How active are energy actors in the US climate policy subsystem?

A descriptive analysis of energy actors’ collaboration activities within belief coalitions in the US climate policy subsystem

Master Thesis

Faculty of Science

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December 2022

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Abstract

In this thesis, the policy beliefs and collaborative activity of energy actors is studied in the US climate policy subsystem. Understanding what policy beliefs actors support and how they interact with other actors in the subsystem can show important actors in the policy design process. The overarching analysis is built upon the concept of the Advocacy Coalitions Framework (ACF) which theorizes that actors build coalitions with other actors that have similar policy beliefs in hopes of increasing the likelihood of success in policy outputs. The interactions within the subsystem and the coalitions can lead to more knowledge on an actor's role in policy design. Policy actors use collaboration to share resources, information and further promote their policy beliefs and further increase their likelihood of policy design success. Based on these ideas the thesis uses cluster and social network analyses to qualitatively and quantitively describe energy actor's roles in the climate policy design. The study has two main goals that both drive to answer the research question. The first goal is to identify which climate policy beliefs energy actors are supporting and building coalitions around. As US climate policy design focuses on clean energy, private organizations in the energy sector will be highly impacted. Both renewable and traditional energy organizations will likely play a role in designing outputs around specific policy preferences beneficial to their cause. The second goal is to quantify the collaborative activity and roles of the energy actors within their coalition as well as the subsystem. The results of the analysis show that energy actors appear in two out of four coalitions in the subsystem. Two energy actors fall within the Climate Neutral coalition, which has little preference on the current policy preferences being debated including climate targets, investments in technology, and programs. The remaining three energy actors support the Climate Tech coalition, which strongly supports the policy belief of reducing GHG emissions in line with the Paris Agreement while using policy instruments focused on government investment in climate change technologies, including CO_2 removal. Overall, energy actors are active collaborators within their respective coalitions, but not the most active. The energy actors generally take up non-central auxiliary roles, with only one energy actor, in the Climate Tech coalition, found to be taking a principal role. The same energy actor has many connections to actors in other coalitions, showing that it could also be taking up a policy broker role in the subsystem.

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1. Introduction

Global issues, such as terrorism, biodiversity loss, and climate change, affect entire populations. These issues rarely have straight forward solutions and are often referred to as "wicked problems" in policy terms. Wicked problems have no true definition, their impacts are uncertain, where a simple solution can't be defined, which makes them incredibly difficult to decipher or study (Rittel and Webber, 1973; Head, 2022). Climate change is one of the most prevalent wicked problem the world is facing today. Increasing weather and climate extremes, rising sea level, and melting ice caps, are all direct impacts of climate change. Science has attributed these specified climate impacts to the increasing amount of Greenhouse Gas (GHG) emissions from anthropogenic sources. The increase in GHG emissions is correlated with the increasing impacts of climate change forcing governments across the globe to implement policy solutions to stop their impacts, like GHG reduction and mitigation tactics (IPCC, 2022).

Climate politics can be traced back to 1970s, with the first notable conference on environmental concerns hosted in Stockholm, the United Nations Conference on the Human Environment (UNCHE). Though, on a global scale immediate cooperation to address the risk of increasing GHG concentrations didn't formally happen until the United Nations Framework Convention on Climate Change (UNFCCC) was ratified at the UN Conference on Environment and Development (UNCED) in Rio de Janeiro (Haibach & Schneider, 2013). An outcome of the UNCED in 1992 was that governments were now collectively committed to taking action against climate change, such as GHG mitigation (Koch et al., 2020). In 2015, a collaborative effort from global leaders resulted in the Paris Agreement, which bound participating countries to limit temperature rise well-below 2°C and attempt to reach carbon neutrality by mid-century (UNFCCC, 2015). To achieve the goals set out in the Paris Agreement, governments across the globe must deploy policy instruments to mitigate and reduce GHG emissions.

Policy instruments such as carbon removal, energy efficiency standards, carbon tax, product prohibitions, and low-carbon energy production are some of the more effective solutions that have had success in reducing GHG emissions (Duval, 2008). Due to the wickedness of the issue, climate policy requires many inputs from a host of multi-level stakeholders. Climate governance involves actors at multiple levels, across governments, organizations, and agencies, that create a theoretical network. Both vertical and horizontal integration of actors are vital to the structure of the climate governance (Fisher & Leifeld, 2019; McGee & Jones, 2019).

In climate governance, a transition to cleaner, more sustainable energy production is at the forefront of discussions. The energy sector is the highest GHG emitter and governments are focused on heavily reducing the GHG emissions from energy production methods (IEA, 2021). The energy sector contributed 36.3 Gigatons (Gt) of carbon dioxide (CO_2) in 2021, a 6% increase from the previous year (IEA, 2021). On top of emitting GHGs, traditional energy production methods face resource depletion and threaten public health through air pollution (Makard et al., 2012). Governments look to deploy climate focused policies and regulations on the energy sector to aid in a sustainable transition to renewable, resilient, and efficient energy sources. Renewable energy sources and low carbon alternatives can cut emissions drastically (IPCC, 2011).

For almost 40 years, the US government has been debating climate change, both the science and the policies to tackle it. Over that span, the US government has failed to produce significant climate legislation (Collomb, 2014). Polarization over international agreements, most notably the Kyoto Protocol and the Paris Agreement, have led to multiple pieces of legislation being voted down in the US Congress (Fisher et al., 2012).

Over the past decade the United States has been the closest to accepting climate legislation. Significant climate policy was proposed in both the American Power Act (2010) and Clean Power Plan (2015) both seemingly cut from federal funding due to lack of bipartisan support. A large part of the lack of support is because of traditional energy companies using their influence to cut out emission reductions and transitional energy plans from policy designs (Downie, 2017).

The US climate policy subsystem is a pluralist government, with a diverse mixture of multi-level actors. The subsystem is interesting because it’s referred to as polycentric governance, forming several coalitions that produce decentralized outcomes. The polycentricity allows for subsystems to overcome policy blockages and collective action issues (Fisher & Leifeld, 2019; Ostrom, 2010). Actors with influence and resources use collaborative methods to share beliefs and preferences to policymakers (Cairney, 2019). The wealth of views, beliefs, and preferences allows climate policy to involve stakeholders at many levels and aims to provide policy outcomes that are a collective benefit.

Due to the pluralist system in the US, energy actors have a large cache of resources to shape policies. Energy actors, both traditional and renewable, have incentives to push climate policy in a certain direction.

The goal within this master's thesis is to study the interactions of energy actors in climate policy. The research question I aim to answer is: *What policy beliefs do energy actors ideologically cluster around and how active are these actors within the US climate policy collaboration network?*

Energy actors in the US system are The traditional energy producers, mostly focused on burning fossil fuels, have been entrenched in US policy networks for years, wielding deep pockets and long-standing connections to curb future energy policies (Brulle, 2018). These companies and their representatives have consistently blocked US climate policy, while the rest of world has succeeded, to some degree, in passing national level policy aiming to cut emissions and utilize cleaner energies. The recent emergence of renewable energy associations with assistance from environmental groups has helped combat the traditional energy companies to an extent through grassroots efforts and advocacy (Shelton & Eakin, 2022). A large volume of political resources come from either side of the energy sector, pushing within their coalitions for advantageous policy outputs.

While many policy studies analyze policy design and how it shapes outcomes, there is a gap in the role of actors in this process (Haelg et. al, 2019). It is important to understand how individual actors act within traditional government structures to enrich policy discussions and outputs (Anderson, 1996). The identification of important actors in policymaking allows for further answers into how policy becomes successful. While other actor-focused studies have looked generally at the entire climate subsystem (Hsu & Rauber, 2021) or specifically at other actor types (Fisher & Leifeld, 2019), there remains a gap detailing the energy sector's interactions.

To answer the research question, I theoretically employ the Advocacy Coalition Framework (ACF) as it identifies actor beliefs in a subsystem as a driver of how policy changes occur (Sabatier & Jenkins-Smith, 1993). I use one of the three premises the ACF is based on; policy can be conceptualized the same as a belief system, in which actors form coalitions with other like-minded actors. (Sabatier, 1988). Following this framework, it suggests that the actors have strong beliefs they want to turn into policy. Actors form allies, who hold similar beliefs, to increase the chances of gaining favorable policy outcomes (Sabatier, 2007; Weible & Sabatier, 2005). These formed coalitions, help to understand where policy ideas develop and eventually, shape the design (Weible & Ingold, 2018). Actors can take on active or passive roles within the coalitions, leading to conclusion about their level of involvement in the policy design. Then, studying what policy beliefs energy actors form coalitions around can lead to understanding how they have influenced climate policy designs.

To further investigate the how energy actors act in the subsystem, I deploy network analytics. Network analysis techniques, a cornerstone of policy studies, has been used to study policymaking through relational patterns (Kenis & Schneider, 1991). Applying network analysis to a subsystem reveals the connection between actors as they push their policy beliefs forward. Collaboration is powerful connection in policymaking that allows actors to share resources and information to further their policy ambitions (Innes & Booher, 2003; Fischer & Sciarini, 2016). The composition of actors in the climate policy subsystem forces collaboration and compromise so that policy is well rounded and effective. Therefore, organizations that are actively collaborating should be more successful in gaining support for their ideas.

