätte', 'pro
duzieren', 'kap', 'ausschreibungen', 'c', 'bauen', 'ihres', 'jemand', 'darf
', 'schaffen', 'sofernen', 'in', 'weiteren', 'achten', 'investitionen', 'sol
lten', 'gemocht', 'ueber', 'sich', 'deinem', 'bspw', 'jenem'

'kw', 'indem', 'musste', 'mittel', 'eigen', 'hoehe', 'koennten', 'stellt', '
allerdings', 'dabei', 'zeit', 'ag', 'weiterhinen', '■', 'demgegenüber', 'bio
gas', 'projeken', 'maßnahmen', 'gemessen', 'eigener', 'würde', 'uvek', 'dir
', 'weiterfuehrung', 'abs', 'sehen', 'pskw', 'dieses', 'des', 'insbesondere
', 'ziele', 'dieser', 'vorgeschlagene', 'gemeinden', 'einiges', 'tun', 'stro
mproduktion', 'regierungsrat', 'hinter', 'gedurft', 'siehe', 'drin', 'müssen
', 'gemusst', 'schweizer', 'photovoltaik', 'vorschalg', 'derzeit', 'besten',
 'später', 'gern', 'folgt', 'antragene', 'anbetracht', 'entstehend', 'verfah
ren', 'konferenz', 'allein', 'zeigt', 'richtig', 'endlich', 'siebentes', 've
rnehmlassungsvorlagen', 'alles', 'beitrage', 'vgl', 'energiegesetzes', 'zeit
punkt', 'morgen', 'sab', 'vernehmlassung', 'haben', 'ober', 'sagt', 'verordn
ung', 'daraus', 'doch', 'stadtverwaltung', 'erfolge', 'erneuerbarer', 'Strom
und', 'desselben', 'grosse', 'welchen', 'kannst', 'seen', 'stellungnahme', '
neunter', 'umweltfreisinnigen', 'nee', 'ena', 'ohne', 'aufgabe', 'zweite', '
rund', 'will', 'ueberarbeitung', 'gemass', 'pariser', 'zugunst', 'energiever
sorgung', 'ihren', 'habt', 'erst', 'eben', 'zurzeit', 'wir', 'demzufolge', '
bfe', 'wirtschaft', 'seine', 'bestimmung', 'natürlich', 'vas', 'tel', 'geoth
ermie', 'moeglichkeiten', 'euch', 'sen', 'ausser', 'wenige', 'anspruch', 'ta
t', 'keiner', 'früher', 'wasserkraftwerk', 'können', 'grafik', 'rolle', 'tei
lweise', 'setzen', 'ausschliesslich', 'könnte', 'erhalten', 'folgenden', 'ka
ntonale', 'mw', 'werdenart', 'deine', 'schaffung', 'zunächst', 'gwha', 'hätt
en', 'daß', 'eigene', 'annahmen', 'fjof', 'seit', 'gar', 'sondern', 'an', 'd
amals', 'zehnter', 'aenderungen', 'entwicklung', 'kwha', 'das', 'sicht', 'be
darf', 'bleiben', 'braucht', 'diesem', 'artikel', 'neunte', 'soferne', 'nur
', 'außerdem', 'bdp', 'kein', 'koennte', 'dafür', 'magst', 'hoechstens', 'st
aatsrat', 'groß', 'forderungen', 'betreffend', 'großer', 'werden', 'angeben
', 'fest', 'gruenliberale', 'wurden', 'nationalrat', 'entsprechen', 'seitdem
', 'es', 'sechstes', 'grenze', 'abb', 'folgen', 'stadt', 'gerade', 'moeglich
keit', 'entsprechende', 'loesung', 'gutes', 'damit', 'mindestens', 'technolo
gie', 'selbst', 'ingesamt', 'ausbauziel', 'zugleich', 'aenderung', 'anders',
 'erreichen', 'richtwerten', 'oder', 'ganzen', 'aber', 'um', 'dahin', 'absat
z', 'vollstaendigen', 'gemaess', 'einsatz', 'guter', 'wirst', 'ausbauziele',
 'spielt', 'niemand', 'evs', 'tag', 'dann', 'nutzen', 'siebter', 'hinblick',
