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Shattered frames in global energy governance: Exploring fragmented interpretations among renewable energy institutions

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ABSTRACT

A global transition towards renewable energy is key for a sustainable future, and effective global governance is required to make this possible. However, global renewable energy governance is often regarded as fragmented and ineffective. Existing research has provided useful insights into the multiplicity of governance goals and diversity in institutions, but an understanding of underlying frames is yet lacking. Frame analysis explores how actors interpret and define a problem in different ways, based on which different solutions can be put forward of which some are more adequate than others. It thus provides a compelling new angle to the scientific debate on fragmentation. This paper therefore poses the question how the global energy challenge and the role of renewables are framed throughout the overall institutional complex for renewable energy, among different institutional types, and across individual institutions. To facilitate the search for an answer, it applies an innovative computational method that allows for a large-scale and multi-level frame analysis. The results demonstrate that renewable energy institutions currently prioritize climate change, with a stronger growing focus on universal access to energy services, while undermining concerns of energy scarcity. Nevertheless, frames vary strongly across different levels of governance, and among various types of institutions. The paper therewith forms an important contribution to our understanding of global renewable energy governance and its fragmented nature.

1. Introduction

A worldwide uptake of renewable energy is key in ensuring a sustainable energy future for all: it can diversify the energy mix for energy security, decentralize deployment to expand energy access, and reduce the environmental externalities of energy use. In other words, renewables are at the center of tackling the energy trilemma [37,48]. However, the current growth rate of renewables in the global energy mix is too slow to meet neither the ‘substantial increase’ by 2030 as intended by Sustainable Development Goal (SDG) 7, nor the two degrees target set by the Paris Agreement [35,47,64]. To speed up the growing share of renewables, effective global governance is key: to coordinate knowledge exchange and technology investments across national borders, and to provide international aid for developing countries [20,29,48]. On the contrary, global (renewable) energy governance developed into a patchwork of overlapping and sometimes competing institutions, which have failed to adequately tackle the energy trilemma due to a lack of clear priorities [16,29,41,68].

Existing scholarship has provided useful insights into the fragmented nature of global (renewable) energy governance, with on the one hand studies elaborating on the various governance challenges [10,16,29], and on the other hand research mapping the multitude of institutions for (renewable) energy [12,18,22,51]. What is, however, yet lacking is a good understanding of underlying frames. These are collections of knowledge, assumptions and worldviews, which can result in different interpretations and alternative definitions of a policy problem [17,24,55]. Based thereon, different problem-solving strategies can be put forward of which some are more adequate than others. Hence, contesting or overlapping frames can play an important role in explaining outcome and effectiveness of global governance [44,45,75]. Frame analysis thus provides a compelling opportunity to uncover how the wide range of renewable energy institutions interpret the global energy challenge in different ways, and therewith, to explore potential explanatory factors of fragmentation of global renewable energy governance and the ineffectiveness towards the energy trilemma.

Therefore, this research poses the question how the global energy challenge and the role of renewables are framed in global governance for renewable energy. Three issue-specific frames for energy are known

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to play a role, which emerged alongside three competing governance goals that form the energy trilemma for energy governance: energy security, energy access and environmental sustainability [10,16,48,67]. However, while many if not most studies look back to examine how these frames developed over time, an examination of how they currently shape global renewable energy governance is yet lacking. Therefore, this paper assesses how these three competing energy frames are distributed throughout the overall institutional complex for renewable energy (macro-level), among different institutional types (meso-level), and across individual institutions (micro-level). This will not only provide insights into the variation of frames across different levels of governance, but also probe differences and commonalities between public and private institutions, as well as public-private partnerships. This in turn is key in further exploring (renewable) energy governance beyond formal and interstate cooperation, which has been identified as a critical research gap [20,68].

A methodology to assess frames for an entire institutional complex and at multiple levels of governance has yet to be explored. Therefore, this paper introduces an innovative and computer-assisted method, which allows for a large-scale and multi-level frame analysis. Based thereon, the paper moves beyond scrutinizing the variety of governance challenges and institutions of global renewable energy governance, towards allocating underlying frames, worldviews and assumptions. It therewith advances our understanding of the fragmented nature of global governance for renewables, and most importantly, provides a novel angel to this scientific debate by shedding light on how it is socially constructed. This is key to fully understand how and why the institutional complex for renewable energy is structured as it is, and how it can be improved to overcome issues associated with fragmentation, and ultimately, to more significantly contribute to tackling the energy trilemma.

The paper is structured as follows. The next section reviews global governance studies for (renewable) energy and frames in energy research, after which Section three explains the methodology in detail. Thereafter, Section four describes the results of the study, which are then discussed in Section five. Finally, Section six highlights a set of policy implications and provides concluding remarks.

2. Literature review

This section provides a literature review on global (renewable) energy governance and frames in energy research, and therewith highlights the research gaps to be addressed through this study.

2.1. Fragmentation of global governance

Global (renewable) energy governance is often characterized as fragmented [16,18,40,48]. In the first place as it deals with different sources of energy and respective technologies, including fossil fuels and nuclear power, as well as solar and wind energy. Most global governors tend to selectively prioritize one energy source and not to cover the whole range [16,48,69]. For instance, the International Atomic Energy Agency (IAEA) concentrates on nuclear energy, the Organization of Petroleum Exporting Countries (OPEC) on oil, and the Global Solar Council (GSC) on energy from sunlight. Studies have highlighted that, as a consequence, an integrated approach is lacking to weigh up the different properties and ramifications of various energy sources and technologies with a critical eye [48].

Second, global energy governance has to navigate multiple urgent challenges, also referred to as the world energy trilemma [29,70,73]: the increasing scarcity of energy sources in the face of a growing demand (i.e. energy security), the large part of the world's population that still lacks access to energy services (i.e. energy access), and the environmental impacts of energy production and consumption (e.g. environmental sustainability) [10,23,37]. To further complicate matters, substantial trade-offs exist between these challenges [59]. For instance, improving energy access leads to an increased energy demand and thus a pressure on energy security, and the most affordable energy source for energy security is often not the one that is most environmentally friendly [42,48]. Since renewables have the potential to contribute to each of the three governance goals, it appears as if these trade-offs are not applicable in the case of global renewable energy governance. This requires nuancing. To illustrate, wind energy is widely produced to alleviate energy security concerns, but the environmental sustainability of wind farms is questionable as they can be a danger to bird lives [41]. Similarly, solar panels are slowly replacing diesel generators to connect rural regions in the developing world to the electricity grid, though photovoltaics cells contain toxic substances [21]. Not to mention new pressures on energy security that emerge as a result of deploying renewables to expand energy access, such as where and how to produce the large amounts of biofuels that match a growing demand [62]. In short, renewable energy may ameliorate trade-offs in the energy trilemma, but should nevertheless be reckoned with. Existing research has provided insights into how global (renewable) energy governance, as a result, developed into three largely isolated arenas with distinctive priorities [10,16,48].

Third, global (renewable) energy governance is institutionally diverse: it includes a high number of institutions that differ strongly in terms of characteristics [16,18,58]. In the case of renewables there exist a number of intergovernmental efforts, such as the International Renewable Energy Agency (IRENA) and the Clean Energy Ministerial, which co-exist with a considerable amount of private initiatives and public-private partnerships, for instance RE100 and the Renewable Energy Policy Network for the 21st Century (REN21). This has prompted scholars to study the institutional complex for energy [12,58,72], and some to zoom in on the institutional complex for renewable energy specifically [6,48,60]. An institutional complex can be seen as the totality of institutions that collectively address a specific issue requiring global governance. However, most mappings are biased towards intergovernmental cooperation and do not take note of the growing significance of transnational and non-state governance [20,68]. Sanderink and colleagues [52] therefore introduced a novel mapping for renewable energy specifically, combining international and transnational spheres. The scholars used the heuristic framework of the global governance triangle developed by Abbott and Snidal [1–3], and distinguished 46 renewable energy institutions according to their constituent actors: public, firm, and civil society organizations (CSO) (see Fig. 1). The seven zones in the governance triangle represent the different combinations of these actor types: institutions in zones 1-3 are steered by a single type of actor, those in zones 4–6 by two actor types, and institutions in central zone 7 include all three types. Hence, previous mapping exercises have not only provided useful insights into the growing number of institutions for renewable energy, but have also contributed a comprehensive toolbox for examining and structuring the increasing fragmentation of global (renewable) energy governance.

In sum, global (renewable) energy governance developed into a patchwork of different institutions that lack an holistic approach to the multiple components of energy, due to which it fails to adequately tackle the energy trilemma and its trade-offs [16,29,41,68]. Existing studies scrutinize the multiplicity of governance goals [10,29,42], describe the institutional complex for (renewable) energy [12,18,22,51], and some even map the multitude of institutions in relation to the different governance goals [40]. However, how these governance challenges are socially constructed, and why the institutional complex for (renewable) energy emerged as such, remains unclear. Frame analysis can uncover the collections of knowledge, assumptions and worldviews that may be underlying the fragmented nature of global (renewable) energy governance and its ineffectiveness towards the energy trilemma.