Methodologically, I built the subsystem actor list from a database of actors' participation in US congressional testimonies, lobbying, and climate conferences. The top participants were selected based on cumulative participation cut off to ensure only highly active actors were included. Network data was collected by providing each actor with questions regarding both stances on policy beliefs/preferences and connections to other actors in the network. The belief data allowed for the building of coalitions through hierarchical cluster analysis. Finally, social network analysis was used to both quantitatively and qualitatively analyze the collaborative interactions within the coalitions at the organizational group level.

The primary analysis is built to answer two parts under the research question. The first is to classify each actor into a belief coalition to understand what policy beliefs energy actors are currently supporting. The second is quantify how active in collaboration energy actors are within the coalitions and the climate policy subsystem. Climate policy research is imperative to understand the innerworkings of how climate policy is designed. This study will add an important piece to this research and will help to further understand how some of the most important industries interact in climate conversations within a country that has failed to implement meaningful climate policy.

It is crucial to understand how energy actors are pushing their policy beliefs in the US. Building out coalitions and quantifying the collaborative activity of energy actors could provide helpful insights into how US climate policy is being designed and influenced by the energy sector. Overall, this thesis should yield results that can provide material for further climate policy research to build on, regarding the energy sector's impact on policy outputs.

2. Literature

2.1 Advocacy Coalition Framework

A seminal framework, the Advocacy Coalition Framework (ACF), aims to provide insights into policy changes as a factor of actor beliefs and network structures (Sabatier & Weible, 2007; Ingold, 2011). The ACF states that policy actors coordinate in coalitions based around beliefs to drive policy changes. Its main concept focuses on the subsystem as the primary unit of analysis and conceptualizes policy processes the same as belief systems (Sabatier, 1988; Sabatier & Weible, 2007). A subsystem is a group of actors within a policy system that focus on an issue and include policymakers, issue experts, and other stakeholders (Heclo, 1978). The ACF proposes that within a subsystem there lies competition for policy changes and processes (Ingold, 2011). Actors inside of each subsystem vie to pass policies that align with their beliefs or are beneficial to their cause. The ACF suggests that actors use beliefs and preferences as building blocks to form alliances and coordinate with other like-minded actors. This aggregation of actors is nominally referred to as an advocacy coalition. The count of coalitions in a subsystem can range from 1-5 depending on how stable or mature the subsystem is. A more stable subsystem will have fewer coalitions (Sabatier & Jenkins-Smith, 1993). According to Sabatier & Jenkins-Smith's work, actors in subsystems do not always act for immediate self-interests but based on their stable beliefs.

The ACF also proposes that there is a three-tiered hierarchal belief system that is vital to the formation of coalitions (Weible & Sabatier, 2005). The first tier of beliefs are deep core beliefs which are normative and ontological expectations, such as views on human nature, social norms, and fundamental values (Ingold, 2011; Sabatier & Jenkins-Smith, 1993). Deep core beliefs include political leanings, liberties, priorities of welfare, or roles of government and span all subsystems. They are akin to religious beliefs where they hardly ever change (Sabatier & Weible, 2005). The second belief tier is policy core beliefs, which usually applies to the beliefs in the actor's specialized subsystem and involve a wide range of beliefs that are often resistant to change. Policy core beliefs involve how the policy subsystem should exist such structure of power, level of actor involvement, and balance of policy instruments. Policy core beliefs are where coalitions usually form and create divergence in the subsystem. The third, and most specific tier, is secondary beliefs, which are not necessarily stable. Secondary beliefs describe an actor's thoughts on budgets, regulations, and other specific tactics that are used to realize policy changes. Actors will often negotiate and compromise on secondary beliefs to preserve deep and policy core beliefs (Jenkins-Smith et al., 2014). All three tiers of beliefs are important in understanding how an actor will approach policy changes. The relationship between policy core beliefs and secondary beliefs describes how coalitions form and to what degree members collaborate in a subsystem (Henry, 2011).

2.2 Coalition Structures & Roles

Not every actor in a subsystem is equally active, thus creating an environment where actors bring different levels of resources to the table and provide coalitions with varying services. There are many types of coordination actors can present. The two most common are strong and weak coordination. Strong coordination occurs when actors develop, communicate, and implement a plan for successful policy changes. Weak coordination sees actors monitor coalition members activity and make strategies based of plans already developed. Weak coordination allows actors to have small inputs to a larger plan without the paying the costs to be integrated in the process (Zafonte & Sabatier, 1998; Sabatier & Jenkins-Smith, 1993). Strong coordination is needed in concentrated amounts to achieve policy success, while weak coordination is often used to mitigate costs. While general thought would believe strong coordination should be isolated, weak coordination allows a multitude of actors to interact within the subsystem without a high cost (Zafonte & Sabatier, 1998). Strong and weak coordination are both imperative to policy change and allow for actors to take different roles within a coalition.

In the ACF, coalition composition varies based on many factors such as subsystem, policy issue, resources, region, and actor involvement. These factors can encourage actors to take on different roles within the coalition (Weible & Ingold, 2018). The two main roles are principal and auxiliary actors. Principal actors take a central position in the coalition and lead most of the communication (Weible, 2008; Zafonte & Sabatier, 1998). Auxiliary actors are on the periphery of the coalition, interacting with only a small portion of the coalition (Weible & Ingold, 2018). It can be assumed that principal actors are involved in strong coordination while auxiliary actors participate in weak coordination. There are several other less common types of actors that contribute to a coalition. Policy brokers provide connection between actors of different coalitions (Ingold, 2011). Acting as a mediator between dissimilar belief systems, policy brokers aim to stabilize the subsystem. Policy brokers are critical to facilitating compromise and help smooth policy discussions between competing coalitions (Ingold & Varone, 2011; Ingold, 2011). Like policy brokers, policy entrepreneurs communicate within the subsystem to finalize policies. Policy entrepreneurs often bare the high cost of coordination on the tradeoff of promoting policy that is beneficial to their self-interest. They lead policy change into their final stages, working for political or economic profit (Minstrom & Norman, 2009; Weible & Ingold, 2018). Finally, general citizens are tangential actor to coalitions by only seldomly communicating and participating in policy exchanges. General citizens either have a slight interest in the subsystem or may be affected by the outcome of a policy change (Weible & Ingold, 2018). Roles within the coalition can reveal influential actors in a policy process and allow researchers the ability to study further how a particular actor is affecting policy designs.

2.3 Collaboration

Policy studies have long faced the question of how collaboration between actors leads to policy successes. In current systems, no policy actor has the ability or resources to influence policy decisions on their own (Schneider et al., 2003). An actor often seeks to collaborate to gain essential resources that they do not possess, increasing their performance and chances of success (Berardo, 2009). In a policy network, collaboration between actors can occur when actors work together to strengthen a position and translate beliefs into policy (Fischer & Sciarini, 2016; Sabatier, 1988). It allows for trust to build and creates a collective thinking rather than individual opportunism (Schneider et al., 2003). Collaborative actions lower an actor’s transactional costs by providing a common knowledge about a topic (Lubell et al., 2010). Collaboration is not limited to only government level actors; it encourages multi-level stakeholders to join forces

(Lee et al., 2012). Collaboration between multiple types of actors encourages information distribution, building lines of communication, and sharing of resources and ideas (Fischer, 2014).

Collaboration is seen in all subsystems but can be more effective in divided topics such as climate policy. In political systems such as the United States, there has been a widening gap for many years between opposing coalitions (Dunlap & McCright, 2008; Fisher et al., 2012). Throughout the politic sphere, multiple stakeholders are collaborating to combat climate change, using innovation with economic prowess to find effective solutions (Elia et al. 2020). Political collaboration is crucial to strengthen arguments and influence climate outcomes (Ingold & Fischer, 2014).

In terms of the ACF, actors within a coalition look to collaborate to implement a common strategy for policymaking (Weible et al., 2004). According to the ACF, actors can form advocacy coalitions by way of a "non-trival degree of coordination". Collaborative relationships between actors can su Weaker coalitions can improve their position in the network through learning and collaborating with new allies (Cairney, 2019). Many collaboration ties between actors in a coalition is a sign of a strong coalition and can translate to policy successes. Ingold & Leifeld (2014) showed that an actor is five times more likely to indicate another actor as influential if they have a collaborative tie with them.

2.4 Climate Policy Subsystem

The perceived effects of climate change grow every day, forcing governments to grapple with creating new policy to mitigate and adapt for the perceived risks. The Paris Agreement not only binds governments to reduction targets, but it exhibits how climate policy aims to marry science-based targets with government interventions. Climate change and the targets set forth to combat it will affect peoples' everyday lives. This requires governments and policy actors to coordinate with many stakeholders to allow for the most effective policies that have the fewest negative impacts on the population.