 'grundsaetzlich', 'prozent', 'drei', 'rahmen', 'zuerst', 'neben', 'sei', 'a
pril', 'machte', 'deren', 'vue', 'allgemeinen', 'aspeken', 'investoren', 'wa
ren', 'eine', 'na', 'zurn', 'ende', 'installation', 'teilnehmen', 'durch', '
keine', 'bzwen', 'kaum', 'mancher', 'bestehende', 'jede', 'studien', 'waehre
nd', 'daselbst', 'gehabt', 'ausland', 'wald', 'offen', 'weg', 'zweiter', 'bi
omasseanlagen', 'durften', 'Finanzierungsmodell', 'sechs', 'deutlich', 'beit
ragene', 'wasserkraft', 'gee', 'uhr', 'angesichts', 'i', 'lediglich', 'erste
n', 'lnvestitionsbeitragen', 'nachdem', 'tagen', 'jemandem', 'siebente', 'ze
igen', 'erste', 'müsst', 'dekarbonisierung', 'migros', 'insgesamt', 'einem',
 'aet', 'moegliche', 'zustimmung', 'meine', 'gekonnt', 'mögt', 'mittels', 't
jahr', 'art', 'obern', 'wichtigen', 'gleitende', 'seid', 'dritter', 'dich',
'manche', 'einfuehrungen', 'unseres', 'namentlich', 'elcom', 'mobilitaet', '
kantone', 'eigenen', 'nehmen', 'stehen', 'sehr', 'gmbh', 'eigenverbrauch', '
maximal', 'vsen', 'ersetzen', 'steht', 'seinem', 'moeglichen', 'enaten', 'be
stehenden', 'darum', 'klimaabkommens', 'weiterhin', 'zurich', 'abstimmung',
'mein', 'ins', 'vorschalgen', 'swiss', 'nr', 'antrage', 'meinem', 'währendde
m', 'gleich', '➔', 'kantonen', 'verfugung', 'nie', 'zb', 'rpg', 'interesse
', 'twh', 'mit', 'kommt', 'klimaziel', 'hohen', 'bund', 'aus', 'welchem', 'z
ehntes', 'aeussern', 'absichts', 'hev', 'werde', 'einigen', 'kraftwerke', 'd
urfte', 'sicherung', 'jahre', 'ob', 'kleinen', 'seiner', 'energetisch', 'stu
die', 'jeden', 'sowie', 'ein', 'derselben', 'organisationen', 'anlage', 'vor
teil', 'heisst', 'dazu', 'einzelnen', 'stossrichtung', 'leicht', 'mochte'

```
'erzeugte', '\xad', 'bereich', 'hoch', 'danken', 'kwkw', 'rechter', 'sollte
', 'regelung', 'rechten', 'betragen', 'gesamtschweizerisch''dermaßen', 'ben'
'vierten', 'anpassen', 'weniger', 'seines', 'nimmt', 'fr', 'neuntes', 'vfas
', 'einmaleins', 'kanton', 'denselben', 'vorschlag', 'storm', 'erfolgt', 'kr
aftwerk', 'erforderlich', 'meinung', 'ja', 'grossen', 'fünften', 'auktionen
', 'fünf', 'mag', 'laeng', 'sinne', 'ebenso', 'dürfen', 'begruesst', 'winter
', 'biomasse', 'ab', 'acht', 'wart', 'unterstuetzt', 'stormversorgung', 'fol
ge', 'bundesrates', 'gemeinde', 'fordern', 'treibstoff', 'stark', 'mal', 'fo
ren', 'moeglichst', 'vorentwurf', 'erfolgen', 'oft', 'andern', 'regierung',
'technologien', 'verbleibenden', 'dessen', 'massnahme', 'beitragen', 'ihrer
', 'wollte', 'willst', 'hoehen', 'sechste', 'subventionen', 'ver\xad', 'bei
', 'wesentlich', 'konnte', 'bundes', 'festlegung', 'jene', 'aspekte', 'schle
cht', 'dürft', 'macht', 'grund', 'wegen', 'genommen', 'teil', 'blick', 'nun
', 'ihrem', 'ihr', 'erhoehung', 'unserer', 'kraftwerken', 'gewollt', 'begrue
ssen', 'fordert', 'dem', 'vorgesehen', 'energieetikette', 'siebten', 'sinnvo