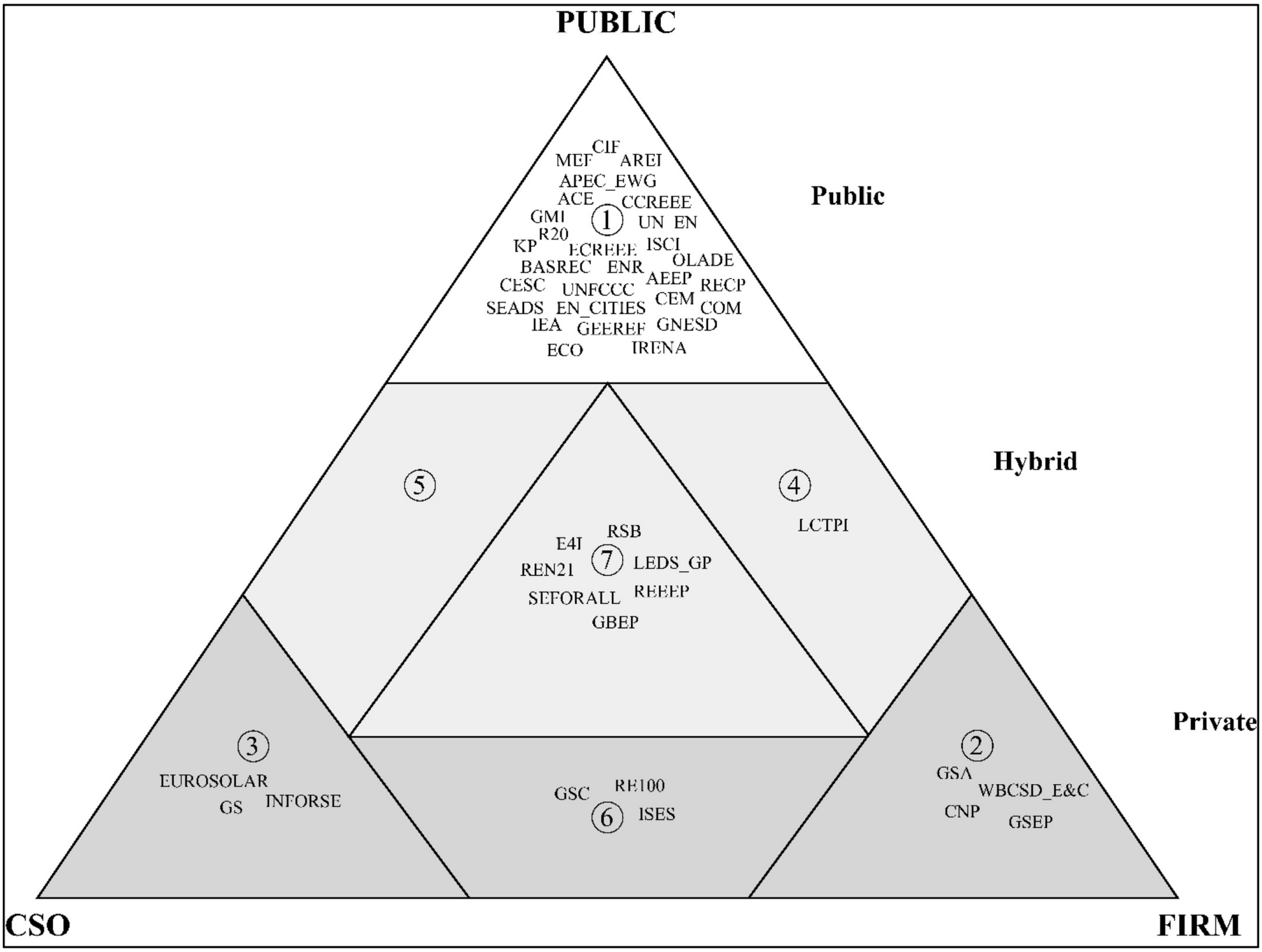

Fig. 1. Global governance triangle for renewable energy based on a heuristic framework by Abbott & Snidal [2,3]; and Abbott [1,52].

2.2. Frames in energy research

Frames and frame analysis have become an increasingly important concept and research method in social science since it originated in the work of Goffman [27]. Also in energy research various approaches have been applied to analyze frames. For example, to explore how frames affect perceptions towards specific energy sources or technologies [7,8,74], to study how frames shape national energy policies [39,43,53], or to examine the role of frames in international energy politics [16,70]. These studies depart from the general idea that actors, based on different assumptions and worldviews, frame a policy problem in different ways, be it strategically or unintentionally [17]. More importantly, they are based on the premise that *"how an issue is framed largely determines what should be done"* [39]; varying considerations and interpretations may result in different policy responses, some better informed and more effective than others towards the issue at hand. Therefore, it is of interest to social science researchers to examine the effects of frames or the contestation between alternative frames, in order to understand why certain objectives and policy instruments are prioritized over others. In other words, frame analysis can help *"to reach a better understanding of the policy process"* [53].

The growing body of literature on energy frames can be distinguished into two streams of research. The first focuses on generic frames, which *"transcend thematic limitations and can be identified in relation to different topics"* [14, 15]. For instance, Bayulgen and Benegal [7] analyze the power of economic frames in shaping public perceptions on renewable energy in the United States. In addition, with a focus on global energy policy, Van de Graaf and Zelli [70] describe the perspectives of 'market liberalists', 'neo-mercantilists', 'environmentalists' and 'social greens' towards the energy challenge based on the work of Clapp and Dauvergne [11]. Furthermore, Sovacool and Brown [57] reveal no less than eight competing frames based on the views ranging from 'technological optimists' to 'conscientious consumers', and even argue that these are not exhaustive [57].

A second stream of research analyzes issue-specific frames, which *"are pertinent only to specific topics"*[14,15]. For example, by using the energy trilemma to distinguish three frames: energy security, energy access and environmental sustainability. Analyzing to what extent these frames resonate in national- and international policymaking provides insights into which objectives are prioritized and if this is potentially undermining the achievement of others. Various studies have provided a good understanding of when these frames emerged, how they were historically shaped, and which actors are the most important advocates, proponents or agents (see summary table 1) [10,16,29,67].

Table 1
Summary of three issue-specific frames in global energy governance: energy security, energy access and environmental sustainability frames (own data: August 29, 2018).

	Energy security	Energy access	Environmental sustainability
Prioritized challenge	To secure an uninterrupted availability of energy supply.	To tackle the widespread persistent lack of access to energy services.	To ensure environmental sustainability of energy systems.
Main proponents	Nation states, international and regional alliances.	Development banks, aid agencies and international development organizations.	Diverse actors, including governmental and non-governmental organizations, mostly related to environment rather than energy.
Role of renewables	To diversify the energy mix, to facilitate more domestic supply, and to alleviate increasing scarcity in the face of growing demand.	To provide decentralized and small-scale energy solutions in remote and off-grid areas.	To substitute fossil fuels, and therewith mitigate climate change and other environmental externalities.

First, the energy access frame emerged in the 1960s in response to a large part of humanity being deprived from economic modernization due to the lack of access to energy [10]. At the time, the global development community focused on facilitating and improving national infrastructures to provide access to energy in off-grid areas in the developing world. Still today, nearly a billion people have no access to electricity and 2.7 billion people continue to rely on biomass, coal and kerosene for cooking [31]. Hence, the focus has in the meantime shifted to decentralized interventions to expand access to energy services specifically, including electricity, and modern cooking fuels and appliances. Here, renewables can play an important role through small-scale solutions, such as solar and wind mini-grids to bring electricity to remote areas, and potentially, solar cookers and improved biomass stoves for cleaner cooking. Although cooking solutions have so far predominantly been designed for other cleaner but non-renewable fuels, in particular liquid petroleum gas [33]. Due to the strong link between energy access and the poverty agenda, mostly international development organizations, development banks, aid agencies and non-governmental organizations (NGOs) are associated with the energy access frame [10].

Second, the energy security frame came to the fore when oil crises in the 1970s resulted in industrial countries facing substantial petroleum shortages. The volatile oil market at the time was dominated by national oil companies in exporting countries, mainly developing nation states, and a consumer front was made up mostly by industrialized countries, which led to geopolitical tensions and energy becoming a matter of international security [10]. Current concerns are related to the rapidly depleting conventional energy sources, resulting in energy scarcity in the face of a growing global energy demand, and therefore focus on an "*uninterrupted availability of energy sources at an affordable price*".[1] Renewables can diversify the global energy mix and thereby alleviate increasing scarcity, and decentralize deployment to reduce dependence on single regions and facilitate more domestic supply [48]. As energy security is considered a top priority for national governments competing over scarce sources, proponents of the frame are predominantly nation states, and international and regional alliances [16].

Third, in parallel to the energy security frame, environmental concerns that were raised at the Stockholm Conference on the Environment (1972) gave rise to the environmental sustainability frame [16]. It focuses on the negative environmental impacts of energy production and consumption, such as air pollution, acid rain, contamination of marine environments, nuclear meltdowns, natural disasters and so forth. However, after the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, the first and foremost concern became climate change [10]. Fossil fuel combustion accounts for two-thirds of the total greenhouse gas emissions and 80% of carbon dioxide [32]. The uptake of renewable energy can significantly reduce such emissions and, in addition, mitigate other environmental impacts such as air pollution. The actors commonly linked to the frame are diverse, including nation states, international alliances, NGOs and private institutions, which are, however, often more related to environment than to energy [10].

In sum, existing studies have advanced our understanding of the dynamics of generic and issue-specific frames for energy, and how they have informed (inter)national energy politics and policies in the past. However, research on how frames shape global renewable energy governance at this point in time has not yet been conducted. This could provide useful insights into why certain governance goals are prioritized over others and by which institutions, and thereby, could help to better understand the global governance process. Moreover, it could explore potential explanatory factors of fragmentation of global renewable energy governance and ineffectiveness towards the energy trilemma. A methodological approach to assess frames for an entire institutional complex and at multiple levels of governance has, however, yet to be explored. Hence, this is where the current research frontier lies and where this research fills a gap.

3. Methodology

Frame analysis serves as an analytical tool to deconstruct different frames, and to examine which frames are more dominant or inferior in discussions on certain topics. It is a technique that is based on the analysis of texts, in order to organize and understand diverse idea-elements into different packages of meaning [13]. This paper developed a novel method for a large-scale and multi-level analysis, required to assess frames for an entire institutional complex. The methodology included the following six steps.

The first was to delineate the institutional complex for renewable energy and to select the institutions for analysis. For this purpose, the global governance triangle for renewable energy was used as described in Section 2.1 (see Fig. 1; [52]), since it presents the most recent and inclusive overview of different forms of governance. It includes 46 international and transnational renewable energy institutions with the intentionality to steer policy and behavior, through significant governance functions and towards a common governance goal: mitigation of climate change through a transformation towards low-carbon or fossil-free energy systems [52].[2] More specifically, they seek to achieve this governance goal by promoting the uptake of renewables globally. It is important to consider that 19 of these institutions focus exclusively on renewable energy, while for the remaining number renewables are but one part of their portfolio [52]. The institutions are situated in the triangle according to their constituent actors (see Fig. 1). The public category includes (groups of) states, cities, regions and international organizations. The firm category refers to (groups of) firms, investors, and industry associations. The CSO category involves (coalitions of)

[1] Definition of energy security derived from: http://www.iea.org/topics/energysecurity/ (accessed: 15-01-2018)

[2] A detailed list of these institutions can be found in Appendix A.

non-governmental organizations (NGOs) and other organizations representing civil society. Thus, the governance triangle not only provides a comprehensive overview of institutions, but simultaneously presents a useful framework to distinguish levels of analysis: the governance triangle as equivalent for the overall institutional complex (macro-level), the individual zones representing the different institutional types (meso-level), and the individual institutions (micro-level).

