

PAUL SCHERRER INSTITUT



Meixi Zhang:: PhD Student :: Paul Scherrer Institut

Identification of Stakeholder Interests in the Energy Transition with Topic Modeling: A Swiss Case Study

3rd Swiss Social Science and Humanities Energy Research workshop,
June 2nd



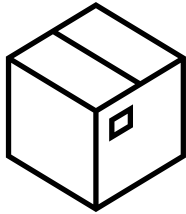
Energy system analysis and dynamic adaptive policy pathways analysis:

- quantify energy transition pathways for achieving net-zero carbon emissions in CH within a European context
- deal with contextual uncertainty using sensitivity analysis
- find optimal timing of policies to reach the Swiss targets

Identify climate policies relevant for Switzerland:

- based on successful international examples
- with **stakeholder consultation** (workshop, position papers)

Stakeholder-informed Policy Instrument Selection for ESM



Lay foundation for implementation of acceptable policy instruments (Díaz et al., 2017)

Conventional Methods

- Large time, cost and communication (Duygan et al. 2020)
- Risk of low response rate in surveys (Lahdelma et al. 2021)
- Selection bias (Kammermann 2019)
- Captures verbal and non-verbal cues

Machine Learning Approaches – Topic Modeling

- Use of newspapers to investigate openness and perception towards a range of energy technologies (Dehler-Holland et al., 2022).
- Use of parliamentary debate to detect bipartisan polarization (Deborah et al., 2021)

Swiss Direct Democracy

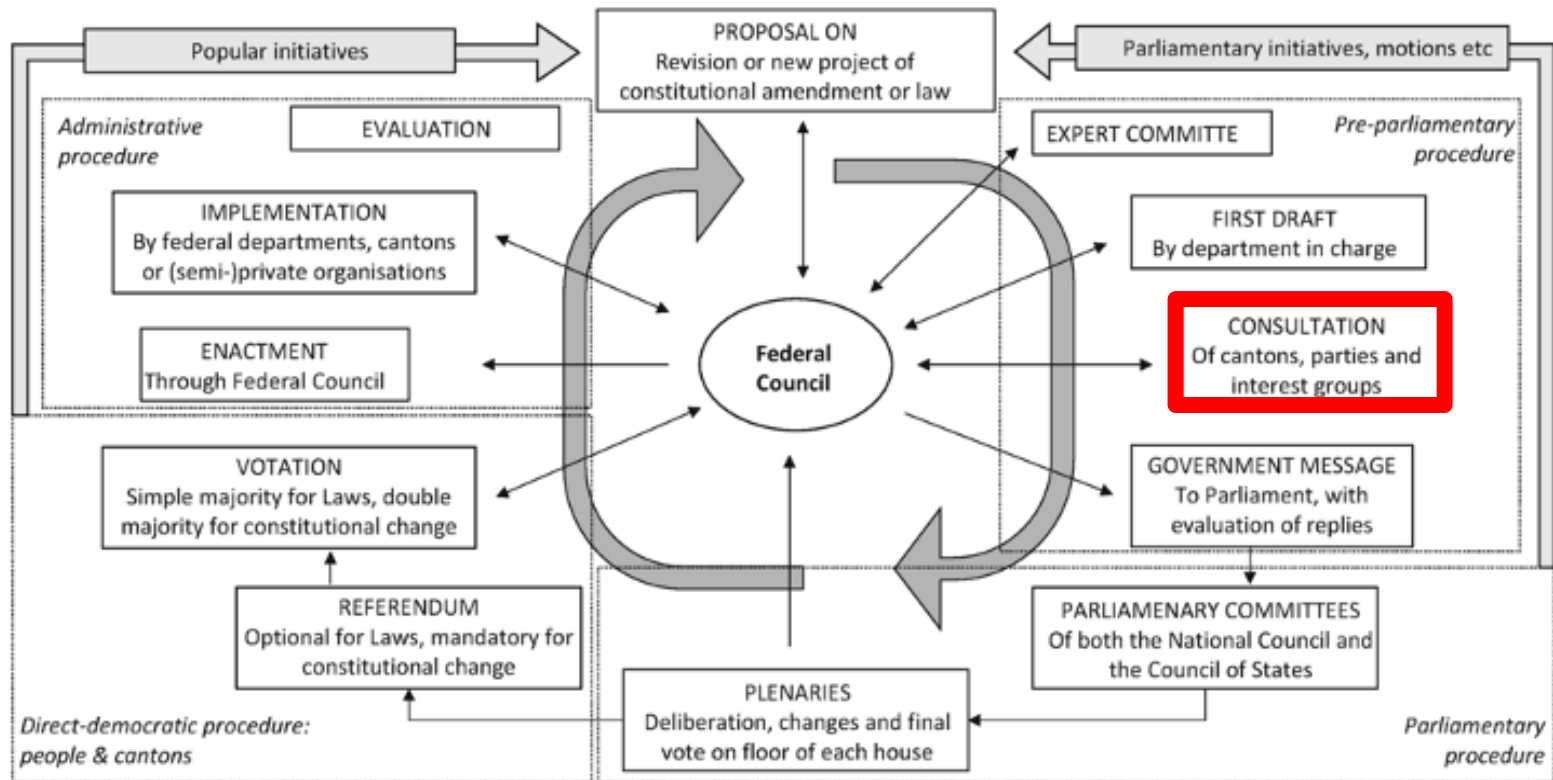
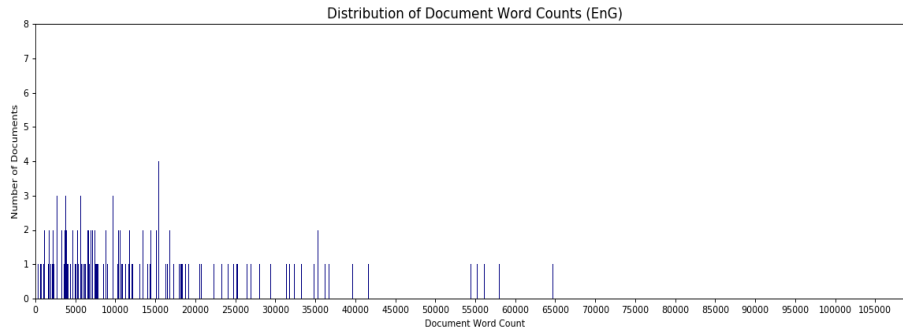