ll', 'petition', 'eb', 'energiegesetz', 'be', 'ebenfalls', 'bin', 'konnten',
 'infolgedessen', 'marktpraemien', 'festgelegt', 'hoehere', 'instrumente', '
lieber', 'verfuegung', 'public', 'gibt', 'manches', 'innen', 'bezug', 'beste
hendenden', 'neuer', 'streichen', 'erstellt', 'gesetzen', 'dafuer', 'verschi
edenen', 'rahmenbedingungen', 'stormerzeugung', 'schreiben', 'bald', 'nieman
den', 'gesagt', 'unser', 'chf', 'welcher', 'zukunft', 'großes', 'weitere', '
zweites', 'energie', 'biomassen', 'hin', 'gewesen', 'b', 'entweder', 'ausger
ichtet', 'wieder', 'stromerzeugung', 'solchen', 'nein', 'investore', 'schwei
z', 'aller', 'siebenten', 'immer', 'tatsaechlich', 'laufenden', 'vsa', 'er',
 'mir', 'swissgrid', 'anpassungen', 'irgend', 'bundesamt', 'ccig', 'paneele
', 'elektrizitaet', 'oeffentlichen', 'leider', 'entsprechend', 'hinaus', 'pr
ojekten', 'investitionsbeitraege', 'was', 'regierungen', 'ziffer', 'monatlic
he', 'stromvg', 'cvp', 'weit', 'gesamen', 'wenn', 'meiner', 'stromabkommen',
 'wohl', 'meinen', 'für', 'anreiz', 'gleichzeitig', 'danach', 'vanen', 'heut
igen', 'sowohl', 'grunden', 'system', 'derselbe', 'betrieb', 'resp', 'akw',
'achter', 'twha', 'basis', 'mussten', 'darauf', 'denen', 'u', 'gasetz', 'zwe
i', 'zudem', 'tiefe', 'potenzial', 'wichtig', 'bau', 'los', 'mai', 'revision
', '≈ ', 'voraussichtlich', 'investitionsbeitragenen', 'habe', 'fahrzeug', '
eloe', 'ich', 'vgln', 'naemlich', 'is', 'ermoeglichen', 'lasst', 'duktion',
'jenen', 'entgegen', 'suisse', 'obwohl', 'auf', 'erachtet', 'pronovo', 'vor
', 'wen', 'neuund', 'somit', 'eautos', 'zwanzig', 'wuerde', 'daher', 'einfac
h', 'alleine', 'wäre', 'netto', 'dies', 'kann', 'viertes', 'vorgeschlagen',
'deshalb', 'davor', 'stormerzeugungen', 'x', 'zurück', 'entspricht', 'erneur
bar', 'foerdern', 'gegensatz', 'standeskommission', 'gr', 'möchte', 'vergang
ene', 'musst', 'energien', 'bereits', 'sind', 'bfen', 'verbindliche', 'mocht
en', 'deiner', 'gem', 'parlament', 'prufen', 'siebte', 'staerker', 'gute', '
viel', 'solang', 'mich', 'ach', 'als', 'besonders', 'vse', 'jahren', 'anteil
', 'notwendig', 'wp', 'vorgabe', 'vorgeschlagenen', 'wem', 'zehnte', 'jetzt
', 'keinen', 'erlaeuternder', 'zu', 'ekz', 'du', 'erlaeuternden', 'abnahmeun
d', 'zusatzlichen', 'lassen', 'halten', 'dafur', 'achte', 'franken', 'bloss
', 'ging', 'vorgaben', 'er\xad', 'zielen', 'schlagen', 'dsv', 'jenes', 'voll
staendig', 'angedachten', 'bemerkung', 'seinen', 'begrußen', 'wurde', 'erhoe
ht', 'biomasseanlage', 'leistung', 'zusammenhang', 'jaehrlich', 'bist', 'auf
grund', 'ihre', 'tragen', 'produktion', 'anderen', 'wahr', 'machen', 'hat',
'foerdermassnahmen', 'seite', 'ermoeglicht', 'gesetz', 'diese', 'eigenes', '
unterstuetzen', 'einige', 'jugendsession', 'vier', 'fuehrt', 'geworden', '•