The second step was to identify and delineate frames for a top-down approach. The paper seeks to uncover how predefined frames are distributed among renewable energy institutions, hence this step was based on a thorough review of existing scholarship [10,16,48,67]. Section 2.2 showed that there is but one possibility to distinguish and assign frames. However, the energy trilemma provided a particularly useful rhetorical device to distinguish issue-specific frames for global renewable energy governance. First, as it provides the opportunity to situate the research's findings pertaining to two dominant streams of research in the realm of fragmentation of global energy governance, related to institutional diversity and the multiplicity of governance goals. Second, as it enables to reflect upon the link between frame constellations and the ineffectiveness of global renewable energy governance towards the energy trilemma. Hence, the following three issue-specific frames were used for the analysis: energy security, energy access and environmental sustainability (see also Table 1).

The third step was to compile the corpus, which is a structured set of texts to be processed and analyzed. The global governance triangle for renewable energy governance formed the starting point for the data collection (see Fig. 1; [52]); for each of the 46 institutions texts were compiled. These include the institutions' official webpages, and in addition, one official document per institution. The latter preferably described the institutions' mission statement or vision, such as a legal agreement or statute. However, if these were not available online, the most recent and comparable document was selected, such as an annual or progress report.[3] The compiled texts were all obtained online and thus assumed to be directed to, and accessible for, a broad and diverse public, presumably inclined to involve renewable energy professionals.

The fourth step was to create a codebook to enable an automated computational method for text analysis.[4] Only this allows for a large-scale and multi-level frame analysis. For this purpose, the qualitative data analysis software QDA Miner was used, in which the quantitative data analysis software WordStat is integrated.[5] A codebook comprises of words, phrases and rules that capture the diverse idea-elements for each frame. A sample of six texts was analyzed manually in QDA Miner: one set of texts per institution representative of each zone in the governance triangle (see Table 2). The words and phrases that were coded as signifying the three frames, were retrieved via WordStat as keywords for the preliminary codebook. Thereafter, an extensive revision procedure was followed to which substantial attention was given. Via WordStat, keywords that were found generic for renewable energy governance were deleted, phrases were extracted and added, and rules were created that capture the correct keywords and phrases in relation to context. Finally, various small adjustments were made to include abbreviations, delete names of respective institutions and capture all tenses of verbs, and singular and plural forms of nouns.

[3] Appendix B provides a more detailed overview of and hyperlinks to the documents compiled.

[4] The final version of the categorization dictionary can be found in Appendix C.

[5] More information on QDA Miner and WordStat: https://provalisresearch.com

Table 2
Overview of sample institutions for manual coding process to create preliminary categorization dictionary (own data: August 29, 2018).

		Sample institutions
Zones in the triangle	1	International Renewable Energy Agency (IRENA)
	2	Global Sustainability Electricity Partnership (GSEP)
	3	The European Association for Renewable Energy (EUROSOLAR)
	4	WBCSD's Low Carbon Technology Partnerships Initiative (WBCSD LCTPi)
	5	-
	6	RE100
	7	Sustainable Energy for All (SEforALL)

The fifth and arguably most important step was to validate the codebook. First, the keywords, phrases and rules were compared with key terms and formulations in the existing literature on the three energy frames [10,16,48,67]. Second, the preliminary codebook was applied to the entire dataset to enable a manual check of each keyword, phrase and rule via the function of 'keywords-in-context' in WordStat, to examine if these capture the correct idea-elements for each frame in relation to context. Third, the codebook was thoroughly discussed among experts in a validation workshop.[6] Finally, when the codebook was completed and the definitive analysis was run, a sample of 10 texts was manually checked and validated.

The sixth and final step was to put the computer to work to quantitatively analyze the corpus, after which the numbers were qualitatively assessed and interpreted. More specifically, the computer calculated the number of times words and phrases were coded related to each frame in the total body of texts, attributed to the totality of institutions (macro-level), to the clusters of institutions in each zone (meso-level), and to each individual institution (micro-level). Since the length of webpages and official documents vary, these numbers are shown in percentages to demonstrate the relative distribution of frames throughout the entire institutional complex, among different types of institutions, and across individual institutions.

Inevitably, employing an innovative methodological approach comes along with limitations. First of all, using computer assisted software for an interpretative study can create problems in terms of interpretative capacity and corrections for context. To limit such possibilities all codes and rules were repeatedly checked by analyzing their contexts, however, it is an ongoing process. Even though inconsistencies are predefined and processed as much as possible, false coding could not entirely be accounted for. Second, with any innovation comes some degree of unknown, though traversing this is necessary for growth in the scientific field. Hence, at times it was difficult to validate certain decisions and actions within the software, and therefore all decisions and actions were accurately reported.[7]

4. Results

The computer-assisted analysis of the corpus, consisting of texts of 46 renewable energy institutions, assigned 7339 codes to 6466 of 29343 sentences. The codes provide insights into the distribution of frames throughout the overall institutional complex (macro-level), among different types of institutions (meso-level), and across the individual institutions (micro-level). The results are described in the sections below, after which these are further discussed in a separate section (Section 5).

[6] The validation workshop was organized as part of the Amsterdam Earth System Governance Lab series on April 26, 2018. Climate and energy governance experts were invited to manually analyze the sample texts, by coding words and phrases, in their view, signifying the three energy frames. The codes were then compared and discussed to validate the researcher's codebook. The experts include Philipp Pattberg, Oscar Widerberg, James Patterson, Dave Huitema, Nicolien van der Grijp and Erick Velazquez Hernandez.

[7] All actions and decisions that were taken to create the categorization dictionary are reported in a protocol, which can be found in Appendix D.

Table 3
Distribution of frames along the institutional complex for renewable energy based on number of codes (own data: August 8, 2018)

	Zones								
	1	2	3	4	5	6	7	#	%
Energy security	988	60	68	29	-	169	202	**1516**	21
Energy access	1628	47	134	13	-	51	762	**2635**	36
Environmental sustainability	1684	389	257	247	-	110	409	**3096**	43
								7247	

4.1. Macro-level

Table 3 presents the frequency of codes assigned to words and phrases for each of the three frames per zone in the governance triangle. The sum of the codes shows that renewable energy institutions predominantly prioritize environmental sustainability as critical energy challenge and define the role of renewables mainly as to tackle the negative impacts of global energy systems on the environment. In addition, energy access concerns are evident among the institutions, interpreting the role of renewables as to contribute to expanding energy services worldwide. As a result, the energy security frame plays a minor role, meaning that to ensure uninterrupted availability of energy sources by diversifying the energy mix is not a priority for global renewable energy governance.

Table 4
Key idea-elements for global renewable energy governance based on high frequency and case-occurrence (own data: August 24, 2018)

Keyword	Frame	Frequency	Keyword	Frame	% Cases
Emissions	EnvS	1009	*Climate change*	EnvS	81.1
Carbon	EnvS	842	*Environmental*	EnvS	78.9
Rural	EA	558	*Emission*	EnvS	76.7
Clean	EnvS	557	*Carbon*	EnvS	74.4
Climate change	EnvS	544	*Clean*	EnvS	62.2
Environmental	EnvS	442	*Developing*	EA	56.7
Energy access	EA	389	*Rural*	EA	52.2
Cook	EA	300	*Supply*	ES	52.2
Supply	ES	289	*Demand*	ES	52.2
Forest	EnvS	277	*Economic growth*	ES	52.2

QDA Miner and WordStat software also allow to zoom in on coded keywords and phrases to uncover what exact idea-elements of which frames resonate most strongly throughout the institutional complex. Table 4 therefore deconstructs the frames in more detail, based on the words and phrases with highest frequency and occurrence in the largest amounts of texts. To illustrate, the phrase 'climate change' was found 544 times and occurred in 81.1% of the texts. The table shows that, in line with the dominant frame, the most important idea-elements relate to the environment and most significantly to climate change. This is evident from the high frequency and occurrence of the keywords 'emissions', 'carbon', 'clean' and 'climate change'. Other important idea-elements are, based on the keywords 'rural', 'developing', 'energy access' and 'cook', linked to the need to expand access to energy services; specifically, clean cooking solutions in rural areas of the developing world. The analysis, however, does not show whether these cooking solutions in fact involve renewable alternative fuels (see Section 2.2). Finally, a small set of energy security idea-elements resonate based on the keywords 'supply', 'demand' and 'economic growth', emphasizing the importance of a secure energy supply in the face of a growing demand, to ensure economic growth. Other idea-elements are less visible, such as the link between energy access and the global poverty agenda, the need for a renewable energy market, or the urgency to reduce air pollution through renewable energy.