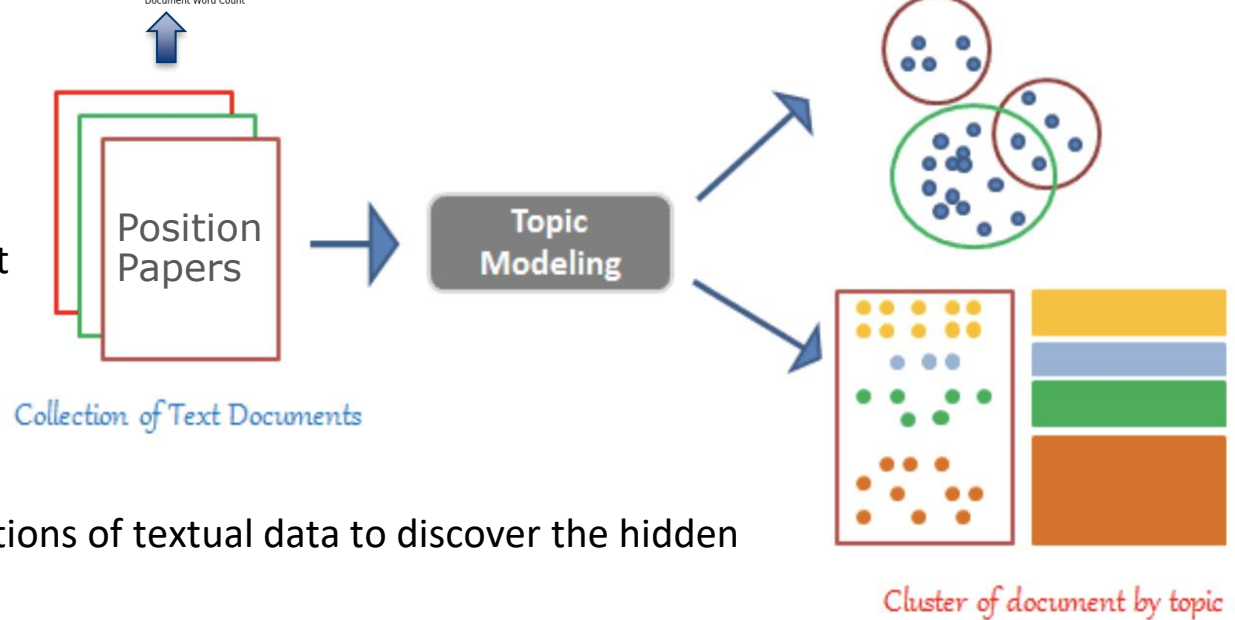
FIG. 1. Swiss legislative process and policy cycle (Linder et al., 2010).