', 'gild', 'pruefen', 'umsetzung', 'foedern', 'ganzer', 'sieht', 'angaben',
'begruendung', 'hingegen', 'endkunden', 'jedem', 'ge\xad', 'begrueßen', 'efs
', 'kleiner', 'warum', 'wollten', 'informationen', 'darfst', 'modell', 'real
isiert', 'voe', 'gelten', 'bekannt', 'solarstorm', 'vielem', 'anpassung', 'b
ezueglich', 'gekannt', 'stand', 'fuehren', 'mueller', 'instrumentes', 'dort
', 'natuerlichen', 'swv', 'nicht', 'stellen', 'revisionsvorlage', 'mehrere'
```

```
's', 'heißt', 'langfristige', 'grundsaetzlichen', 'absicht', 'war', 'buchsta
ben', 'erhoht', 'derjenige', 'satt', 'investitionsbeitraegen''recht', 'beitr
ag', 'ansicht', 'solcher', 'vielleicht', 'kriterien', 'ehrlich', 'entwicklun
gen', 'bst', 'statt', 'versorgungssicherheit', 'abstimmungen', 'reveng', 'zu
bau', 'weiteres', 'bedeutung', 'modellen', 'würden', 'auslaufen', 'instrumen
t', 'gab', 'demnach', 'generiert', 'coemissionen', 'derzeitigen', 'ii', 'nie
mandem', 'liegen', 'anlagen', 'daran', 'zum', 'vpod', 'standorte', 'streichu
ng', 'zehnten', 'einer', 'ausdruecklich', 'van', 'unter', 'ejf', 'während',
'dritte', 'privaten', 'könnt', 'weil', 'möglich', 'beznau', 'jener', 'diejen
igen', 'en', 'empfehlen', 'massnahmen', 'kurz', 'ganz', 'investitionsbeitrag
ene', 'alten', 'erwartet', 'energiewende', 'fünfte', 'weko', 'diejenige', 's
ieben', 'voraus', 'gerne', 'hatten', 'notwendign', 'eeng', 'neuen', 'bhkw',
'erlaeuterungen', 'siebtes', 'lnvestitionsbeitrage', 'wo', 'motion', 'hinaus
en', 'arten', 'fall', 'beim', 'solche', 'bisher', 'manchen', 'beispiel', 'en
ergetischen', 'vergangenen', 'bestimmungen', 'seien', 'jedermanns', 'fiir',
'drittel', 'markt'
```

Appendix C

Table 3 Stakeholders Two-Level Grouping

Stakeholder	Sub_Group	Nature	SubNature
Energie Club Schweiz	0.1	Union	Energy/Climate/ Landscape
Carnot-Cournot Netzwerk	0.1	Think Tank	Political Consulting
Schweizerische Arbeitsgemeinschaft für die Berggebiete (SAB)	0.1	Community	Community
Task Force Wald +Holz +Energie	0.1	Working Group	Wood
WaldSchweiz	0.1	Association	Wood
Holzenergie Schweiz	0.1	Society	Wood
Verband der Schweizersichen Cementindustrie (Cemsuisse)	0.1	Association	Industry
Verband Fernwärme Schweiz (VFS)	0.1	Association	District Heating
Aarau	0.1	Canton	Canton
Holzindustrie Schweiz	0.1	Association	Wood
IG Holzenergie Nordwestschweiz	0.1	Society	Wood
Schweizerischer Verband des Personals öffentlicher Dienste (VPOD)	0.1	Association	Association
Lausanne	0.1	Canton	Canton
Vereinigung Kantonaler Gebäudeversicherungen (KGV)	0.1	Union	Building
Waadt	0.1	Canton	Canton
Obwalden	0.1	Canton	Canton
Uri	0.1	Canton	Canton
EPFL	0.1	Academia	Academia
BauenSchweiz	0.1	Association	Electricity
Appenzeller Wind AG	0.1	Energy Production Company	Wind
Holzenergie	0.1	Society	Wood
Arbeitsgruppe Christen +Energien (ACE)	0.1	Working Group	Nuclear