Furthermore, the distribution of frames can be studied in relation to the years the renewable energy institutions were established (Fig. 2), which provides historical context to these frame constellations. As seen in Section 2.2, each timespan is associated with different political and natural events, resulting in different dominant frames. The chart in Fig. 2 thus questions whether the time period in which the institutions

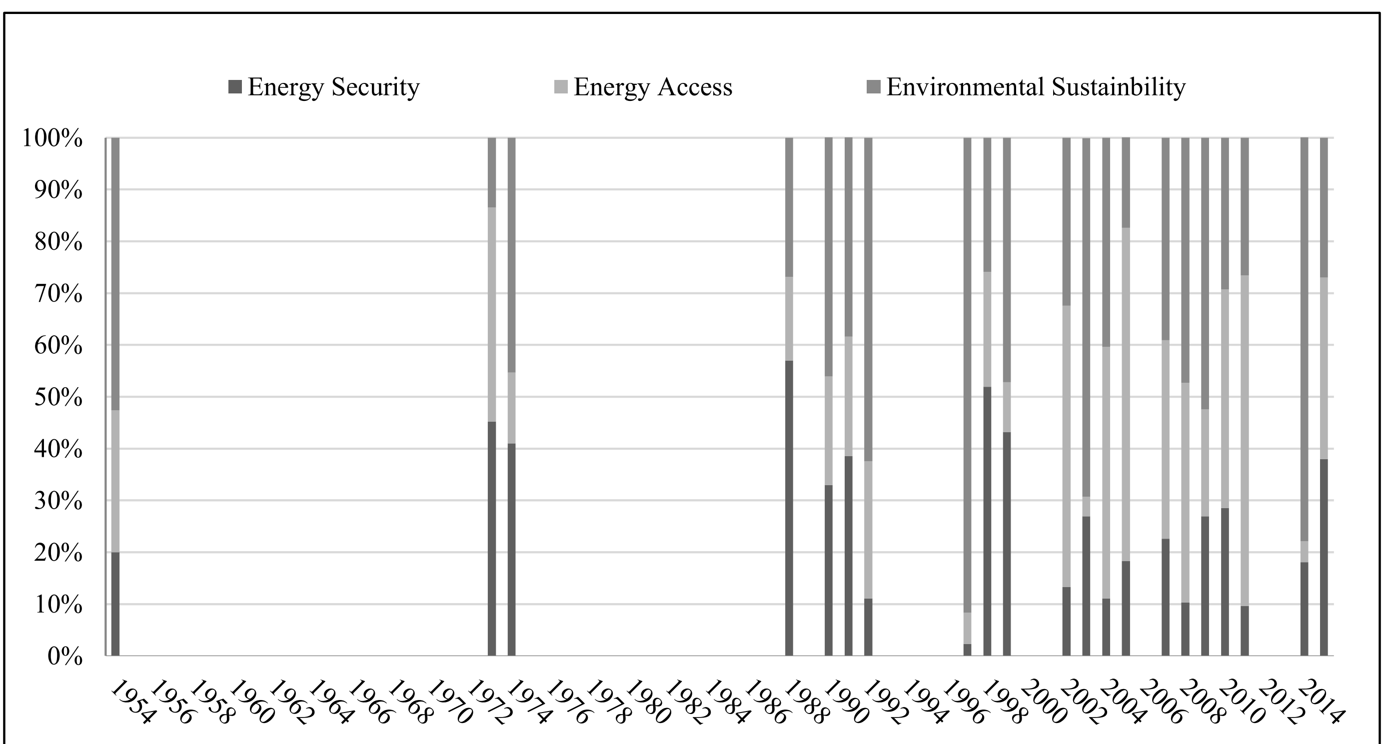

Fig. 2. Relative distribution of frames juxtaposed with the start years of the institutions from 1954 to 2015 (own data: August 29, 2018).

were established[8], influences how these institutions frame the energy challenge and the role of renewables at this point in time. There are three observations that are of particular interest. First, the relative importance of the energy security frame among institutions established between 1970 and 1990, which decreases afterwards. Second, the growing dominance of the environmental sustainability frame in the 1990s in parallel to a moderate proliferation of institutions. Third, an even stronger wave of institutions in the 2000s appears to be accompanied by the growing significance of the energy access frame.

In short, even though the link between energy security and economic growth is recognized, and the urgency to expand energy access in rural areas even more strongly, the climate change issue is considered most critical for global renewable energy governance. This focus appears to be rooted in the 1990s, although the growing significance of the energy access frame in the 2000s may indicate an ongoing shift. Notwithstanding, at this point in time the role of renewables is mostly defined as to mitigate greenhouse gas emissions, particularly through providing clean energy services in developing countries.

4.2. Meso-level

It is important to consider that the distribution of frames for the institutional complex as a whole does not apply to the individual zones of the governance triangle, and therewith, to the different types of institutions involved in global renewable energy governance. Therefore, Fig. 3 includes a chart demonstrating the relative distribution of frames in percentages per zone of the governance triangle. Only zone 1, including public institutions constituted by (groups of) states, international organizations, cities and regions, shows percentages that are somewhat similar to the overall institutional complex. In other words, public institutions frame the global energy challenge as one primarily related to environmental sustainability, with a growing focus on energy access, while the energy security frame is lagging behind.

Studying zones 2–7 demonstrates that differences exist in how the global energy challenge and the role of renewables are perceived among the remaining institutional types. First, in zone 2 and 3 including private institutions led by (groups of) firms, investors and industry associations, or (coalitions of) NGOs and other CSOs respectively, and in zone 4, in which firm actors collaborate with public actors, the environmental sustainability frame prevails even more strongly over both the energy access and energy security frames. Second, in zone 7 where all three actor-types unite in so-called public-private partnerships, it is rather the energy access frame that dominates at the expense of both the environmental sustainability and energy security frames. Finally, in zone 6 that

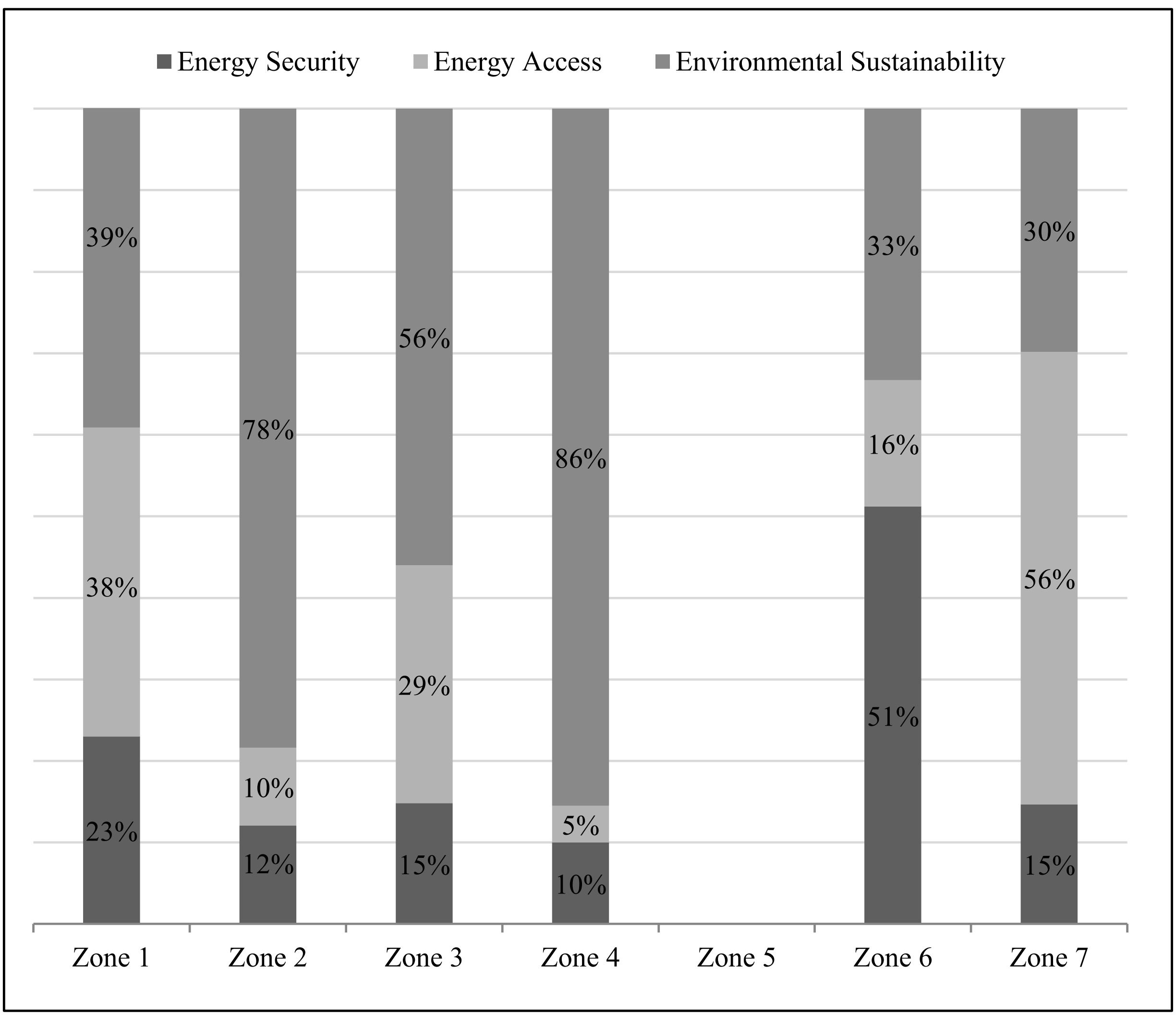

Fig. 3. Relative distribution of frames in percentages per zone in the governance triangle for renewable energy (own data: August 29, 2018).

[8] Please take note that the years do not correspond to when the analyzed texts were published.

includes institutions in which CSOs and firm actors join forces, the energy security frame resonates very strongly.

In sum, the environmental sustainability frame is generally supported across all institutional types, while energy access is prioritized by public-private partnerships, and energy security by private initiatives. The most integrated view towards the three governance goals is promoted by public institutions.