- **Consultation phase** (“Vernehmlassung”): allows the integration of not only the political parties’ but also interest groups’ and cantons’ opinions into the legislative process
- Opinions are officially written down as **position papers** (“Stellungnahme”)

Topic Modeling in Context of Stakeholder Analysis



- 215 stakeholders' official position papers
- Towards Energiegesetz 2020

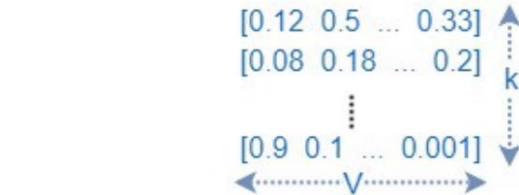


- summarizes large collections of textual data to discover the hidden topical patterns
- interpreting the words that define a topic as stakeholder interests
- Cluster stakeholders based on the topics

Latent Dirichlet Allocation Graphic Representation

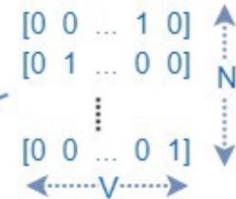
Topic- word parameter vector

0.78



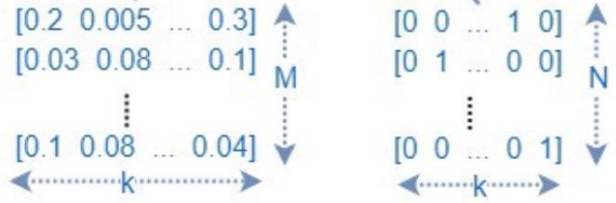
Distribution of the words for the topics (Join Posterior Probability)

Observed variable of a word given a document



Document-topic parameter vector

0.3



Distribution of topics for all the documents (Join Posterior Probability)

Distribution of a given topic for a document

FIG.2. Plate notation of LDA (Blei et al., 2001).

Glimpse into the Stakeholders

Energy/Electricity Supply

- Alpiq Holding AG
- BKW Energie AG
- Axpo
- Technische Gemeindebetriebe (TGB)
- Verband Schweizerischer Elektrizitätsunternehmen (VSE)
- SwissGrid
- Pronovo AG
- ...

Industry

- Gruppe Grosser Stormkunden (GGS)
- Schweizerischer Gewerbeverband (SGV)
- Credit Suisse Energy Infrastructure Partners AG
- ...

Mobility

- Touring Club Suisse (TCS)
- Verkehrs-Club der Schweiz (VCS)
- Verband Freier Autohandel Schweiz (VFAS)
- AutoSchweiz
- Oberwalliser Gruppe Umwelt und Verkehr
- Avenenergy Suisse
- ...

Building

- Gebäudehülle Schweiz
- Hauseigentümerverband
- Vereinigung Kantonaler Gebäudeversicherungen
- Konferenz der Gebäudetechnikverbände
- ...