Smart Grid CH	0.1	Society	Distribution Network Operator
Azienda elettrica ticinese	0.1	Electricity Wholesaler	Electricity

Verband Aargauischer Stromversorger (VAS)	0.1	Association	Electricity
Associazione Catef-Camera Ticinese dell'Economia Fondiaria (CATEF)	0.1	Association	Building
Paysage Libre Fribourg	0.1	Association	Wind
Vereinigung Aargeuischer Abwasserreinigungsanlagen (VARA)	0.1	Union	Waste
Kommunikation Schweiz (ks/cs)	0.1	Association	Industry
Verband der Personalvertretungen der Schweizerischen Elektrizitätswirtschaft (VPE)	0.1	Association	Electricity
Schaffhausen	0.1	Canton	Canton
Eidgenössisch-Demokratische Union	0.1	Political Party	Political Party
FDP Die Liberalen	0.1	Political Party	Political Party
Thurgau	0.1	Canton	Canton
Schwyz	0.1	Canton	Canton
FDP Die Liberalen Ortspartei Weiningen ZH	0.1	Political Party	Political Party
St Gallisch Appenzellische Kraftwerk Ag (SAK)	0.1	Energy Production Company	Energy/Climate/ Landscape
Energia Legno Svizzera Italiana (AELSI)	0.1	Energy Production Company	Energy/Climate/ Landscape
Schweizerische Greina-Stiftung(SGS)	0.2	Foundation	Energy/Climate/ Landscape
Glarus	0.2	Canton	Canton
Solar Agentur	0.2	Society	Solar
Solothurn	0.2	Canton	Canton
Basel Landschaft	0.3	Commune	Commune
Zuerich	0.3	Canton	Canton
PV2Grid	0.3	Individual	Solar
Der Auto Gewerbe Verband Schweiz (AGVS)	0.3	Association	Mobility
Le Centre Patronal	0.3	Cooperative	Cooperative
Verband Unabhängiger Energieerzeuger (VESE)	0.3	Association	Energy/Climat/ Landscape
Schweizerische Solarenergie Vereinigung (SSES)	0.3	Union	Solar
Schweizer Alpen-Club (SAC)	1.1	Society	Energy/Climate/ Landscape

Pro Natura	1.1	Foundation	Energy/Climate/ Landscape
Stiftung PUSCH	1.1	Foundation	Energy/Climate/ Landscape
Schweizerischer Fischerei-Verband (SFV)	1.1	Association	Energy/Climate/ Landscape
Gebaeudehuelle Schweiz	1.1	Association	Building
Trift Komitee	1.1	Society	Energy/Climate/ Landscape
Verkehrs-Club der Schweiz (VCS)	1.1	Society	Mobility
WWF	1.1	Foundation	Energy/Climate/ Landscape
Aqua viva	1.1	Association	Energy/Climate/ Landscape
Bird Life	1.1	Association	Energy/Climate/ Landscape
Greenpeace	1.1	Non-Profit Organization	Energy/Climate/ Landscape
Chambre de Commerce d'Industrie et des Service (CCIG)	1.1	Association	Chamber Of Commerce
Schweizerische Energie-Stiftung	1.1	Foundation	Energy/Climate/ Landscape
Evangelische Volkspartei der Schweiz (EVP)	1.1	Political Party	Political Party
Schweizerischen Maschinen-, Elektro- und Metall-Industrie (Swissmem)	1.1	Association	Industry
Geneva	1.1	Canton	Canton
Gruene Partei der Schweiz (GPS)	1.1	Political Party	Political Party
Jugendsession	1.1	General Assembly	General Assembly
Sozialdemokratische Partei der Schweiz (SP)	1.1	Political Party	Political Party
Naturfreudue	1.1	Association	Energy/Climate/ Landscape