4.3. Micro-level

Finally, Fig. 4 zooms in on the relative distribution of frames per individual renewable energy institution. The first observation that

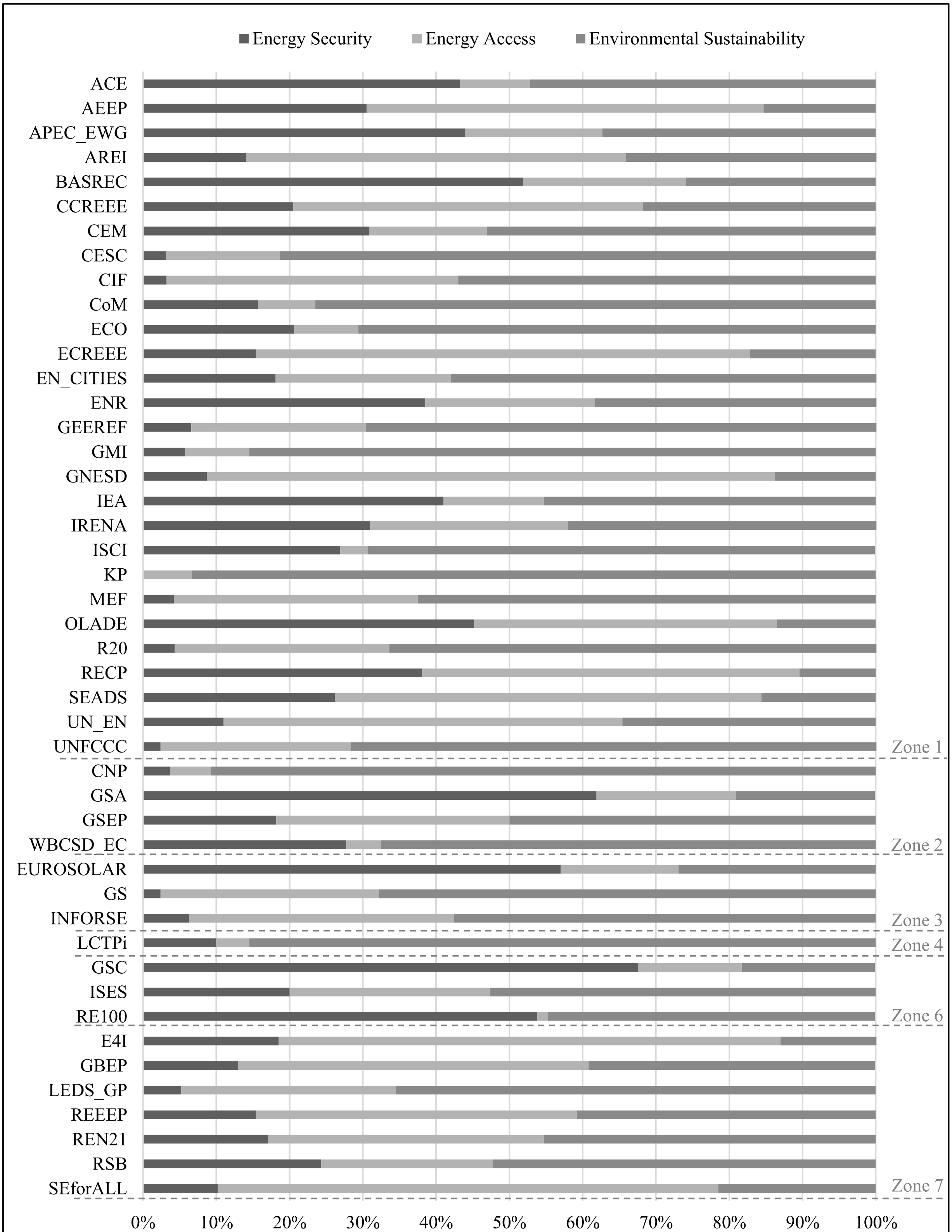

Fig. 4. Relative distribution of frames per individual institution per zone in the governance triangle (own data: August 29, 2018).

comes to the fore is that there are only a few institutions that show a similar distribution of frames compared to the overall institutional complex. These are the Global Sustainability Electricity Partnership (formerly E8) (GSEP), the International Network for Sustainable Energy (INFORSE) and REN21. This implies that the majority of institutions diverts from these frame constellations and prioritize the governance goals more selectively. Some of these cases are highlighted below.

First, while the energy security frame plays a small part in the overall institutional complex, there is a number of institutions that consider secure energy supplies as a top priority. These include regional alliances, such as the Baltic Sea Region Energy Cooperation (BASREC), the Energy Working Group of the Asia-Pacific Economic Cooperation (APEC EWG), and the Latin American Energy Cooperation (OLADE). However, they co-exist with a number of private institutions led by firms and CSOs, as seen in the previous section: the Global Solar Alliance (GSA), the Global Solar Council (GSC), the European Association for Renewable Energy (EUROSOLAR), and the RE100 initiative. Examining the texts of these institutions more closely, shows that these private institutions strongly relate to the idea of a global renewable energy market [46] and a solar energy market in particular [19,25,26].

Second, there is a set of institutions that prioritize the energy access frame strongly over the other two. Among these are Energy for Impact (E4I), the Global Network on Energy for Sustainable Development (GNESD), the two Centers for Renewable Energy and Energy Efficiency for the Economic Community of West-African States and the Caribbean (respectively, ECREEE and CCREEE), the Africa-European Union Energy Partnership (AEEP), and finally, Sustainable Energy for All (SEforALL). These are institutions that are heavily connected to the global development agenda: they generally provide assistance in developing countries to eventually improve the populations' quality of life.

Third, the environmental sustainability frame is broadly supported throughout the overall institutional complex and among all institutional types, but four institutions stand out when it comes to promoting renewables to mitigate climate change specifically. These include the Kyoto Protocol, designed to set binding emission mitigation targets, but also the Carbon Neutral Protocol (CNP) and Global Methane Initiative (GMI), similarly focusing on emission reductions. The fourth institution is the Clean Energy Solutions Center (CESC) that focuses on clean energy technologies.

Finally, only one institution is found to frame the global energy challenge as simultaneously related to energy security, energy access and environmental sustainability, and to recognize the role of renewables to alleviate energy scarcity, expand energy services and mitigate environmental impacts at the same time: IRENA. Examining the international organization's statute confirms that IRENA believes in the potential of renewables to alleviate problems of energy security and volatile energy prices, to reduce greenhouse gas emissions, and to provide access to energy in isolated and remote regions and islands [34].

5. Discussion

The results described in the previous section showed how renewable energy institutions currently frame the global energy challenge and the role of renewables. The next sections discuss the most striking findings in relation to historical and political context from the macro- to the micro-level.

5.1. Macro-level

The environmental sustainability frame comes out dominant in the overall institutional complex for renewable energy, and it particularly targets the issue of climate change. This focus appears to be linked to a first proliferation of renewable energy institutions in the 1990s [50]. During that time the threat of climate change received increasing interest, ultimately resulting in the UN convention on climate change and the Kyoto Protocol. Hence, global governance for renewable energy appears to have developed in parallel to climate governance, due to which its current frame constellations are heavily influenced by international climate negotiations at that time.

However, the growing significance of the energy access frame from the early 2000s onwards suggests a shift of focus towards the provision of energy services to those in need. This may be related to the growing consensus within the UN on the strong link between energy and poverty [37,48]. Whilst the Millennium Development Goals (MDGs) were still criticized for not including energy-related targets [4,9,30], the subsequent 2030 Agenda for Sustainable Development (Agenda 2030) did include a specific goal on energy. SDG 7 was introduced to *"Ensure access to affordable, reliable, sustainable and modern energy for all",* and more specifically, target 7.2 called for a substantial increase of the share of renewable energy in the global energy mix by 2030 [63]. Moreover, at the latest High-Level Political Forum on Sustainable Development in 2018, where progress on various SDGs was reviewed, SDG 7 was regarded as to make or break the achievement of all other SDGs [65]. Hence, the introduction of SDG 7 appears to have triggered a new wave of institutions framing renewables as to tackle the energy access challenge.

Consequently, it is particularly the energy security frame that is currently lagging behind. This is presumably related to the continued noninclusive and narrow scope of energy security debates. These have progressed at the international level, for instance at the G8 and G20, and have even broadened its dimensions towards the environment, affordability and efficiency [16,56,67]. Nevertheless, 'exploitation' remains dominant over 'exploration' [10]; when push comes to shove, these debates are about the stability and reliability of the single largest source of energy, oil [16]. As a consequence, energy security debates appear to still undermine the potential of renewables to diversify the energy mix and alleviate concerns of scarcity, resulting in weak links to global renewable energy governance.

These findings demonstrate how consensus at the UN significantly influences how renewable energy institutions frame the global energy challenge and the role of renewables. This has primarily led to increased entanglement of global climate and development agendas, while new dimensions to energy security are failed to appreciate.

5.2. Meso-level

The results have also shown that with diversity in institutions comes a variety of ways to frame the global energy challenge and the role of renewables; different actor constellations foster different frames. Although the environmental sustainability frame is the only constant: it is broadly supported by public as well as private institutions, and public-private partnerships. This is presumably related to the strong focus on climate change as prioritized challenge, which itself is globally governed by a wide array of institutions with different characteristics (see Table 1; [1,10,38,71]). Thus, as the institutional complex for renewable energy developed in parallel, the idea to increase the share of renewables for environmental sustainability, and to tackle climate change specifically, is widely supported.

Nonetheless, differences were found between various types of institutions in terms of their frame constellations. Public institutions appear to prioritize energy access in addition to environmental sustainability, while undermining the energy security dimension. This is at odds with two widely held assumptions: such institutions are traditionally seen as main proponents of the energy security frame, and are in the same vein criticized for not actively contributing to energy access (see Table 1; [10,16]). This can first be explained by the continued dominance of national policy-making when it comes to energy security: it is often seen as a matter of national security, due to which nation states remain reluctant to give up sovereign control [36,48]. Second, national governments are not legally bound, but at least held responsible to contribute to Agenda 2030, and achieve universal energy access in line with SDG 7 [63]. Hence, public institutions presumably prefer to leave energy security up to national policy-making, while promoting renewable energy for environmental sustainability and energy access: challenges that have, in contrast, been accepted as to tackle through transboundary cooperation.

Private institutions, steered by either firm actors or CSOs, advocate for the environmental sustainability frame even more strongly. Those exclusive led by CSOs also raise concerns about energy access, although these were expected to be stronger; the frame originated in the international development community, traditionally including aid agencies and NGOs (see Table 1; [10]). Most striking, however, is the dominating energy security frame among private institutions in which firm actors join forces with CSOs. International energy security discussions are often criticized for lacking multi-actor involvement [10]. A closer examination showed that this peculiar link is related to the private institutions' plea for a global market for renewables and solar energy in particular. As traditional energy sources have for the past three decades predominantly been governed through market mechanisms [28], these institutions' may have strategically used this frame to promote renewables as competitive. Thus, for global renewable energy governance energy security is no longer a 'state-only' affair.