The relevance of climate, environmental and energy issues and the subsystem that they create, is the center of many recent policy studies (Ingold, 2011; Jasny et al., 2015; Ingold et al., 2016; Kukkonenn et al., 2017). Understanding the climate policy subsystem is imperative for furthering research and understanding future policy outcomes. Due to the structure of climate policy subsystems, they are ideally suited for application of the ACF. Climate policy processes often comprise of multi-organizational and level actors that are collaborating with like-minded associates to convert beliefs into outcomes (Liftin, 2000; McGee & Jones, 2019). Solutions for the climate issue require expertise from many stakeholders that allow information to be communicated throughout the subsystem. Policymakers, scientific experts, industry leaders, and advocacy groups interact in the subsystem to promote their targets and goals. Depending on the political system, actors will need to play different roles and have changing levels of access to policymakers. Therefore, not all climate policy subsystems have the same structure.

The climate policy subsystem mainly debates on how to mitigate and adapt to the growing effects of climate change. Many policy instruments aim to reduce GHG emissions and transition to cleaner, renewable energy sources. This requires buy-in from all levels and sectors of the subsystem. Domestic policy instruments to reduce GHGs and transition to sustainable energy fall into two categories of approaches (Stavins, 1997; Tang et al., 2020). The first, a command-and-control approach, prohibits or alters the use of materials and processes that emit high levels of GHGs. Current command-and-control methods exist to set a limit to processes with little flexibility and force businesses to use low carbon alternatives. Some limitations include emission requirements on energy production, motor vehicle fuels, or building materials (Guo et al., 2021). The second, a market-based approach, assigns a value to emitting GHGs, including externalities. These often included a carbon tax or cap and trade systems that achieve emission reductions by pricing the minimum cost of abatement with the market (Ruth et al., 2000; Veal & Mousaz, 2012). Whether to use specific command-and-control or market-based instruments, are some of the most debated beliefs in the climate subsystem. These specific policy instruments often are the root to coalition formation in the climate policy subsystem.

However, the fractured nature of beliefs on climate policy creates a divided and often polycentric subsystem which sees many coalitions promoting their beliefs (Fisher & Leifeld, 2019). This polycentric network allows for increased opportunities for collaboration, experimenting, and information sharing (Cole, 2015). Although, in some systems where politic views shape actors' stances on climate policy, this can create a rift in coalitions. The contrast in views on climate changes can create policy blockages in the subsystem and delay important policies from being implemented (Dunlap & McCright, 2008, Fisher et al., 2012). The nature of climate policy and the coalitions that form, highlight the importance of understanding how actors effect policy design. An actor's positions in their coalitions can lead to conclusions about their contributions to climate policy action, or inaction.

2.5 Energy Actors

GHG reduction goals and sustainable transition plans directly impact the energy sector. The energy industry is set to incur massive capital cost in the transition to sustainable production (Hirth & Steckel, 2016). One projection finds that a transition to 100% renewable energy grid by 2050 would cost roughly $72.8 trillion USD, across the top 143 countries in the world (Jacobson et al., 2019). The energy sector is a clear leader of GHG emissions, they contribute to roughly 73% of all emissions, thus foreshadowing major changes for energy producers and providers (Ritchie et al., 2020). New energy technologies focus on low-carbon production aiming to unlock the huge potential for emission reductions (Geels, 2014). While the renewable energy sector is developing, still around 80% of energy production is produced by high emitting fossil fuels (IEA, 2021). Fossil fuel companies are still very lucrative and influential in society. Restrictions and regulations to fossil fuels have not been easy to enact as the tradition energy industry often fights against a sustainable transition (Christophers, 2022).

There is much in the balance regarding a sustainable energy transition and the dynamics have split climate policy subsystems. The diverse nature of the climate policy subsystem allows private actors to have the ability to push policy forward based on their resources (such as money, expertise, or public support) (Cairney, 2019). Traditional energy companies account for large portions of lobbying and influence in government. In the US between 2000 and 2016, fossil fuel, electric utility, and transportation accounted for 56.2% (~$1.2 billion USD) of climate lobbying dollars (Brulle, 2018). Fossil fuel dependent companies or traditional energy actors aim to collaborate with policymakers to keep a transition to clean energy off the table (Downie, 2018). On the opposite side, renewable energy companies/associations along with environmental groups promote clean energy policies and technologies, only at a much smaller scale. Their efforts account for only 6.1% of total US climate lobbying dollars between 2000-2016 (Brulle, 2018). As seen in the US, the imbalance of the climate lobbying dollars in favor of fossil fuels industries can be seen as a major cause of climate policy inaction.

Both sides if the energy sector use their resources to drive policy conversation for their benefit, forming the main advocacy coalitions in the subsystem. Traditional energy actors claim a transition will be too expensive and could be detrimental to economic growth (Schimpf et al., 2021). This argument that traditional energy infrastructures would be too costly to transition out of, creates a political stalemate form and is referred to as “carbon lock-in” (Downie, 2017; Unruh, 2000). Carbon lock-in has provided policymakers with a dilemma economically and influentially. The traditional energy actors have such a large institutional investment in climate policy subsystems, it is hard to overcome and implement effective clean energy policy (Aklin & Urpelainen, 2013).

With so much on the line, both sustainable and traditional energy actors look to use their resources to influence climate policies to their benefit. Deploying the ACF, it is proposed that energy actors will build and contribute to coalitions that share similar beliefs on climate policy preferences. This with help strengthen their beliefs and ultimately lead to success in policies. Thus, I have exposed the conceptual frameworks and the importance of energy actors in the climate politics. In the next section, I lay out the intricacies of the research design and the proposed analysis used to apply the literature to a case.

3. Data & Methods

3.1 US Climate Policy Network (Case)

The United States is an ideal system to define roles of energy actors in climate policy. In 2018, the United States was the second largest emitter of greenhouse gases and had yet to implement meaningful climate policy (IPCC, 2018; Friedrich et al., 2020). There has been a clear absence of US climate policy since the 1970s. Although, since 2000 there have been oscillating efforts to pass or block climate and clean energy policies dependent on the parties in power (Mildenberger, 2021). The US government is a bipartisan system that has deep rooted polarization around climate policy, with two main groups (Fisher et al., 2012). Traditionally, the polarization in the subsystem breaks into two large groups or belief coalitions across the issue, one supporting economic prosperity in while rejecting climate policies and the other focusing on pushing climate regulation (Fisher & Leifeld, 2019). Either side of the issue can break into smaller coalitions depending on the policy preferences being debated (Basseches et al., 2022).

With the stagnation of climate policies, it is thought that traditional energy actors have a significant impact on policy outcomes.

Traditional energy actors are the most prominent lobbyist in the subsystem and wield their resources in opposition of climate policy (Downie, 2017; Downie, 2018). They are the largest contributors of lobbying dollar since 2000, and likely are collaborating to shape policy design in their favor. Contrary to the lack of climate and clean energy policy in the US, renewable energy production increased by ~12% since 2019 (US EIA, 2022). Private efforts from outside of policy have grown and increased share of renewable energy produced in the US. Both traditional and renewables have shown successes despite the other in recent years. The efforts from both the traditional and renewable energy sectors show that they are working hard to actively to promote their positions.

The timeframe in this case is using the most recent government policymaking forum, 116th congressional session (2019-2020). This timeframe saw a substantial growth in government hearings regarding climate issues. In comparison to the previous congressional session there was a 376% increase in climate related hearings, including both the House of Representatives and the Senate. This session also saw the establishment of the Select Committee on the Climate Crisis, which is a committee of congressional representatives tasked with investigating the climate crisis and crafting meaningful policies in response to their findings. The committee and increase in climate discussions, proves there was a concerted effort from government officials to push climate policy forward during this time.

3.2 Actor Selection

The data comes from an on-going project, the Climate Constituencies Project (CCP). The CCP is an iterative project that studies how climate policy networks are evolving around the United States. The project focuses on actors that are active participants in congressional hearings. Congressional hearings are used as a tool for policymakers to speak on issues important to them. The policymakers can invite "experts" to give testimonies on the topic to deepen policymakers understanding of the topic. During this iteration of the CCP, I was a part of the research team helping collect and analyze the data that is also used as the data in this study.

The first step of the actor identification process was to create a pool of all actors that may be important in climate discussions during the 116th Congressional session. I compiled a list of all actors, both congressional and invited “experts”, that spoke in climate or clean energy related hearings during this session. To complete the search of congressional hearings I used Govinfo.gov which is a US government run archive of all public records information from the three branches of government. To only gain results that were climate or clean energy related, I used three phrases in the search criteria, “climate change”, “greenhouse gas”, and “global warming”. This search of the 116th congressional session in both the house and senate yielded 553 document results. Then I manually read each of the search results for relevance to the topic. I sorted through the results and found only 64 hearings were of direct relation to the topic. The filtering of hearings ensures that actors are either policymakers or thought to be “experts” by policymakers directly involved in climate or clean energy related conversations. From the 64 hearings, 516 individual testimonies were given. I then compiled a list of all actors that gave testimonies and how many times they spoke. This number was their “participation score”. The final goal was to identify the 100 most active actors in the climate policy subsystem to build out a network. To add depth to the selection process, I included added a point, for each, to the “participation score” if the actor was an active lobbyist during the timeframe or if they participated in the UN’s Conference of the Parties 21 (COP21), where the Paris Agreement was engineered. Participation in lobbying and/or climate conferences, such as COP21, indicate an actor’s activity in the climate space outside of policymaking. I finalized the list by taking the top 100 participation scores plus ties. The final actor list was 110 actors.