Abwasserreinigungsanlage Worblental	1.2	Energy Production Company	Waste
Abwassderverband Region Lenzburg	1.2	Association	Waste
Azienda Cantonale dei Rifuti	1.2	Energy Production Company	Waste
Schweizerischer Verband der Umweltfachleute (svu/asep)	1.2	Association	Professional
Zug	1.2	Canton	Canton
Schweizerische Volkspartei (SVP)	1.2	Political Party	Political Party

Touring Club Suisse (TCS)	1.2	Non-Profit Organization	Mobility
Isone	1.2	Commune	Commune
Aargauische Industrie-und Handelskammer	1.2	Association	Chamber Of Commerce
Villigen	1.2	Commune	Commune
Marugg +Bruni AG	1.2	Energy Production Company	Waste
EIT swiss	1.2	Association	Electricity
pronovo	1.2	Competence Center	Energy Production
Ryser Ingenieure AG	1.2	Energy Production Company	Waste
Infrawatt	1.2	Association	Waste
Teleiscaldamento del Bellinzonese SA (Teris)	1.2	Energy Production Company	Waste
Abwasserverband Altenrhein	1.2	Association	Waste
Abwasserverband Morgental	1.2	Association	Waste
Schweizerischer Baumeisterverband	1.2	Association	Farmer
Credit Suisse Energy Infrastructure Partners AG	1.2	Investment Manager	Investment Manager
Hauseigentuemerverband	1.2	Association	Building
Hunziker Betatech AG	1.2	Association	Waste
Energie Genossenschaft Schweiz	1.2	Cooperative	Energy/Climate/ Landscape
Teleriscaldamento del Bellinzonese SA	1.2	Energy Production Company	Waste
Stiftung Landschaftschutz Schweiz	1.2	Foundation	Energy/Climate/ Landscape
Gastro Suisse	1.2	Association	Industry
Pro Landschaft AR/AI	1.2	Association	Energy/Climate/ Landscape
Verband Schweizer Abwasser- und Gewässerschutzfachleute (VSA)	1.2	Association	Professional
Azienda Cantonale dei Rifiuti	1.2	Energy Production Company	Waste
Biomass	1.3	Society	Biomass
Holzbau Schweiz	1.3	Association	Wood
Verein für Umweltgerechte Energie (VUE)	1.3	Society	Energy/Climate/ Landscape
AEE Suisse	1.3	Association	Energy/Climate/ Landscape

Klimaschutz Schweiz/ Gletscher Initiative	2.1	Society	Energy/Climate/ Landscape
Vento ludens	2.1	Energy Production Company	Wind
Suisse Éole	2.1	Society	Wind
Verein Energiewende Muri-Gümligen	2.1	Society	Energy/Climate/ Landscape
Basel Stadt	2.2	Canton	Canton
Optima Solar	2.2	Cooperative	Solar
Buegerlich-Demokratische Partei Schweiz (BDP)	2.2	Political Party	Political Party
Regierungskonferenz der Gebirgskantone (RKGK)	2.2	Conference	Conference
Technischen Gemeindebetriebe (TGB)	2.2	Energy Service Provider	Energy Service Provider
Elektrizitätswerk der Stadt Zürich (ewz)	2.2	Electricity Network	Electricity Network
Dachverband Schweizer Verteilnetzbetrieber (DSV)	2.2	Association	Distribution Network Operator
Swiss Cleantech	2.2	Association	Political Consulting
Industrielle Werke Basel (IWB)	2.2	Energy Utility Company	Energy Utility
Verband Schweizerischer Elektrizitätsunternehmen (VSE)	2.2	Association	Electricity