Public-private partnerships come forward as the most important proponents for the energy access frame. This may be explained by the rise of multi-stakeholder partnerships since the World Summit on Sustainable Development (WSSD) in 2002. Such partnerships are seen as a response to weak intergovernmental attempts to tackle the complexity of sustainable development [5]. At the time, only a small set of partnerships, registered under the WSSD, focused on energy-related issues [61]. However, Agenda 2030 included SDG 17 to revitalize partnerships for sustainable development. More specifically, partnerships between governments, the private sector and civil society are considered a requirement to achieve the SDGs, including SDG 7 [63]. The growing recognition of the importance of energy access for sustainable development, in combination with the key role assigned to global partnerships, appears to have led to significant support for the energy access frame across public-private partnerships.

These figures show that the environmental sustainability frame is widely supported, which is no surprise as renewable energy and climate governance seem closely tied. In contrast, the energy security and energy access frames are connected to specific and more surprising institutional types. Whereas international energy security discussions are traditionally restricted to governmental actors, it is the private institutions that gladly bring a global renewable energy market to the table. And, while the energy access issue was originally raised by the development community, it has now become a main concern for public-private partnerships.

5.3. Micro-level

Zooming in on the micro-level, the individual institutions, even more so demonstrated that overall frame constellations are not to be assumed to apply across governance levels, nor among individual institutions. More specifically, it showed how the largest part of institutions selectively advocate either one or two of the frames. For each of the three frames, specific individual institutions were found as important advocates, of which some are well-known global governors.

First, it comes as no surprise that the Kyoto Protocol and its framework convention (UNFCCC), are found to prioritize the environmental sustainability frame and particularly climate change. These two international agreements are at the center of the institutional complex for climate change [38,71], and are therefore presumably also key in framing renewables as to mitigate emissions that cause a changing climate. Second, SEforALL comes forward as a significant proponent for the energy access frame. The UN initiative was initially seen as belated recognition for energy being missing from the MDGs [9,48], but from then onwards played a central role in formulating international commitments on energy to be included in Agenda 2030, and nowadays serves as a platform to catalyze action towards achieving SDG 7 [54]. Thus, SEforALL continues to play an important role in promoting renewables for energy access. Third, for the energy security frame various institutions were found. These include well-known regional alliances, such as APEC and OLADE, and a small set of private institutions, for instance GSA and GSC. As these institutions mostly focus on specific regions or solar energy respectively, a central institution with global outreach for the energy security frame seems to be absent. Such an institution may, however, be required to accommodate a more prominent role for renewables to alleviate increasing energy scarcity.

Ultimately, IRENA was found as the one institution promoting an integrated view: it showed an almost equal distribution of the three frames. The agency's inclusive stance towards the global energy challenge goes well with the 'soft' mandate of IRENA, which is designed not to impose rules or determine strategic directions, but to gather and disseminate comprehensive and unbiased information on renewable energy technologies and policies [66]. This softness, and perhaps also inclusiveness, is what led to the unique success story of IRENA, being the only multilateral body on renewable energy that is close to universal membership [49,66]. This places the institution not only at the center of the institutional complex for renewable energy, but also of the global energy challenge itself.

These findings reaffirm that global (renewable) energy governance developed into three rather autonomous governance arenas with distinctive priorities [10,48]. Moreover, they suggest that the lack of one integrated view towards the global energy challenge and the role of renewables is the underlying cause. One holistic frame that is shared by the multitude of institutions for renewable energy may be infeasible, but perhaps a more balanced representation of the three energy frames can be achieved. For instance, if a more central institution was to be found for the energy security frame, as is the case with the UNFCCC and SEforALL for the environmental sustainability and energy access frames respectively. Furthermore, there is possibly a special role to play by IRENA, to promote a more integrated frame or at least keep a watchful eye on the governance goals' trade-offs.

6. Conclusions and policy implications

A global transition towards renewable energy is paramount for a sustainable future, and effective global governance is required to accomplish this: to facilitate knowledge exchange and technology investments across borders, and to coordinate international aid. On the contrary, global governance for renewable energy is currently characterized as fragmented and ineffective. Existing research has therefore delved into the multiplicity of governance goals and the diversity in institutions for global renewable energy governance. What remained, however, underexplored is an assessment of underlying frames. Therefore, this paper posed the question how the global energy challenge and the role of renewables are framed in global renewable energy governance. Furthermore, it introduced an innovative methodology for frame analysis, to enable an examination of frame constellations at different levels of governance: for the overall institutional complex, across different institutional types, and among individual institutions.

The results first demonstrated that the institutional complex prioritizes climate change as the most urgent issue for renewable energy governance, although a shift appears to be on its way focusing on expanding energy access. As a result, international dialogue on energy security has yet failed to adequately enter global renewable energy governance. The figures then highlighted the broad support across different types of institutions for renewables to tackle climate change, while private institutions gladly join discussions on renewables for energy security, and public-private partnerships have risen to improve universal access to clean energy. Finally, the numbers showed how a large majority of institutions selectively support either one or two of the frames, while establishing a central role for IRENA. In conclusion, besides the governance goals and the institutional complex, also the frame constellations of global renewable energy governance are highly fragmented: the three energy frames are unevenly spread across the overall institutional complex, different frame constellations are found among institutional types, and associated governance goals are selectively prioritized by individual institutions.

These fragmented frame constellations are possibly hampering the effectiveness of global renewable energy governance towards the energy trilemma. The role of renewables is currently framed as to reduce emissions that cause climate change, particularly by providing clean energy to those who are lacking access in developing countries. This increased enmeshment of the environmental sustainability and energy access frames may, however, obstruct a complete substitution of fossil fuels by renewables in developed countries, as long as the threat of energy scarcity is not seriously considered. Therefore, increased efforts may be required to create a more balanced and integrated view on the global energy challenge and to entrust renewable energy the role to interactively address energy security, energy access and environmental sustainability concerns. The one appropriate institution to strategically frame and promote the role of renewables as such is IRENA. The agency not only places itself at the center of the global energy challenge, but is also highly inclusive and closing in on universal membership. As this research has shown, despite the trend of diffuse governing authority beyond the state, it is multilateral cooperation that remains key in creating understandings and consensus on contemporary threats to humanity. Although one holistic frame shared throughout the entire institutional complex for renewable energy may be utopian, this paper argues for a central role for IRENA in promoting and safeguarding a more balanced distribution of energy frames. Regardless of the resources needed to define the role of IRENA as such, it may result in a more effective contribution of the overall institutional complex to tackling the energy trilemma in every aspect.

When considering these findings, conclusions and implications, it important to take into account three potential limitations of this study, which came to the fore while conducting the research. First, there is a slight risk that the results are biased towards the environmental sustainability frame. While significant efforts have been made to treat this research paper as a stand-along study, it originated in a larger research project that sought to analyze global governance of the climate-energy nexus, and therewith, institutions to which the goal of climate change mitigation is inherent.[9] Second, the codebook remains specific to this study and cannot simply be used to analyze similar frames for another set of texts. This is due to the fact that the preliminary codebook was created based on sample texts derived from the corpus to be analyzed, and that the revision process involved applying the preliminary codebook to the corpus (see Section 3). Finally, the findings remain mostly descriptive and the links of fragmented frame constellations to ineffectiveness of global governance could only be speculated upon. This is the result of performing a large-scale analysis by the means of a computational method, which limits the possibility to create deeper understandings of frames and their effects.

Irrespectively, the study gives rise to interesting future research directions. The first is to build on the findings presented in this paper, and relate these to the level of intentionality among renewable energy institutions in framing the global energy challenge: why does an institution pick a specific frame? Second and in relation to this, it is of interest to examine the link between frames and audience: do different audiences foster different frames across renewable energy institutions? Third, it is highly relevant to study how a shift in framing the global energy challenge can be set in motion? Such endeavors are necessary to ultimately answer the primary question how the effectiveness of global renewable energy governance can be improved towards the energy trilemma. Finally, research should further explore the opportunities of methodological innovations for frame analysis as well as for text analysis more broadly. Yet, so far this study provides important and novel contributions to the fields of (renewable) energy research and social science: it advances our understanding of global renewable energy governance and sheds new light on its fragmented nature. Furthermore, it extends frame theory and analysis to global governance studies and introduces a new methodological approach.

Declaration of Competing Interest

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

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Appendix A. List of global renewable energy institutions

ZONE	ACRONYM	NAME	YEAR	MEMBERS	ROLE	ACTORS
1	AREI	Africa Renewable Energy Initiative	2015	6	10	Public
1	CEM	Clean Energy Ministerial	2009	24	6	Public
1	GMI	Global Methane Initiative	2010	18	6	Public
1	IRENA	International Renewable Energy Agency	2009	149	3	Public
1	ISCI	International Solar Cities Initiative	2003	5	3	Public
1	MEF	Major Economies Forum	2009	17	3	Public
1	R20	Regions 20	2010	48	6	Public
1	RECP	Africa-EU Renewable Energy Cooperation Program	2010	2	7	Public
1	ACE	Association of Southeast Asian Nations Centre for Energy	1999	10	3	Public
1	AEEP	Africa-EU Energy Partnership	2007	6	6	Public
1	APEC_EWG	Asian-Pacific Economic Cooperation Energy Working Group	1990	21	3	Public
1	BASREC	Baltic Sea Region Energy Cooperation	1998	11	2	Public

[9] This study was conducted in the context of the CLIMENGO project, which is a research project that aims to map the institutional complexity of global climate and energy governance, evaluate its effectiveness and legitimacy, and develop a knowledge base for decision-makers.