Common Concerns

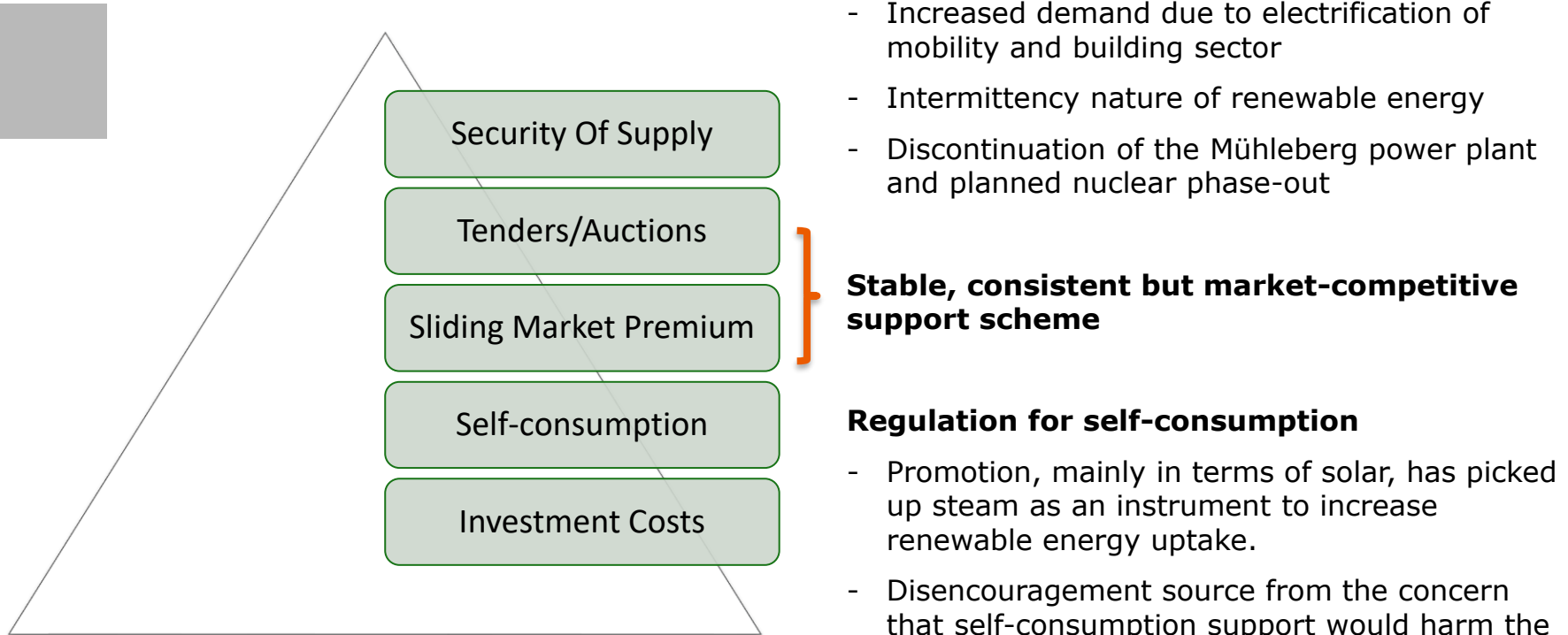


FIG.2. Graphic design of the common concerns, non-hierarchal

Security of supply is of the highest concern

- Increased demand due to electrification of mobility and building sector
- Intermittency nature of renewable energy
- Discontinuation of the Mühleberg power plant and planned nuclear phase-out

Stable, consistent but market-competitive support scheme

Regulation for self-consumption

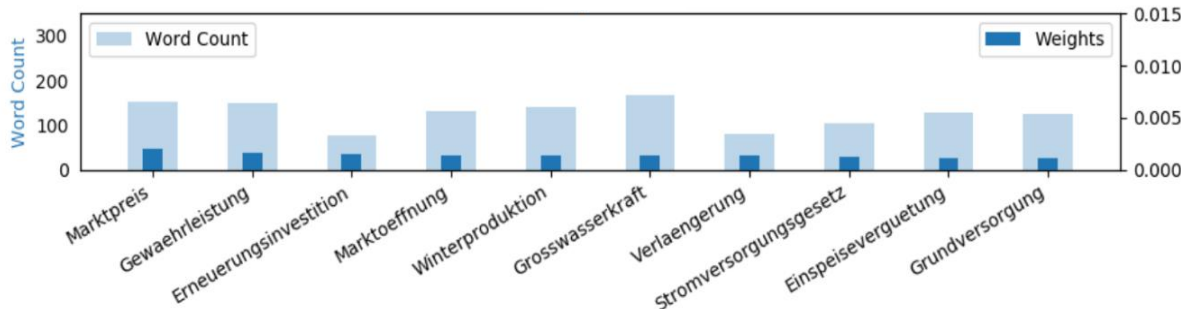
- Promotion, mainly in terms of solar, has picked up steam as an instrument to increase renewable energy uptake.
- Discouragement source from the concern that self-consumption support would harm the optimal planning of building surface utilization