Alpiq Holding AG	2.2	Energy Utility Company	Energy Utility
Christlichdemokratische Volkspartei (CVP)	2.2	Political Party	Political Party
Handelskammer Beider Basel	2.3	Association	Chamber Of Commerce
Regio Energie Solothurn	2.3	Energy Utility Company	Energy Utility
Kantonales Elektrizitätswerk Nidwalden (EWN)	2.3	Electricity Network	Electricity Network
Gruenliberale	2.3	Political Party	Political Party
Elektrzitätswerke des Kantons Zürich (EKZ)	2.3	Electricity Network	Electricity Network
Avenergy Suisse	2.3	Association	Mobility
Energie Thun AG	2.3	Energy Service Provider	Energy Service Provider
Energie Wasser Bern (ewb)	2.3	Energy Utility Company	Energy Utility
AVAG AG	2.3	Energy Production Company	Waste

Eniwa AG	2.3	Energy Utility Company	Energy Utility
Energie Uri	2.3	Energy Service Provider	Energy Service Provider
Association Non au prac Éolien	2.3	Association	Wind
H2 Energy AG	2.3	Energy Production Company	Hydrogen
Industrielle Betriebe Interlaken AG (IBI)	2.3	Energy Utility Company	Energy Utility
Erdgas Einsiedeln (gaz energie)	2.3	Energy Production Company	Gas
Schweizerischer Staedteverband	2.3	Association	Service
REPower	2.3	Energy Utility Company	Energy Utility
AutoSchweiz	2.3	Association	Mobility
Eidgenössische Elektrizitätskommission (EICom)	2.3	Federal Office	Electricity
BKW Energie AG	2.3	Energy Utility Company	Energy Utility
Centralschweizerische Kraftwerke AG (CKW AG)	2.3	Energy Utility Company	Energy Utility
Verband Freier Autohandel Schweiz (VFAS)	2.3	Association	Mobility
Axpo	2.3	Energy Utility Company	Energy Utility
Paysage Libre Freie Landschaft	2.3	Association	Energy/Climate/ Landscape
SwissPower	2.3	Competence Center	Energy
SwissGrid	2.3	Competence Center	Electricity Network
Die Solothurner Handelskammer	2.3	Association	Chamber Of Commerce
Casa.fair	2.3	Association	Building
Oberwalliser Gruppe Umwelt und Verkehr	2.3	Association	Mobility
Graubuenden	2.3	Canton	Canton
Zuerich City	2.3	Canton	Canton
POWERLOOP	2.3	Association	Heat
Swiss Small Hydro	2.3	Association	Hydropower
Energie Service Biel/Bienne (ESB)	2.3	Energy Service Provider	Energy Service Provider
Strasseschweiz	2.3	Association	Mobility
Verband der Schweizerischen Gasindustrie	2.3	Association	Gas

Eidgenössischen Natur-und Heimatschutzkommission (ENHK)	2.3	Federal Office	Energy/Climate/ Landscape
Neuchatel	2.3	Commune	Commune
Gaznat SA	2.3	Energy Production Company	Gas
Delemont	3.1	Commune	Commune
SACEN SA	3.1	Society	Electricity
Kraftwerke Oberhasli AG (KWO)	3.1	Energy Production Company	Energy Production Company
Schweizerischer Wasserwirtschaftverband (SWV)	3.1	Association	Hydropower
ETH Rat	3.1	Academia	Academia
Kraftwerk Hinterrhein AG (KHR)	3.1	Energy Production Company	Energy Production Company