Due to the nature of the survey, the only actor identifiers allowed for the data was the actor type. Each actor was broken down into the following nine (9) actor types based on their core role or operation.

Actor Type description	Actor Type Code
Businesses and Business Associations/Trade Groups	BUS
Energy Businesses and Business Associations/Trade Groups	ENG
Democratic Members of the US Congress	CON-D
Republican Members of the US Congress	CON-R
Non-Governmental Organizations (includes professional associations and think tank)	NGO
Environmental Groups	ENV
Scientists	SCI
Subnational Governmental Representatives	SUB-GOV
US Executive Branch (which includes representatives from government agencies)	GOV

Table 1. Actor Grouping Classifications

3.3 Survey Responses

Using the finalized actor list, an anonymous survey was conducted to gain data on other actor's beliefs, organizational, activity around climate and energy policies in the United States. All selected top actors were given the opportunity to answer the survey, although only actors that completed the survey were included in the analysis. Out of the 110 actors chosen for the survey 71 responded giving a 64.5% response rate. Table 2 shows the breakdown of each Organization Type's (Org Type) total actors contacted and how many completed the survey.

Org Type	Survey Completed (Contacted)	Response Rate
BUS	16 (27)	59.3%
ENG	5 (9)	55.6%
CON-D	8 (15)	53.3%
CON-R	5 (9)	55.6%
ENV	13 (16)	81.3%
NGO	13 (15)	86.7%
GOV	3 (3)	100.0%
SUB-GOV	6 (14)	42.9%
SCI	2 (2)	50.0%
Totals	71 (110)	64.5%

Table 2. Survey Responses by Org Type

The survey took place in 2022 but focused on the 116th congressional session (2019-2020). Each actor was contacted and asked to identify a representative that had the best knowledge of their work in the US climate policy subsystem. The survey comprised of questions in two parts. The first part included several questions asking on the actor's preference for certain policy instruments on climate and energy policy. Responses were on a five-point Likert scale (1 – strongly disagree to 5 – strongly agree). If an actor strongly agrees with a policy instrument, I considered them to support the underlying belief or preference. The second part of the survey asked each actor to identify if any of the other top actors in the built network are a source of scientific information, a regular collaborator, or if they perceive them as an influential. The responses were binary with a 1 for yes and a 0 for no.

Out of the 16 policy belief and preference questions asked in the CCP survey, I selected the top questions based on two criteria, political conflict and relevance to current policy conversations. The first criteria, political conflict is utilized as coalitions are usually based off the most conflictive beliefs and preferences (Weible & Ingold, 2018). To determine political conflict, I calculated the standard deviation and mean of the responses for each question. I looked to identify questions that have high standard deviation with a mean close to the median. This provided questions that have a good distribution of responses from actors and likely split the subsystem. The second criteria, relevance to political conversation, is more descriptive. I used conversations from 1-on-1 interviews with respondents to gauge which preferences are most important to them. Each respondent was asked about the work they are doing within the subsystem. Any question that was largely discussed gave greater weight. The most talked about topics were the policy preferences and beliefs, including reducing GHGs, clean energy transitions, and policy instruments. Combining these two criteria, five questions were selected to run the cluster analysis on and build the coalitions.

Please look at the below for a list of the debates, proposals, and decisions being discussed in the United States today. For each item on the list, please indicate the number that best expresses your group's typical level of support for the debate, proposal, or decision, from Strongly Disagree (1) to Strongly Agree (5)…	
Q1	The US should meet or exceed reduction target of greenhouse gas (GHG) emissions by 50-52% below 2005 levels by 2030.
Q2	Federal legislation should include the Clean Electricity Performance Program.
Q3	US energy policy should prioritize the replacement of fossil fuels with renewable/clean energy sources.
Q4	Federal funding should be dedicated to research on technological responses to climate change.
Q5	The US should invest more money in carbon dioxide removal.

Table 3. Survey Question (Selected from CCP)

The final collection of questions, seen in Table 3, were two policy beliefs (Q1 & Q3) and three policy preference (Q2, Q4, & Q5). Q1 asks about an important question to determine whether or not the actor believes climate policies that target GHG emissions are important. The response to this question should reveal whether the actor supports climate policy and GHG emission as a concept, therefore this is a policy belief. Q2 is a question that focuses on the Clean Electricity Performance Program, which is a specific policy instrument used to implement emissions regulations on the energy sector. An actor's stance on a policy instrument can be considered their policy preference. Q3 focuses on the agreement of the actor to focus on a clean energy transition. A transition to clean energy is a policy belief as it more of a concept than an instrument. Q4 and Q5 both focus on specific ways to fund responses to climate change, Q4 through more broad research and Q5 through carbon dioxide removal. Both are ways to implement climate policy rather than an overarching belief. Therefore, both Q4 and Q5 are policy preferences.

3.4 Cluster Analysis

Following the ACF, the climate subsystem should break out into coalitions based on policy beliefs and preferences (Kukkonen et al. 2017). To build these coalitions, I utilize the cluster analysis method. Cluster analysis uses a collection of data points' similarities and dissimilarities to determine which points are most similar, then groups them together (Edwards & Cavalli-Sforza, 1965). For this study we deploy hierarchal clustering, which operates by iteratively reducing the number of actors n to $n-1$ with the least amount of data loss. Each step of the iterative process finds the two subsets that, when grouped, loses the least amount of information of the entire set of points (Ward, 1963). The process is done until the desired number of subsets (clusters) are left. The cluster analysis in this study uses actors and their responses to the selected policy beliefs and preferences questions (seen in Table 3). Clustering actors based on their agreement with these questions should indicate the most likely belief coalitions. Thus, I operationalize actors' responses as the beliefs in which to build the coalitions.

3.5 Social Network Analysis

The second analysis was the social network analysis (SNA). SNA looks at the network among actors and provides insights into the relation between actors as well as the position each actor takes within the network (Wasserman & Faust, 2012). SNA allows mathematical analysis at the actor and group level (Saqr & Alamro, 2019). The analysis can focus on homogeneity and performance of nodes, here we mostly focus on performance (Borgatti et al. 2009). Both quantitative and visual outcomes are possible through SNA (Freeman, 2000).

The aim of using SNA in this study is to analyze how energy actors interact and collaborate within the subsystem and in their respective coalitions. Collaboration within a network is the cooperation between actors to reach a common payoff (Ingold & Leifeld, 2014). I operationalize the collaboration by utilizing the survey question that asked actors who they have collaborated with on climate issues. This will reveal which actors perceive each other as collaborators. The collaboration survey data allows to evaluate the existence of collaboration ties between actors. A tie is present between two actors if Actor A indicates Actor B as a regular collaborator. In this study, the ties are directed, meaning that Actor A can perceive Actor B as a collaborator, but Actor B does not have to reciprocate the existence of a tie. Although, a reciprocated tie can indicate a more trustful bond between actors (Hanneman & Riddle, 2005).

An actor's collaboration activity is studied both at the subsystem and coalition level, this is to help identify the different roles actors take up.

Quantitatively, I utilized in-degree, out-degree, and betweenness centralities to show the position of each actor. Degree centralities identify all the connection between actors and usually indicate popularity or activity (Zhang, 2010). In-degree centrality calculates the number of incoming collaboration ties over the total number of possible ties, where out-degree centrality is the same concept only using the outgoing collaboration ties. These two statistics provide insight into which actors are indicated as being most collaborative. Betweenness centrality indicates how often an actor is the shortest path between two other actors (Freeman, 1977). Betweenness will help see which actors are the best at connecting other actors in collaboration. With these statistics for actors, it will aid in identifying which actors are the most collaborative and best at fostering collaboration in the subsystem and their coalitions.

Visualizations of the networks are also used in the analysis to easily see the structure of the subsystem and the position each actor take up. Network visualizations help quickly communicate the core findings, discover other narratives that are hidden from statistics, and confirm pervious analyses (D'Andrea et al., 2009). The graphics that come out of the analysis will solidify the quantitative findings and can better show how a particular actor group collaborates.

3.6 Analysis Methodology

The first step of this process is to get the raw data from the survey into the analyzable format. Using the five questions seen in Table 3, I built an actor-belief distance matrix (weighted affiliation matrix). In order to start to identify the belief coalitions in the subsystem, the affiliation matrix was transformed into an actor-actor adjacency matrix. The transformation to the adjacency matrix used the Manhattan distance (Metz et al. 2021). This adjacency matrix shows the distance between actors based on dissimilarities in their beliefs, meaning the larger the value between two actors the less similar their beliefs.

Before running the cluster analysis, I discovered the optimal number of clusters by using the elbow method which minimizes the total within sum of squares (Omar et al., 2020). Therefore, hierarchical clustering with the discovered amount of clusters will give the best representation of how the climate subsystem is structured upon the most important and conflictive beliefs. Finally, Using the dissimilarity calculation between actors, I deployed a hierarchical clustering using the ward.D2 method to build out the coalitions. This method groups the actors with the smallest dissimilarities together into a set number of clusters, four in the study. The outcome of this was a dendrogram and a number cluster attribute for each actor.