- **Security of supply has been a long-term concern in CH even before the 2022 energy crisis in Europe**
- **Investment cost remains as a fundamental factor of consideration towards policy acceptance**

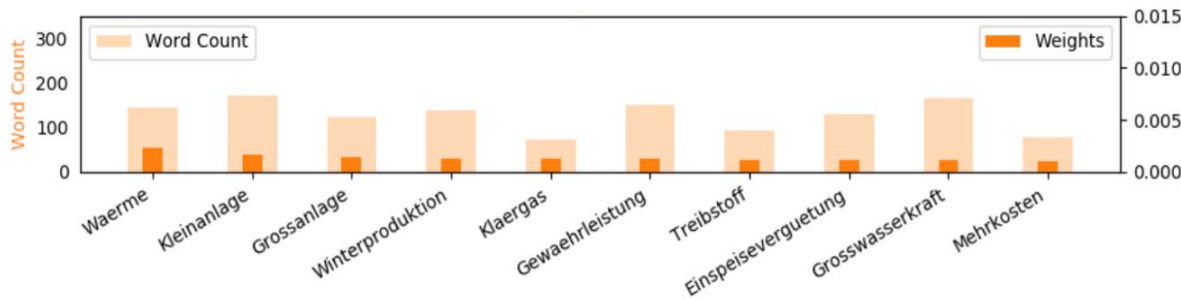
Stakeholder Clustering based on Topics

Word Count and Importance of Topic Keywords

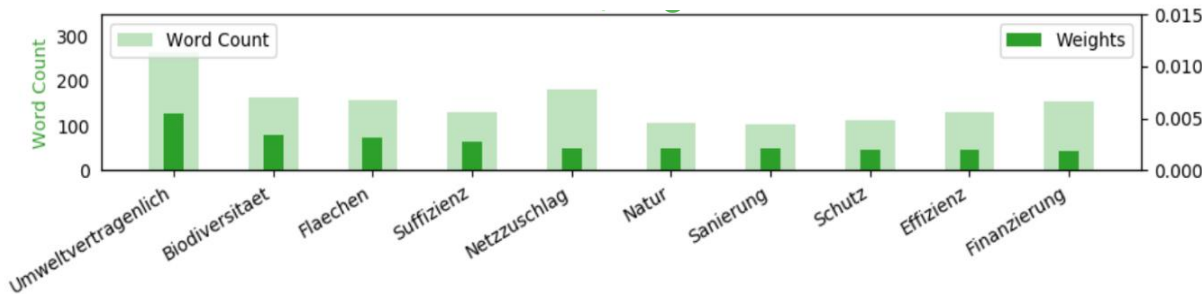
Market-orientation



Energy Security



“Pro-ecology”



- Word Count: the **absolute frequency** of the term’s occurrence in the corpus
- Weight: the **relative occurrence** of the word under the respective topic

Energy Supply

- Strong preference towards a subsidy regime that distinguishes between large-scale and small-scale installations
- Welcoming of sliding market premium
- Reconsideration of the remuneration and redelivery tariff due to electricity market liberalization

Industry

- Reluctance accepting the continuation of grid surcharges
- Prevention of market distortion and support technology-neutral tenders

Building

- Prioritize heat production in winter and support sector-coupling
- Utilization solar panels for self-consumption
- Rejection of emission labeling of mass-produced equipments and installations

Mobility

- Instruments should be uncomplicated and with the least administrative effort
- Ensure no additional bureaucratic burden on SMEs

Topic Modeling with LDA Usefulness

- Identify common drivers and concerns across the groups
- Associate stakeholders into clusters and use certain stakeholders as indicators
- Reduce size of stakeholders to the most representative for stakeholder meeting

Points of Cautiousness with Topic Modeling

- It shows the most weighted terms but not the sentiment towards the word (Qualitative Support/Sentiment Analysis)
- When the documents fundamentally relate to the same theme, certain amount of effort is necessary to sieve through for unique and specific words to emerge.