Engadiner Kraftwerke AG (EKW)	3.1	Energy Production Company	Energy Production Company
Mettmenstetten	3.1	Commune	Commune
SolarSpar	3.1	Society	Solar
Service Industries des Genèva (SIG)	3.1	Association	Chamber Of Commerce
Swiss Solar	3.1	Society	Solar
Bern	3.1	Canton	Canton
STS Wind GmbH	3.2	Energy Production Company	Wind
Schweizerischer Verband für Umwelt Technik	3.2	Association	Professional
Wettbewerbskommission (WEKO)	3.2	Miliz Body	Miliz Body
La Forestière	3.2	Cooperative	Wood
FrauendaSchweiz Bäuerinnen-und Landfrauenverband	3.2	Association	Farmer
Fachverbamd Landwirtschaftliches Biogas (Ökostorm)	3.2	Association	Gas
Eidgenössischen Kommission für Konsumentenfragen (EKK)	3.2	Federal Office	Industry
Berner Bauern Verband	3.2	Association	Farmer
Mhylab	3.3	Competence Center	Hydropower
St.Gallen	3.3	Canton	Canton
InteressenGemeinschaft Energieintensiven Branchen (IGEB)	3.3	Cooperative	Industry
Romande Energie	3.3	Energy Utility Company	Energy Utility

Gruppe Grosse Stromkunden (GGS)	3.3	Society	Industry
Ticino	3.3	Canton	Canton
l'Association vaudoise de promotion des métier de la terre (Prométerre)	3.3	Association	Energy/Climate/ Landscape
Ziegelindustrie Schweiz	3.3	Society	Industry
ARA Region Bern AG	3.4	Energy Production Company	Waste
Konferenz Kantonaler Energiedirektoren (EnDK)	3.4	Conference	Conference
Akademien der Wissenshaften Schweiz	3.4	Academia	Academia
Energie 360	3.4	Energy Service Provider	Energy Service Provider
Fachvereinigung Wärmepumpen Schwei	3.4	Union	District Heating
Geothermie Schweiz	3.4	Association	Geothermal
Konferenz für Wald Willdtiere und Landschaft	3.4	Conference	Wood
Schweizerischer Gemeindeverband	3.4	Association	Association
Konferenz der Gebaeudetechnik-verbaende	3.4	Conference	Building
Verband Schweizer Gemüseproduzenten (VSGP)	3.4	Association	Farmer
Valais	3.4	Canton	Canton
MIGROS Genossenschafts	3.4	Cooperative	Industry
Schaffhausen Bauernverband	3.4	Association	Farmer
Arbeitsgruppe Berggebiet (AG)	3.4	Working Group	Working Group
Association des Groupements et Organisations Romandes de l'Agriculture (AGORA)	3.4	Association	Energy/Climate/ Landscape
Verband der Betreiber Schweizerischer Abfallverwertungsanlagen (VBSA)	3.4	Association	Waste
Forces Motrices Valaisannes (FMV)	3.4	Energy Production Company	Energy Production Company
EnAlpin AG	3.4	Energy Utility Company	Energy Utility
Elektrizitätswerk des Bezirks Schwyz (ebs)	3.4	Electricity Network	Electricity Network
AEW Energie AG	3.4	Energy Utility Company	Energy Utility
Nidwalden	3.4	Canton	Canton

Luzerne	3.4	Canton	Canton
Jura	3.4	Canton	Canton
Schweizerische-Liechtensteinischer Gebaeudetechnikverband	3.4	Association	Building
Appenzell Ausserrhoden	3.4	Canton	Canton
Appenzell Rhoden	3.4	Canton	Canton
Groupe E	3.4	Energy Service Provider	Energy Service Provider
Fribourg	3.4	Canton	Canton

Appendix D