To start the Social Analysis, I built five actor-actor directed adjacency matrices using the collaboration data. One matrix for each coalition, determined in the cluster analysis, and one of the entire subsystem. I then built network visualization from each matrix using the *ggplot2* package in *R*. Then I ran the quantitative analysis on each matrix using the *igraph* package in *R*. The results yielded the in-degree, out-degree, and betweenness for each actor in their respective network. Finally, I grouped actors based on organization type and calculated the mean of the centrality statistics for each organization type.

4. Analysis & Results

The results in this section are split into two processes - the first is the cluster analysis of the climate subsystem to reveal the coalitions that form around the five important and conflictive policy beliefs/preferences. The second uses SNA and the coalitions found in the cluster analysis to study collaborative activity of individual actors and what roles they play in the network.

4.1 Belief Coalitions

Figure 1 is the outcome of the hierarchal clustering analysis from the adjacency matrix showing the dissimilarities between actors in the three policy preferences and two policy beliefs. According to the elbow method, four clusters are optimal for the network, denoted by colors and dashed boxes.

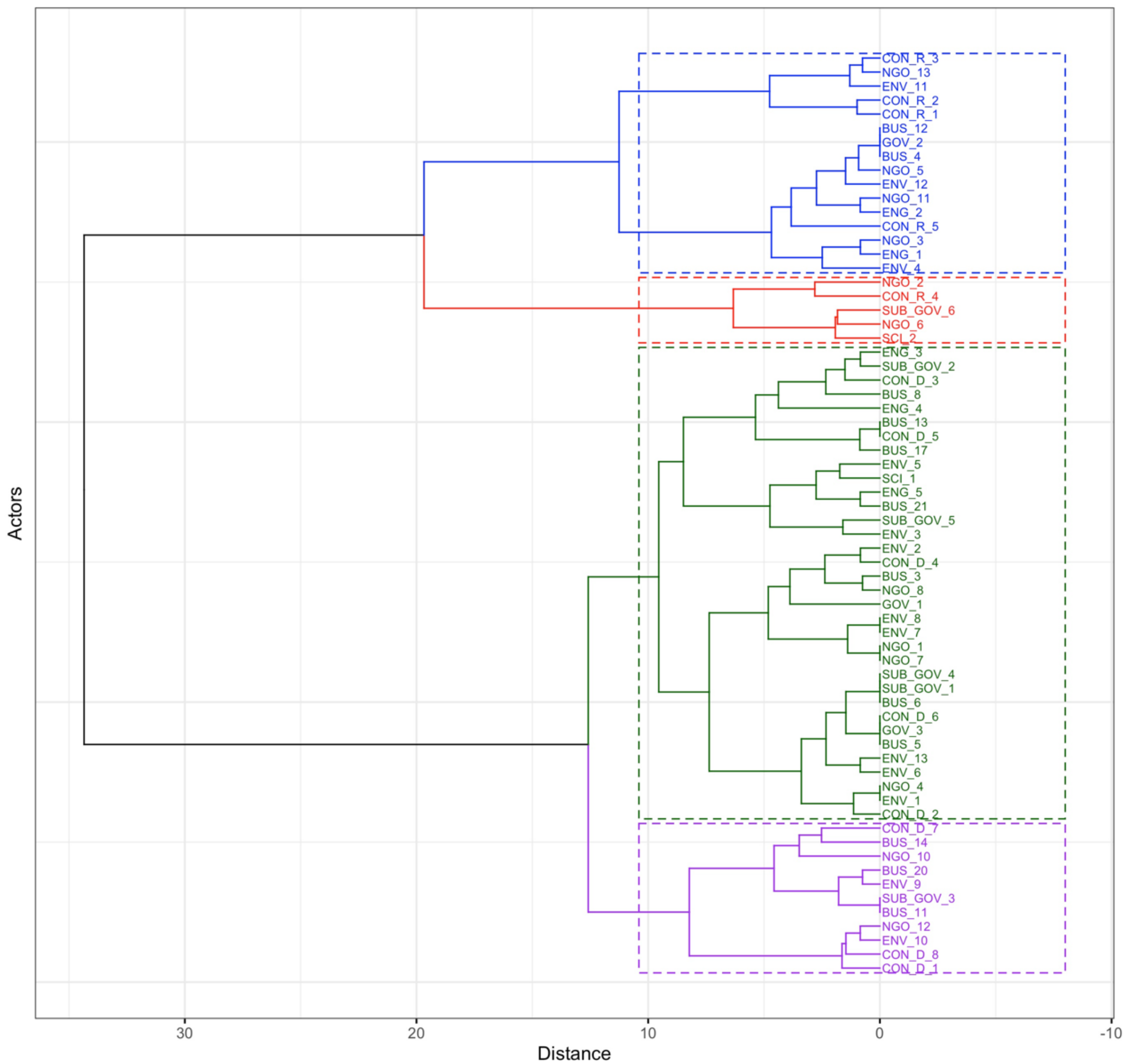

Figure 1. Results of cluster analysis. Colors and boxes denote optimal clusters.

Org Type	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
BUS	2		7	3	12
CON-D	1		5	3	9
CON-R	3	1			4
ENG	**2**		**3**		**5**
ENV	3		8	2	13
GOV	1		2		3
NGO	4	2	4	2	12
SCI		1	1		2
SUB-GOV		1	4	1	6
Total	16	5	34	11	66

Table 4. Distribution of organization types per coalition

Each cluster can be translated into a belief coalition. The dendrogram shows that all the clusters are heterogeneous and that no one actor type exclusively controls a belief coalition. Each coalition is made up of several actor types that work together to strengthen their positions and push for policies that support their beliefs. The dendrogram also shows that the four clusters are not of equal size. Cluster 1 (blue) with 16 actors and Cluster 4 (purple) with 11 actors are both of medium size. Cluster 2 (red) is small and made up of 5 actors. The largest share and majority of the actors in the subsystem (51.5%) comprise Cluster 3 (green) with 34 actors. Belief coalitions utilize resources and connections to further their beliefs. The larger the coalition is the more access to resources they have. Cluster 3 has the largest share of actors and the most access resource sharing and collaboration.

Table 4 provides the breakdown of clusters by tallying the number of organization types in each. Cluster 3 has the most actor types with only the Republican Representatives of Congress (CON-R) not present. Cluster 1 has seven of the nine organization types represented with only Scientists (SCI) and Subnational Governmental Representatives (SUB-GOV) not appearing. Cluster 1 and Cluster 3 are also the only clusters that have Energy Businesses and Business Associations/Trade Groups (ENG) grouped in. The highest share an organization type holds in a cluster is 40% in Cluster 2, which has Non-Governmental Organizations (NGO) making up two of its five actors. Organization types are distributed between clusters with no organization type exclusively belonging to a single cluster. Although in Cluster 3, six of the eight organization types have over 50% of their represented actors included.

The responses by each actor are shown in a visual format in Figure 2. Figure 2 along with distribution of organization types allows for interpretations of what the main beliefs are in each cluster. The first cluster has 16 actors, their responses were mostly “3” or yellow, meaning they are often indifferent to the questions. They may sometimes be slightly motivated one way or another on a policy beliefs or preferences but all actors in this cluster answers at least two questions with a “3”. This cluster is noted as “Climate Neutral”, with actors from seven different organization types. The second cluster has 5 actors, each of them strongly disagreeing with at least two of the policy preferences and beliefs asked and only two responses fell into agreement. This “Climate Opposed” cluster is comprised of NGO (2), SCI (1), CON-R (1) and SUB-GOV (1). All of the actors in the Climate Opposed cluster have strong stances against furthering climate policy beliefs and preferences in policy outputs.

The final two clusters fall into pro-climate mindsets, where responds have strong agreement with the two policy beliefs but differ on the policy preferences needed to reach the climate goals. The larger of the two clusters, has 34 actors who favor investing in technologies to reach goals and in particular CO_2 removal technologies. Three energy actors are grouped into this “Climate Tech” cluster, along with most of ENV and CON-D types. The only group not represented in the Climate Tech coalition were CON-R members. Finally, the fourth cluster has 11 actors that strongly support programs like the Clean Electricity Performance Plan that regulate emissions rather than investing in new greener technologies. The “Climate Programs” cluster has a disagreement that implementing CO_2 removal technologies and funding greener tech is the best method. Importantly, ENG actors are almost completely neutral or in agreement with their responses. Only ENG_4 strongly disagreed with the use of CO_2 removal technologies.