1	CCREEE	Caribbean Centre for Renewable Energy and Energy Efficiency	2015	19	6	Public
1	CIF	Climate Investment Funds	2008	35	4	Public
1	CoM	Covenant of Mayors	2008	6115	1	Public
1	ECO	ECO Partnerships on Clean Energy and Efficiency	2008	2	3	Public
1	ECREEE	Economic Community Of West African States Centre for Renewable Energy and Energy Efficiency	2008	15	6	Public
1	EN_CITIES	Energy Cities	1990	179	6	Public
1	EnR	European Energy Network	1991	22	3	Public
1	GEEREF	Global Energy Efficiency and Renewable Energy Fund	2008	1	4	Public
1	GNESD	Global Network on Energy for Sustainable Development	2002	2	6	Public
1	IEA	International Energy Agency	1974	1	6	Public
1	KP	Kyoto Protocol	1997	192	1	Public
1	OLADE	Latin American Energy Organization	1973	26	6	Public
1	SEADS	Strategic Energy Advisory and Dialogue Service	2004	1	3	Public
1	UNFCCC	United Nations Framework Convention on Climate Change	1992	195	1	Public
1	CESC	Clean Energy Solutions Centre	2009	1	3	Public
1	UN_EN	UN Energy	2004	6	6	Public
2	GSA	Global Solar Alliance	2015	3	3	Firms
2	GSEP	Global Sustainability Electricity Partnership (formerly the E8)	1992	11	6	Firm
2	CNP	CarbonNeutral Protocol	1997	1	1	Firm
2	WBCSD..E.C	World Business Council on Sustainable Development - Energy & Climate Cluster	1992	1	6	Firm
3	EUROSOLAR	The European Association for Renewable Energy	1988	1	6	CSO
3	INFORSE	International Network for Sustainable Energy	1992	1	3	CSO
3	GS	The Gold Standard	2004	1	1	CSO
4	LCTPi	Low Carbon Technology Partnerships initiative	2014	3	3	Public/Firm
6	GSC	Global Solar Council	2015	39	6	Firm/CSO/Firm
6	ISES	International Solar Energy Society	1954	1	3	CSO/Firm
6	RE100	RE100	2014	2	1	Firm/CSO
7	GBEP	Global Bioenergy Partnership	2007	37	6	Public/Firm/CSO
7	REEEP	Renewable Energy and Energy Efficiency Partnership (REEEP)	2002	354	4	Public/Firm/CSO
7	REN21	The Renewable Energy Policy Network for the 21st Century	2005	52	3	Public/Firm/CSO
7	RSB	The Roundtable on Sustainable Biofuels (RSB Standard)	2007	80	1	Public/Firm/CSO
7	LEDS_GP	Low Emissions Development Strategies Global Partnership	2011	27	3	Public/Firm/CSO
7	SEforALL	Sustainable Energy for All	2011	2	1	Public/Firm/CSO
7	E4I	Energy for impact (former GVEP)	2005	19	6	Public/Firm/CSO

Appendix B. List of textual dataset

INSTITUTION	WEBSITE	DOCUMENT NAME
ACE	www.aseanenergy.org (accessed: February 2018)	Annual report 2016 (accessed: February 2018)
AEEP	www.euei-pdf.org/en/aeep (accessed: February 2018)	Success stories (accessed: February 2018)
APEC	www.apec.org/Groups/SOM-Steering-Committee-on-Economic-and-Technical-Cooperation/Working-Groups/Energy.aspx (accessed: February 2018)	Report (accessed: February 2018)
AREI	www.arei.org (accessed: February 2018)	Framework (accessed: February 2018)
BASREC	www.basrec.net (accessed: February 2018)	Report (accessed: February 2018)
CCREEE	www.ccreee.org (accessed: February 2018)	No resources available on CCREEE's website
CEM	www.cleanenergyministerial.org (accessed: February 2018)	CEM8 summary report (accessed: February 2018)
CESC	www.cleanenergysolutions.org (accessed: February 2018)	Brochure (accessed: February 2018)
CIF	www.climateinvestmentfunds.org (accessed: February 2018)	Annual report 2016 (accessed: February 2018)
CNP	www.carbonneutral.com (accessed: February 2018)	Protocol 2017 (accessed: February 2018)
CoM	www.covenantofmayors.eu (accessed: February 2018)	Commitment document (accessed: February 2018)
E4I	www.energy4impact.org (accessed: February 2018)	Annual review 2017 (accessed: February 2018)
EC	www.energy-cities.eu (accessed: February 2018)	Transition study (accessed: February 2018)
ECO	www.ecopartnerships.lbl.gov (accessed: February 2018)	Fact sheet (accessed: February 2018)
ECREEE	www.ecreee.org (accessed: February 2018)	Report (accessed: February 2018)
EnR	www.enr-network.org (accessed: February 2018)	Presidency work plan 2017-2018 (accessed: February 2018)
EUROSOLAR	www.eurosolar.de/en/ (accessed: February 2018)	Annual report 2016 (accessed: February 2018)
GBEP	www.globalbioenergy.org (accessed: February 2018)	Information sheet (accessed: February 2018)
GEEREF	www.geeref.com (accessed: February 2018)	Impact report (accessed: February 2018)
GMI	www.globalmethane.org (accessed: February 2018)	Fact sheet (accessed: February 2018)
GNESD	www.gnesd.org (accessed: February 2018)	Outcomes assessment report (accessed: February 2018)
GS	www.goldstandard.org (accessed: February 2018)	Annual report 2016 (accessed: February 2018)
GSA	www.global-solar-alliance.com/eng/ (accessed: February 2018)	Press statements (accessed: February 2018)
GSC	www.globalsolarcouncil.org (accessed: February 2018)	Outlook report (accessed: August 2018)
GSEP	www.globalelectricity.org/en/ (accessed: February 2018)	Annual report 2016-2017 (accessed: February 2018)
IEA	www.iea.org (accessed: February 2018)	WEO executive summary 2017 (accessed: February 2018)
INFORSE	www.inforse.org (accessed: February 2018)	News item November 2017 (accessed: February 2018)
IRENA	www.irena.org (accessed: February 2018)	Statute (accessed: February 2018)
ISCI	www.iscicities.org (accessed: February 2018)	Initiative (accessed: February 2018)
ISES	www.ises.org/home/ (accessed: February 2018)	Blog (accessed: February 2018)
KP	www.unfccc.int/process/the-kyoto-protocol (accessed: February 2018)	Protocol (accessed: February 2018)

LCTPi	www.lctpi.wbcsd.org (accessed: February 2018)	Progress report (accessed: February 2018)
LEDS_GP	www.ledsgp.org (accessed: February 2018)	Work plan (accessed: February 2018)
MEF	www.majoreconomiesforumorg (website not working)	Declaration (accessed: August 2018)
OLADE	www.olade.org/?lang-en (accessed: February 2018)	Balances of useful energy manual (accessed: February 2018)
R20	www.regions20.org (accessed: February 2018)	Report (accessed: February 2018)
RE100	www.there100.org (accessed: February 2018)	Annual report 2017 (accessed: February 2018)
RECP	www.africa-eu-renewables.org (accessed: February 2018)	Strategy 2020 (accessed: August 2018)
REEEP	www.reeep.org (accessed: February 2018)	Annual report 2016 (accessed: February 2018)
REN21	www.ren21.net (accessed: February 2018)	Annual report 2017 (accessed: February 2018)
RSB	www.rsb.org (accessed: February 2018)	Annual review 2015 (accessed: February 2018)
SEforALL	www.se4all.org (accessed: February 2018)	Strategic framework (accessed: February 2018)
SEADS	www.euei-pdf.org/en/seads (accessed: February 2018)	Brochure (accessed: February 2018)
UN_EN	www.un-energy.org (accessed: February 2018)	Activities (accessed: February 2018)
UNFCCC	www.unfccc.int (accessed: February 2018)	Convention (accessed: February 2018)
WBCSD_EC	www.wbcsd.org/work-program/energy-and-climate.aspx (accessed: February 2018)	Accounting outline (accessed: February 2018)

Appendix C. The categorization dictionary for energy frames

Energy Security	COMPETITIV*
	CONSUMER*
	DISRUPTION*
	ECONOMIC_GROWTH
	ELECTRICITY_MARKET*
	ELECTRICITY_SECURITY
	ENERGY_MARKET
	ENERGY_SECURITY
	GAS_MARKET*
	OIL_MARKET*
	POWER_MARKET*
	PRODUCER*
	SECURITY_OF_ELECTRICITY
	SECURITY_OF_ENERGY
	SECURITY_OF_SUPPLY
	SOLAR_MARKET*
	STATE_OWNED
	VOLATIL*
	SUPPLY_SECURITY
	DEMAND near ENERGY, ELECTRICITY, FUEL*, ELECTRIF*
	RELIAB* before ENERGY, ELECTRICITY, SUPPL*
	SECUR* near ENERGY, ELECTRICITY, SUPPL*
	SUPPL* near ENERGY, ELECTRICITY, FUEL, ELECTRIF*
Energy Access	COOK*
	DECENTRAL*
	ECONOMIC_DEVELOPMENT
	ELECTRICITY_ACCESS
	ELECTRICITY_SERVIC*
	ENERGY_ACCESS
	ENERGY_SERVIC*
	HUMAN_DEVELOPMENT
	INCLUSIV*
	POVERTY
	QUALITY_OF_LIFE
	RURAL
	SMALL_SCALE
	SUSTAINABLE_DEVELOPMENT_GOAL*
	TECHNICAL_ASSISTANCE
	WORLD_BANK
	ACCESS before ELECTRICITY, ENERGY
	DEVELOPING before WORLD, ECONOM*, REGION*, COMMUNIT*, COUNTR*, NATION, NATIONS, STAT*
	DEVELOPMENT before BANK*, CORPORATION*, ORGANI*ATION*, AGENC*, COMMUNIT*, AGENDA*
Environmental Sustainability	*FOREST*
	CLIMATE_CHANGE
	CONTAMIN*
	DEGRAD*
	EARTH_SUMMIT
	ECOSYSTEM*
	EMISSION*
	ENVIRONMENTAL*
	FRAMEWORK_CONVENTION_ON_CLIMATE_CHANGE
	GLOBAL_WARMING
	GREENHOUSE_GAS_CONCENTRATION*
	PARIS_AGREEMENT

PLANET*
POLLUT*
CARBON not before EMISSION*
CLEAN before ENERGY, COOK*, TECH*, POWER, TRANSPORT*, FUEL*, ELECTRICITY
ENVIRONMENT after THE, SUSTAINABLE, NATURAL, URBAN
UNFCCC not after FRAMEWORK_CONVENTION_ON_CLIMATE_CHANGE