Mein Dank geht an

- Panos Evangelos
- Tom Kober
- Prof. Anthony Patt



- Blei, D., Ng, A., & Jordan, M. (2001). Latent Dirichlet Allocation. *Journal of Machine Learning Research*, 601-608.
- Dehler-Holland, Joris, Kira Schumacher, and Wolf Fichtner. 2021. "Topic Modeling Uncovers Shifts in Media Framing of the German Renewable Energy Act." *Patterns* 2(1): 100169. <https://www.sciencedirect.com/science/article/pii/S2666389920302336>.
- Díaz, Paula, Carolina Adler, and Anthony Patt. 2017. "Do Stakeholders' Perspectives on Renewable Energy Infrastructure Pose a Risk to Energy Policy Implementation? A Case of a Hydropower Plant in Switzerland." *Energy Policy* 108: 21–28. <https://www.sciencedirect.com/science/article/pii/S0301421517303178>.
- Guber, Deborah Lynn, Jeremiah Bohr, and Riley E Dunlap. 2021. "'Time to Wake Up': Climate Change Advocacy in a Polarized Congress, 1996-2015." *Environmental Politics* 30(4): 538–58. <https://doi.org/10.1080/09644016.2020.1786333>.
- Kammermann, Lorenz, and Karin Ingold. 2019. "Going beyond Technocratic and Democratic Principles: Stakeholder Acceptance of Instruments in Swiss Energy Policy." *Policy Sciences* 52.
- Linder, Wolf, and Sean Mueller. 2021. *Swiss Democracy: Possible Solutions to Conflict in Multicultural Societies*.
- Sadaf Alam Miimu Airaksinen, Risto Lahdelma. 2021. "Attitudes and Approaches of Finnish Retrofit Industry Stakeholders toward Achieving Nearly Zero-Energy Buildings." *Sustainability* 13(13): 7.
- Wolf, L., & Müller, S. (2010). *Swiss Democracy: Possible Solutions to Conflict in Multicultural Societies*. London: Palgrave Macmillan.