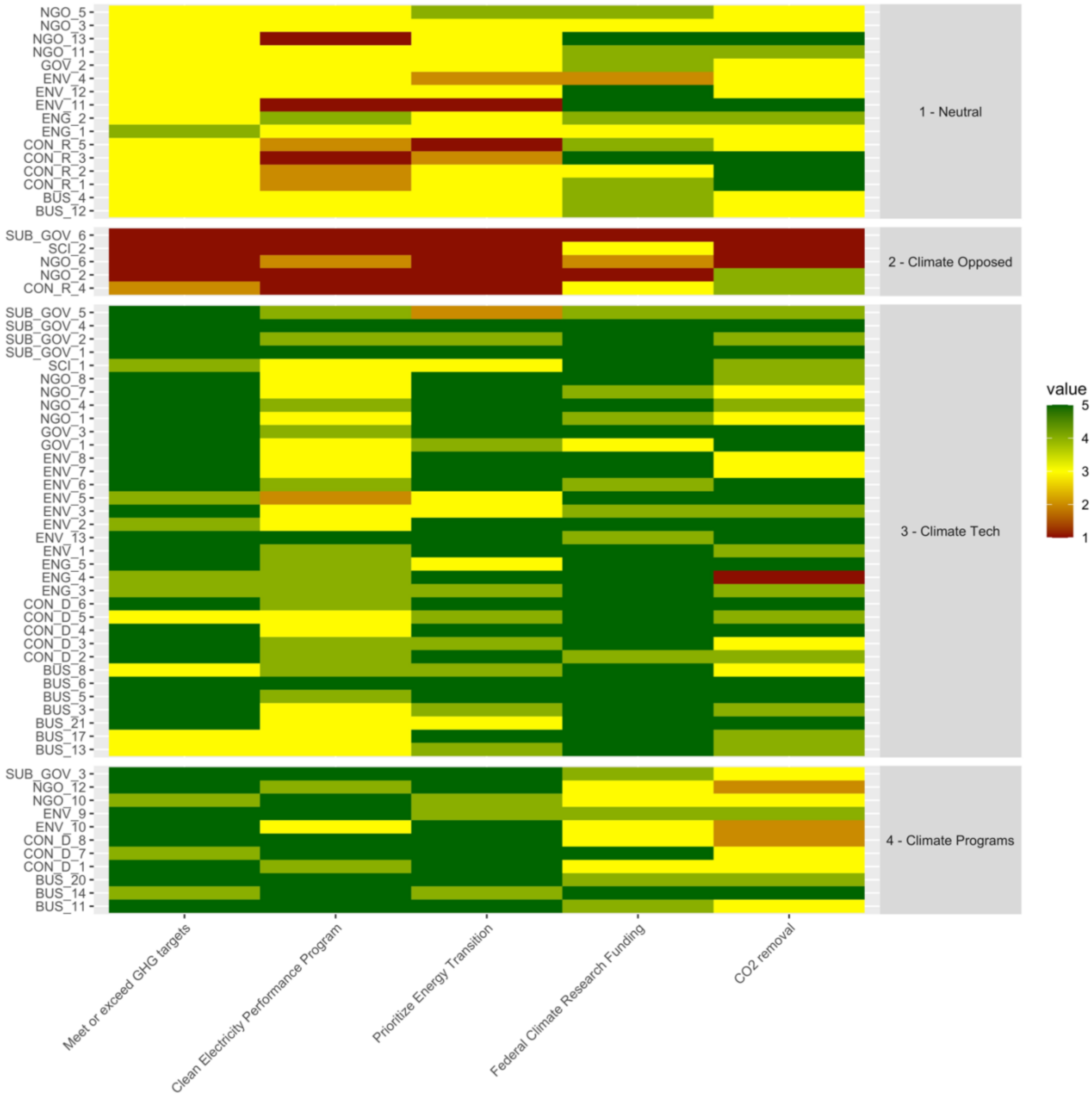

Figure 2. Survey responses of actors

4.2 Collaboration

Figures 3 – 6, show the collaboration ties within each cluster built from the cluster analysis. Ties are directed, and organization type is noted buy color. These figures visually show which actors are believe each other as collaborators. The position of the nodes indicates the activity level of the actor and how collaborative they are within their belief cluster.