Appendix D. Protocol for Frame Analysis using QDA Miner and Wordstat

1.	Download QDA Miner and WordStat: http://provalisresearch.com/downloads/trial-versions/
2.	Collect mission statements from all institutions included in the renewable energy governance triangle[a]
3.	*Create a project from a list of documents: import* and *add* the representative[b] *cases*[c], one for each zone of the renewable energy governance triangle, this will be your coding sample
4.	Add *variables* and respective definition: 'Name' of the institution (Nominal/Ordinal), 'Start' of its creation (Numeric > Integer), 'Zone'[d] (Numeric > Integer) and assign them to each *case*.
5.	One *case* at a time[e], code[f] each relevant *segment* under one, or more, if applicable, frames[g] (*categories*), using pre-identified *sub-categories* from literature as *codes*. Assign a color to each category, all *sub-categories* under each must have the same color. In order to keep track of coded *segments*, go to 'Document' > 'Coded text' and enable 'Code colors'.
6.	After coding all *cases*, use function of 'Coding Retrieval' to retrieve *segments* of each code.
7.	Run *WordStat* for each set of retrieved *segments* and save *keywords* ('Frequencies' tab, save as Excel file).
8.	Create an inclusive 'Categorization Dictionary' in *WordStat* resembling the *codebook* in *QDA Miner*, and add all retrieved *keywords* respectively.
To revise and improve the dictionary:	
9.	*Create a new project file* on *QDA Miner* using all collected mission statements from the whole renewable energy governance triangle (including the ones considered for the sample), add them as *cases* and assign *variables*.
10.	On the QDA Miner autocoded project file, perform 'Content Analysis' using WordStat and select the previously created '*Categorization Dictionary*' ('Up to level': 2; untick 'Categories Only' and tick 'Allow Overlaps'), whilst also selecting the *exclusion dictionary* 'English.exc'.
11.	Using the *Frequencies* page, sort by 'frequencies' and 'case-occurrence' – this allows you to detect verbs and *keywords* that are generic within the issue area, list them and delete them if appropriate. *Threshold based on trials: frequency ≥ 500 and case-occurrence ≥ 75%, which implies that the keywords are detected 500 times in the whole dataset and occur in 68 or more texts of the total of 90.*
12.	Using the *Extraction* page and the *phrases* tab you can detect *phrases* that are frequently used in the dataset. Note these and if appropriate add these as *phrases* to the dictionary. *Threshold based on trials: 'Min words': 2, 'Max words': 5 and 'Min frequency': 30, which implies that phrases are not shorter than 2 words, no longer than 5 words, and occur at least 30 times in the whole dataset.*
13.	On the *Co-occurrences* options ('Clustering': Keywords/Categories; 'Occurrence': Same sentence; 'Index': *Jaccard's coefficient*; 'Type': Word *co-occurrence – First Order*, 'Remove single word clusters'), explore 'Proximity Plot' (Table; 'Target items': Select as appropriate) – this helps you to create *phrases* instead of single keywords. *Threshold based on trials: Jaccard's Coefficient ≥ 0.200, which indicates that of all sentences containing either one of these words, 20% or more contains both words.*
14.	On the *Dictionary* page and in the dictionary viewer (i) adjust *keywords* by using (*) to capture plural and singular nouns and all tenses of the verbs in one keyword, (ii) add *phrases* that capture the full meaning of abbreviations and (iii) remove all *keywords* that refer to the name of an institution included in the dataset.
15.	By studying *Keyword-in-context* ('List': Included; 'Sort by': Keyword & After or Keyword & Before; 'Context delimiter': Sentences; 'Keyword': select and check each keyword individually) – together with the foregoing revisions these analyses will form the basis of the dictionary's rules.
16.	Based on the foregoing analyses and while looking at the *Keyword-in-context* page, on the Dictionary viewer: (i) Remove words that do not fit the correct context, that are generic in the issue area, that occur once and/or that are linked to other important *keywords*. (ii) Create *phrases* if a particular combination of *keywords* occurs frequently (iii) 'Add *rules*' to 'Target words, *phrases* or *categories*' using the available 'Operators' (and, not, near, not near, before, not before, after, not after), based on *keyword frequencies*, word patterns and contexts. Save the dictionary.
17.	After deleting all codes from the QDA Miner project file and saving it as a new one, perform 'Content Analysis' with WordStat. Before selecting the revised dictionary on the *Dictionary page*, run a *frequency* analysis to retrieve important *keywords* that appear in a high % of cases but that you might have missed on the sample. Select and update the revised dictionary.
18.	As assurance, via the *keyword-in-context* page check all keyword*, phrases* and rules individually if they capture the right words and *phrases* in the correct context.
To retrieve results:	
19.	Create a new *project file* on *QDA Miner* using all collected mission statements from the whole renewable energy governance triangle (including the ones considered for the sample), add them as *cases* and assign *variables*.
20.	Perform 'Content Analysis' using *WordStat* on the complete project file, apply the *'Categorization Dictionary*' ('Up to level': 2, 'Categories Only' and 'Allow Overlaps').
21.	Via the *Frequencies* page '*Apply QDA Miner codes to text segments using all content categories'* to automatically code the texts in QDA Miner, using a categorization dictionary created in Wordstat.
22.	If possible and necessary manually correct for false coding, by removing or adding codes.
23.	In *QDA Miner* use *analyze > coding by variables* to statistically compare the four of them according to previously assigned *variables 'Zone', 'Year' and/or 'Name'* ('Codes': All; 'Tabulate with': 'Zone', 'Year' or 'Role'). Create *crosstabulation* by displaying as 'count' or as 'column percent', this enables one to explore the distribution of frames in relation to (i) the seven zones, (ii) year of creation of the institutions, and/or (iii) the individual institutions.
24.	Via WordStat and on the *Frequencies page* retrieve the sub-*categories* (i) that are most frequently coded ('Sort by': *frequency*') and (ii) the sub-categories with the highest *case-occurrence* ('Sort by': *case-occurrence'*. This allows one to explore the narratives that prevail the most in the whole dataset.

Definitions

<u>**General**</u>	
Cases	= Basic unit of analysis of a project. In this case, it consists of a mission statement and represents an institution.
Variables	= Used to specify the properties associated with a case.
Segment	= Set of words within a text that can be coded according to its storyline
Storyline	= Meaning
Categories	= Frames
Keywords	= Words within segments
<u>**QDA Miner**</u>	
Codebook	= Set of codes used in QDA Miner

Virtual grouping function	= Allows one to temporarily group all codes in a category to instruct QDA Miner to compute frequencies and obtain statistics at the category level without reporting statistics on codes underneath it.
Coding by variable tool	= Useful for identifying or testing potential code similarities or differences between subgroup of cases (categorical variable) or to assess the relationship between these codes and other numerical variables.
Column percent	= Each value consists on the % of coded segments under a specific category (row/frame) in relation to the total percentage of coded segments within that value of the chosen variable.
Count	= Will retrieve the total number of words that have been assigned to a specific code.
Total percent	= Each value translates into the % of coded segments under a specific category (row/meta-frame) in relation to the total percentage of coded segments within the project file.
WordStat	
Dictionaries page	= Allows one to adjust various text analysis processes, create and modify dictionaries, exclusion and substitution lists, as well as add, remove and edit existing entries in those dictionaries.
Categorization dictionary	= The categorization process allows one to change specific words, word patterns, or phrases to other words, keywords or content categories and/or to extract a list or specific words or codes. This process requires the specification of an inclusion dictionary. This dictionary may be used to remove variant forms of a word in order to treat all of them as single word. It may also be used as a thesaurus to perform automatic coding of words into categories or concepts.
Exclusion dictionary	= Is used to remove all words that are not to be included in the content analysis.
Rules editor	= May be used to define complex coding rules allowing one to specify under which conditions a particular item or category of item should be coded.
Frequencies page	= Is used to display a frequency table of words or category names, and to retrieve a list of leftover words.
Code frequency	= Allows you to count the total number of times a code has been used.
Case occurrence	= Allows you to compare the number of cases in which at least one instance of this code appears. If a code is used more than once in the same case, it will be counted only one.
Extraction page	= May be used to extract useful features from the text collection.
Phrases	= Enables the identification of idioms and common phrases and will allow one to add them to a content analysis dictionary as well as perform co-occurrence analysis and comparison analysis of those phrases.
Co-occurrence page	= Allows one to explore connections between words, keywords, phrases or content categories. Thus specifies how a co-occurrence will be defined. By default a co-occurrence is said to happen every time two words or two categories appear in the same case, paragraph or sentence.
Co-occurrences – first order	= Allows you to compare the number of cases in which at least one instance of this code appears. If a code is used more than once in the same case, it will be counted only one.
Index	= Let's you select the similarity measure used in clustering and in multidimensional scaling. Four measures/coefficients are available.
Jaccard's coefficient	= Is computed from a fourfold table as a/(a + b + c) where a represents cases where both items occur, and b and c represent cases where one item is found but not the other. In this coefficient equal weight is given to matches and non-matches.
Keyword-in-context page	= Enables one to display a concordance table word patterns or phrases, or of all items related to a content category. Such a table is very useful to validate a dictionary by allowing one to examine in context how words are being used.

For more detailed information, please consult *QDA Miner* User's Guide, available at http://www.provalisresearch.com/Documents/QDAMiner32.pdf, or *WordStat* User's Guide, available at http://www.provalisresearch.com/Documents/WordStat6.pdf.

[a] Keep track of which type of document or section of a document is used for each institution.

[b] An institution is hereby considered representative if it is acknowledged as a governing body of the given issue area by literature. Also one tries to choose texts that are comparable in length and style (writing, etc.).

[c] The texts of these documents must be as clean and simple as possible with font color black; even if they're copy-paste from the respective institution's homepage section. Pictures must be deleted as well as unnecessary spaces, hyperlinks, bullets or extra formatting. When PDFs are used, this editing can be done directly on QDA Miner's working environment.

[d] Types of actors (1-7): ZONE 1 = State; ZONE 2 = Firms; ZONE 3 = Civil Society Organizations (CSO); ZONE 4 = State + Firms; ZONE 5 = State + CSO; ZONE 4 = CSO + Firm; ZONE 7 = State + CSO + Firm.

[e] *All cases* must share the same codes' portfolio to choose from (codebook), new ones should add up to the set and systematic review of previous cases might be needed.

[f] *Codes* are just words that purport to give meaning to segments/narratives under one of the three frames; they do not necessarily have an inherent scientific value.

[g] *Environmental Sustainability*, Energy Access and Energy Security. For definitions and further discussion see Section 2.2.

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