0- Energy Security, 1-Market, 2-Environment

Document_No	dominant_To	103		0	191		0
172	Swiss Small Hydro	0	Gruenliberale	0	191	Le Centre Patronal	0
88	Touring Club Suisse	0	102 FDP Die Liberalen	0	192	Chambre de Commerce d'Industrie et des Services	0
87	Strassschweiz	0	140 Klimaschutz Schweiz/ Gletscher Initiative	0	37	Vento ludens	0
86	AutoSchweiz	0	99 Casa.fair	0	5	Zug	0
84	Gastro Suisse	0	97 BauenSchweiz (EIT Suissetec)	0	4	Valais	0
154	Biomass	0	96 Schweizerische-Liechtensteinischer Gebaedete	0	210	Verband der Schweizerischen Cementindustrie (C)	1
157	Fachvereinigung Wärmepumpen Schweiz	0	95 Schweizerischer Baumeisterverband	0	128	Verband Schweizer Abwasser- und Gewässersch	1
158	Geothermie Schweiz	0	57 Energie Thun AG	0	211	Ziegelindustrie Schweiz	1
77	Konferenz für Wald Willdtiere und Landschaft	0	56 Energie Service Biel/Bienne (ESB)	0	205	Vereinigung Kantonaler Gebäudeversicherungen	1
162	IG Holzenergie Nordwestschweiz	0	125 Ryser Ingenieure AG	0	151	EPFL	1
75	St Gallisch Appenzelische Kraftwerk Ag (SAK)	0	54 Elektrizitätswerke des Kantons Zürich	0	141	Vereinigung Aargauischer Abwasserreinigungsan	1
163	Mhylab	0	34 SwissPower	0	175	Task Force Wald +Holz +Energie	1
89	Verband Freier Autohandel Schweiz	0	193 Handelskammer Beider Basel	0	170	STS Wind GmbH	1
164	Optima Solar	0	8 Aarau	0	188	Arbeitsgruppe Christen +Energien (ACE)	1
71	Regio Energie Solothurn	0	207 WaldSchweiz	0	167	Solar Agentur	1
166	Schweizerischer Verband für Umwelt Technik	0	197 PV2Grid	0	161	Holzindustrie Schweiz	1
168	SolarSpar	0	10 Appenzell Ausserrhoden	0	160	Holzenergie Schweiz	1
67	Industrielle Werke Basel (IWB)	0	29 Schwyz	0	159	Holzenergie	1
66	Industrielle Betriebe Interlaken AG (IBI)	0	206 Schweizerischer Verband des Personals Öffentli	0	153	Akademien der Wissenschaften Schweiz	1
64	Groupe E	0	12 Solothurn	0	196	La Forestière	1
171	Suisse Éole	0	35 Technischen Gemeindebetriebe (TGB)	0	198	MIGROS Genossenschafts	1
124	Marugg +Bruni AG	0	27 St.Gallen	0	199	l'Association vaudoise de promotion des métiers	1
174	Swiss Solar	0	14 Basel Stadt	0	176	Verband der Betreiber Schweizerischer Abfallver	1
60	Eniwa AG	0	201 Schaffhausen Bauernverband	0	148	Schweizerische Greina-Stiftung(SGS)	1
58	Energie Wasser Bern	0	202 FrauendaSchweiz Bäuerinnen-und Landfrauenve	0	200	pronovo	1
165	POWERLOOP	0	22 Jura	0	146	Paysage Libre Freie Landschaft	1
90	Der Auto Gewerbe Verband Schweiz (AGVS)	0	15 Isone	0	136	Stiftung Landschaftschutz Schweiz	1
92	Hauseigentuemerverband	0	203 Die Solothurner Handelskammer	0	0	Ticino	1
94	Konferenz der gebaedetechnik-verbaende	0	20 Glarus	0	213	InteressenGemeinschaft Energieintensiven Bran	1
123	Hunziker Betatech AG	0	19 Mettmenstetten	0	113	Gaznat SA	1
126	Telescaledamento del Bellinzonese SA (Teris)	0	16 Fribourg	0	79	Wettbewerbskommission (WEKO)	1
121	Abwasserreinigungsanlage Worblental	0	26 Obwalden	0	78	Regierungskonferenz der Gebirgskantone (RKGK)	1
120	ARA Region Bern AG	0	204 Verband Schweizer Gemüseproduzenten (VSGP)	0	76	Schweizerischer Wasserwirtschaftverband (SWV)	1
119	Abwasserverband Region Lenzburg	0	36 Telescaledamento del Bellinzonese SA	0	72	REPower	1
118	Abwasserverband Morgental	0	6 Zuerich	0	70	Kraftwerke Oberhasli AG (KWO)	1
117	Abwasserverband Altenrhein	0	177 Verband Fernwärme Schweiz (VFS)	0	69	Kraftwerk Hinterrhein AG (KHR)	1
116	Infrawatt	0	52 EIT swiss	0	68	Kantonales Elektrizitätswerk Nidwalden (EWN)	1
115	Erdgas Einsiedeln (gaz energie)	0	179 Verein für Umweltgerechte Energie (VUE)	0	63	Energia Legno Svizzera Italiana (AELSI)	1
114	Verband der Schweizerischen Gasindustrie	0	183 Credit Suisse Energy Infrastructure Partners AG	0	62	Forces Motrices Valaisannes (FMV)	1
127	Azienda Cantonale dei Rifiuti	0	185 Verein Energiewende Muri-Gümligen	0	61	Energie Uri	1
	(waste incineration plants)	0	48 BKW Energie AG	0	59	Engadiner Kraftwerke AG (EKW)	1
112	Schweizerischer Staedteverband	0	186 Fachverband Landwirtschaftliches Biogas (Ökos)	0	55	EnAlpin AG	1
111	Schweizerischer Gemeindeverband	0	46 Azienda cantonale dei rifiuti	0	81	Eidgenössischen Natur-und Heimatschutzkomm	1
110	Schweizerische Arbeitsgemeinschaft für die Berg	0	208 Aargauische Industrie-und Handelskammer	0	53	Elektrizitätswerk der Stadt Zürich(ewz)	1
130	Paysage Libre Fribourg	0	209 Arbeitsgruppe Berggebiet c/o Solidaritätsfond L	0	50	Dachverband Schweizer Verteilnetzbetreiber (DS)	1
131	Pro Landschaft AR/AI	0	17 Geneva	0	49	Centralschweizerische Kraftwerke AG (CKW AG)	1
212	Schweizerischen Maschinen-, Elektro- und Meta	0	44 Avenergy Suisse	0	47	Azienda elettrica ticinese	1
135	Schweizerischer Verband der Umweltfachleute (0	189 Association des Groupements et Organisations	0	45	Axpo	1
		0	190 Berner Bauern Verband	0	43	Alpiq Holding AG	1
		0	41 Smart Grid CH	0	42	AEW Energie AG	1
		0	40 Verband Schweizerischer Elektrizitätsunternehm	0	39	Verband der Personalvertretungen der Schweiz	1