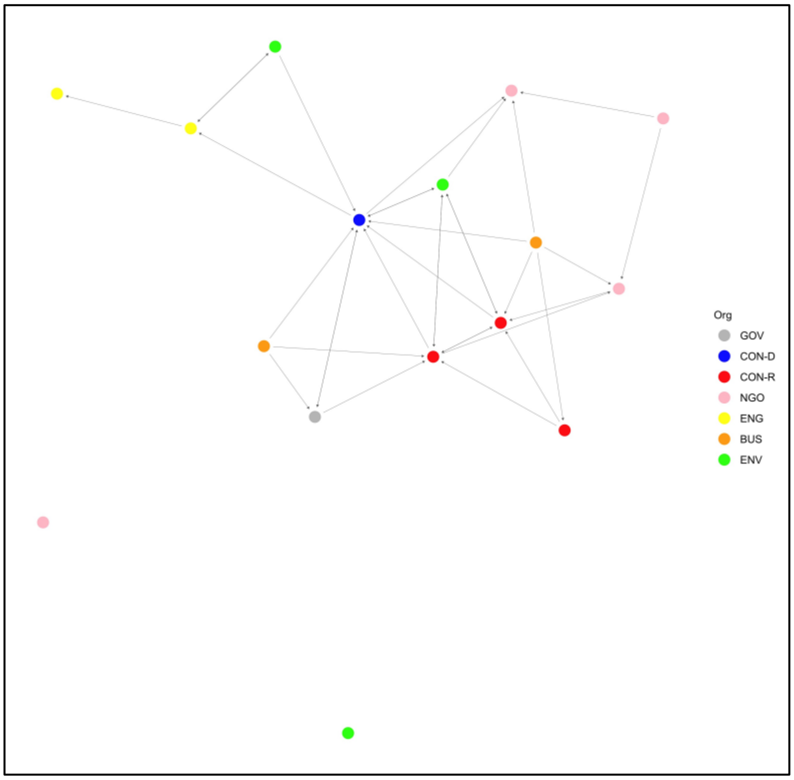

Figure 3. Climate Neutral Collaboration Network

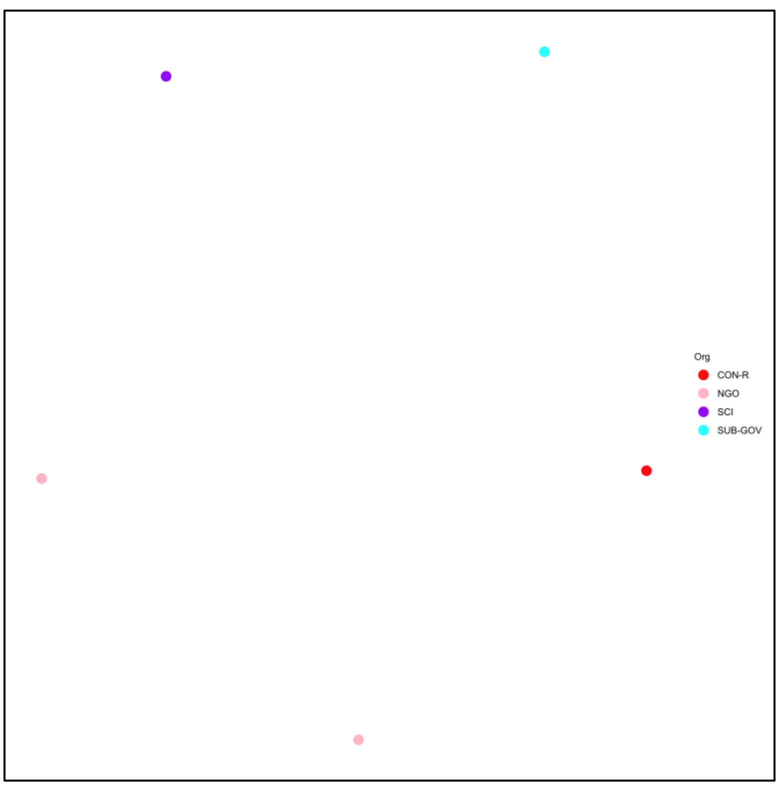

Figure 4. Climate Opposed Collaboration Network

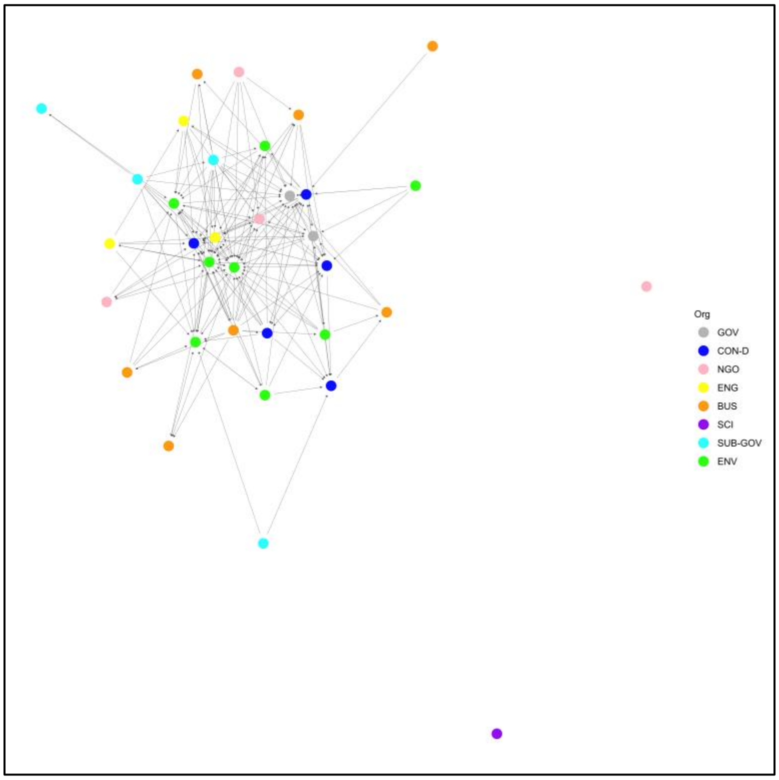

Figure 5. Climate Tech Collaboration Network

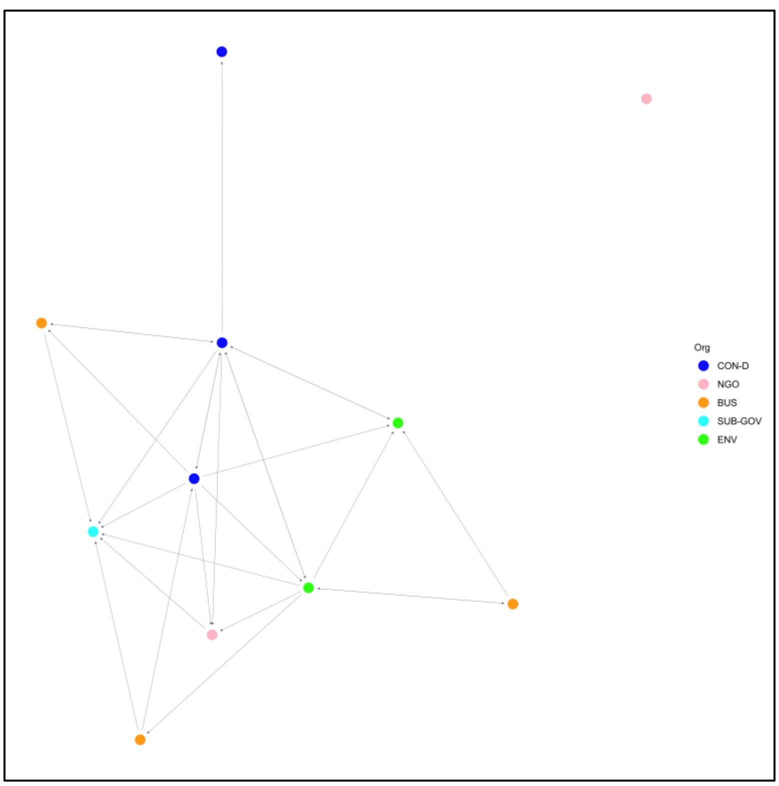

Figure 6. Climate Programs Collaboration Network

Three out of the four belief clusters have a significant number of actors identifying each other as collaborators. Only Figure 4, showing the collaboration network of the Climate Opposed belief cluster, has no ties between the actors and exhibits no significance from node position and cannot be considered a coalition. Each of the remaining belief clusters show collaboration ties and can be considered coalitons. Figure 3, Climate Neutral coalition collaboration network, has two outliers with no connections. The remaining nodes have one or more collaborative tie. CON-R actors (3) are centrally located in the coaliton, collaborating with each other as well as connecting with other types. This coalition is split into two sides, one side has two ENG and one ENV actors(s) while the other side is made up of a six other organization types. The single CON-D actor is a connection point between the two sides of the coalition. In this coalition ENG actor take on an auxiliary role, being peripheral to the main collaborative activity.

Figure 5 shows the collaboration network of the Climate Tech coalition, the largest of the coalitions. The network is close knit and the tightest packed around many central actors. Many of the internal actors have many connections and not one organization type dominates the activity. Several peripheral actors are connected by a few ties, while there are two outliers with no ties. ENG actors have many connections and are located toward the central of the network. The positions of the ENG actors show they are likely principal actors in the Climate Tech coalition. Particularly, one ENG actor is central with a multitude of ties and directly in the middle of the network. Other central organization types appear to be ENV, CON-D and GOV, each has multiple actors with many incoming and outgoing ties, taking up principal roles. The other collaborative organization types (BUS, NGO, and SUB-GOV) are mostly on the outside of the coalition and acting as auxiliary actors.

Finally, Figure 6 shows the Climate Programs' collaboration network. The network only has one outlier (NGO) with no connections, taking on a general citizen role. The rest of the coalition is evenly distributed. Two of the CON-D actors appear as the most ingrained in the network, having ties to a majority of the actors and are most likely to act as the principal roles.

Table 5 is a quantitative look at the belief clusters, showing statistics that indicate activity in their respective belief cluster at the organization type level. The organization types are evaluated for the mean of each centrality statistic (In-degree, Out-degree, and Betweenness) to provide organization level analysis of the activity in their belief cluster.

	Org Type	Mean Out-Degree	Mean In-Degree	Mean Betweenness
1 – Climate Neutral (n=16)	BUS (n=2)	0.267	0.000	0.000
	CON-D (n=1)	0.267	0.467	51.5
	CON-R (n=3)	0.200	0.244	11.500
	ENG (n=2)	**0.067**	**0.100**	**10.500**
	ENG_1	*0.133*	*0.133*	*21.0*
	ENG_2	*0.000*	*0.067*	*0.000*
	ENV (n=3)	0.133	0.089	5.000
	GOV (n=1)	0.133	0.133	3.000
	NGO (n=4)	0.050	0.117	2.000
2 – Climate Opposed (n=5)	CON-R (n=1)	0	0	0
	NGO (n=2)	0	0	0
	SCI (n=1)	0	0	0
	SUB-GOV (n=1)	0	0	0
3 – Climate Tech (n=34)	BUS (n=7)	0.143	0.052	12.573
	CON-D (n=5)	0.188	0.273	32.558
	ENG (n=3)	**0.232**	**0.152**	**22.973**
	ENG_3	*0.182*	*0.060*	*1.750*
	ENG_4	*0.333*	*0.364*	*55.686*
	ENG_5	*0.182*	*0.030*	*11.483*
	ENV (n=8)	0.193	0.296	52.320
	GOV (n=2)	0.152	0.364	34.243
	NGO (n=4)	0.121	0.084	4.383
	SCI (n=1)	0.000	0.000	0.000
	SUB-GOV (n=4)	0.174	0.015	0.925
4 – Climate Programs (n=11)	BUS (n=3)	0.200	0.133	0.278
	CON-D (n=3)	0.433	0.233	9.722
	ENV (n=2)	0.350	0.350	8.000
	NGO (n=2)	0.050	0.150	0.000
	SUB-GOV (n=1)	0.000	0.600	0.000

Table 5. Results of Centrality statistics by belief cluster and organization type

Within the Climate Neutral coalition, the single CON-D actor is the most collaborative having the highest value in all three centrality statistics. As noted visually, this actor is the connector between the two sides of the coalition, boasting a 51.4 mean betweenness centrality. In the same coalition, ENG actors have little collaborative activity with only a 0.067 mean in-degree and 0.100 mean out-degree. Although, the ENG actors are connecting their shared collaborators in the coalition with the third highest mean betweenness (10.5). The remaining actor types in this coalition are active but are not particularly prominent. ENG_1 is clearly more collaborative than ENG_2 and is quite important to the stream of information and resources in the coalition with a betweenness of 21.0.

Next, Climate Opposed belief cluster has no collaborative ties between actors meaning all centrality statistics are zero. This belief cluster is not a coalition and is a group of outliers that do not collaborate and disagree with current climate policy options.

The Climate Tech coalition has the largest number of ties and actors, giving the best representation of how collaborative organization type are within a coalition. ENG actors are actively collaborating with the highest mean out-degree (0.232), and fourth in mean in-degree (0.152) and mean betweenness (22.973). ENG actors have strong centrality statistics in this coalition and likely are collaborating to push forward climate policy that promotes clean energy technologies. Other active organization types include ENV and GOV actors, who exhibit slightly higher centrality statistics. These types have a majority of the principal actors in coalition that drive success and collaboration. ENV actors are the most connective having the highest mean betweenness (52.320). While GOV actors are the most collaborated with organization type with a 0.364 mean in-degree. Of the three ENG actors in this coalition, ENG_4 is the most collaborative having the highest statistics in each category by a good margin.

Finally, the Climate Programs coalition is championed by two main organization types, ENV and CON-D. Both organization types are two of the top three in all mean centrality statistics. The centrality statistics confirms these two organization types are the most collaborative in this coalition, taking on principal roles. The single SUB-GOV actor in this coalition has the highest mean in-degree (0.600) but no outgoing ties. This actor assumes the role of an auxiliary actor who is important to the active collaborators in the coalition but could have little resources or want to collaborator further.

Taking a step back to look at the entire network allows to see how integral actors are to the working of the network. Also, it allows one to visualize positions and possible roles actors can take on between coalitions, such as policy brokers. Figure 7 is the collaboration network of all actors in the subsystem. Table 6 calculates the centrality statistics by organization type for the entire subsystem.