0- Energy Security, 1-Market, 2-Environment

39	Verband der Personalvertretungen der Schweiz	1
38	Verband Aargauischer Stromversorger (VAS)	1
33	SwissGrid	1
30	Thurgau	1
28	Schaffhausen	1
23	Luzerne	1
51	Elektrizitätswerk des Bezirks Schwyz (ebs Energi	1
82	Eidgenössischen Kommission für Konsumentent	1
65	H2 Energy AG	1
98	Ca.tef	1
85	Gruppe Grosse Stromkunden	1
107	Buegerlich-Demokratische Partei Schweiz	1
108	Christlichdemokratische Volkspartei	1
104	Gruene	2
105	Sozialdemokratische Partei der Schweiz	2
134	Schweizerischer Fischerei-Verband (SFV)	2
133	Schweizer Alpen-Club (SAC)	2
132	Stiftung PUSCH	2
194	Jugendsession	2
195	Kommunikation Schweiz (ks/cs)	2
32	Service Industries des Genève	2
31	Municipality of Delemont	2
129	Pro Natura	2
155	Energie 360	2
25	Nidwalden	2
24	Neuchatel	2
109	Eidgenössisch-Demokratische Union	2
21	Graubunden	2
18	Villigen	2
13	Basel Landschaft	2
11	Bern	2
9	Appenzell Rhoden	2
7	Zuerich City	2
3	Lausanne	2
2	Vaud	2
1	Uri	2
187	Appenzeller Wind AG	2
137	Trift Komitee	2
138	Umweltfreisinnige St.Gallen	2
184	Energie Club Schweiz	2
83	Konferenz Kantonaler Energiedirektoren (EnDK)	2
80	Eidgenössische Elektrizitätskommission (ElCom)	2
152	ETH Rat	2
91	Gebaeudehuelle Schweiz	2
74	SFACEN SA	2
73	Romande Energie	2
150	Oberwalliser Gruppe Umwelt und Verkehr	2
149	Naturfreudue	2
93	Holzbau Schweiz	2
147	Greenpeace	2
169	Schweizerische Solarenergie Vereinigung (SSES/	2

156	Energie Genossenschaft Schweiz	2
122	AVAG AG	2
173	Swiss Cleantech	2
144	Bird Life	2
143	Aqua viva	2
142	WWF	2
100	Evangelische Volkspartei der Schweiz	2
178	Verband Unabhängiger Energieerzeuger (VESE)	2
101	FDP Die Liberalen Ortspartei Weiningen ZH	2
180	Dachorganisation der Wirtschaft für Erneuerbar	2
181	Association Non au prac Éolien	2
182	Carnot-Cournot Netzwerk	2
139	Verkehrs-Club der Schweiz (VCS)	2
145	Schweizerische Energie-Stiftung	2
106	Schweizerische Volkspartei	2

Coherence Scores based on the Number of Topics (Energy Law 2020)