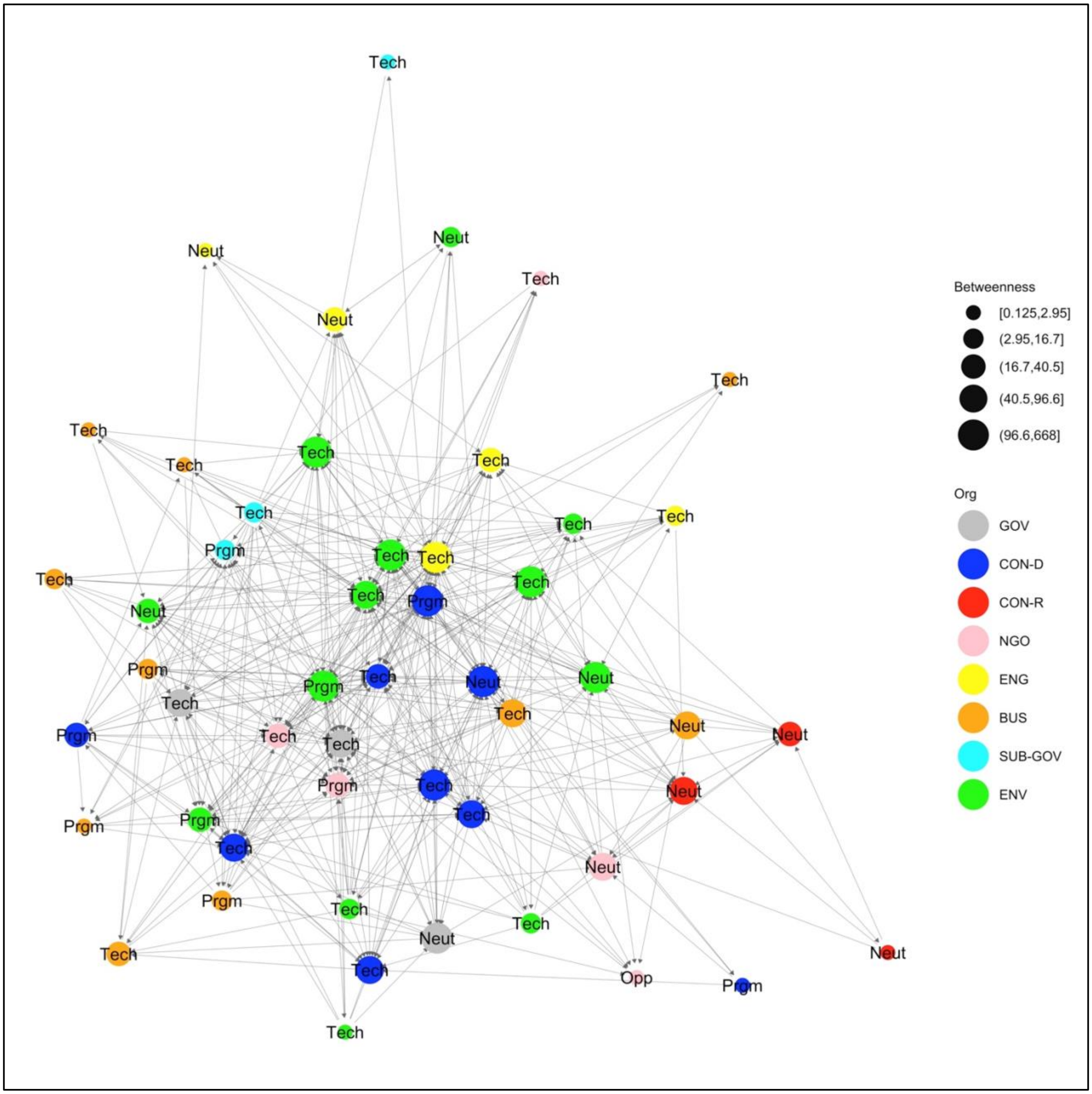

Figure 7. Collaboration network of climate policy subsystem. Labeled by cluster.

Org Type	Mean Out-Degree	Mean In-Degree	Mean Betweenness
BUS	0.128	0.037	13.374
CON-D	0.203	0.246	164.138
CON-R	0.046	0.085	16.558
ENG	**0.148**	**0.132**	**51.307**
ENG_1	*0.077*	*0.108*	*19.012*
ENG_2	*0.031*	*0.046*	*1.858*
ENG_3	*0.169*	*0.154*	*40.481*
ENG_4	*0.308*	*0.292*	*189.897*
ENG_5	*0.154*	*0.062*	*5.288*
ENV	0.187	0.212	118.699
GOV	0.138	0.272	94.740
NGO	0.068	0.085	11.133
SCI	0.000	0.008	0.000

Table 6. Results of centrality statistics for climate subsystem collaboration network

Figure 7 shows that there are many connections between actors not in the same coalition. The network is heterogeneous and densely packed around a group of collaborative actors. The size of each node is the representation of betweenness centrality. The larger node sizes are better connectors and regularly reside in the center of the network. These central actors have ties to other coalitions, implying that they may take on the role of policy brokers. Primarily these central actors are from ENV and CON-D organization types with the two highest mean betweenness scores, 164.138 and 118.699 respectively. ENG actors have the betweenness of 51.307, ranked fourth among organization types. ENG_4, from Climate Tech, has the highest values in each statistical category out of all the ENG organization type actors.

5. Discussion

This section builds on the results of both the cluster analysis and social network analysis of the US climate policy network. The results of each analysis are expanded upon regarding the theoretical framework, methodology, and the selected case. The outcomes of this section aim to provide resolutions to the overarching research question and acknowledge opportunities for further analysis.

5.1 Energy Actors in Belief Clusters

The construction of the US climate policy subsystem in this study provided a group of actors that are prominently active in climate policy discussions. The actors' survey responses granted the ability to quantify their current policy beliefs and preferences. The ACF offers an approach to understand how these actors collaborate to promote their beliefs and turn them into policy. Four belief clusters resulted from the cluster analysis, one opposed to climate policy, one neutral and two agreeing but with differing climate policy preferences. Energy businesses and trade groups (ENG) were only present in Climate Neutral and Climate Tech coalitions. ENG actors likely appear in the Climate Neutral cluster because a transition to clean energy has a high upfront cost for them, but climate risks and stakeholder demands show that a transition is imperative. The other ENG actors fall into the Climate Tech cluster which supports research for climate response and CO_2 capture technologies. These policy preferences are mitigating GHG emissions through future technologies and not regulating the current methods of the energy industry. Climate and clean energy technology development shifts some costs to outside firms. Supporting climate technology policies allows energy companies to continue business as usual until these technologies are sound and economically viable.

The ENG organization type includes both traditional energy actors and new renewable energy actors. Using only the organization type as the identifier, it is hard to differentiate which energy type falls into which belief cluster. It is noted that no ENG actors fall in the Climate Opposed belief cluster indicating that the even traditional energy businesses don't fully disagree with climate policy instruments that are currently being discussed. This is a positive sign that traditional energy actors are more amenable to supporting climate policy than in the past. All

The belief clusters that ENG actors show up in are very balanced and heterogeneous. All organization types likely share resources and information with other organizations in these coalitions. Within the Climate Tech coalition, the ENG all strongly agree with investing in technology that address climate responses which is a core belief of the coalition. Although ENG_4 strongly disagrees with the use of CO_2 removal which is another describing belief of the coalition. In the Climate Neutral colaiton, The ENG actors don't have all responses the same but neither feel strongly about any response which is a characteristic of the entire coalition. Actors of all type have varied responses but are seen as coalitons based on similar responses regarding the core policy beliefs. The majority of the responding actors agree that climate policy is required, therefore we see pro-climate divide of coalitions based on policy preferences. There is no dominating actor types in any of the coalitions confirming that there are plenty of connections and resources needed to be successful in this subsystem. ENG actors appear to support similar beliefs with a combination of types, notably CON-D, ENV, BUS, and NGO. It appears to necessary for ENG actors to collaborate with a mixture of like-minded actors to promote their policy beliefs.

5.2 Energy Actors' Collaboration in US Climate Policy Subsystem

At a high level, studying the size and composition of the coalitions reveals the overall strength of the coalitions. The Climate Tech coalitions is the largest and most tightly packed, resulting in the strongest coalition in the subsystem. The Climate Opposed cluster cannot be considered a coalition as it has zero collaborative ties between actors. The results support that the Climate Tech coalition should have success encouraging policy preferences such as investments in research and carbon dioxide removal technologies. Since the US has not been able to pass significant climate legislation, this analysis indicates a shift in the subsystem from previously strong opposition to climate policy. It is possible that the absence of ENG actors in the Climate Opposed group, reveals that traditional energy actors are now less strongly opposed to climate policy.

Looking at where the ENG actors appear in their coalitions, it is surprising that they are mostly on the outside of the central actors. Although ENG actors have many in-coming and outgoing connections, there are other organization types that have more actors in the center of coalitions. Within the Neutral coalition, the ENG actors are not the most central and have split out to one side, taking up auxiliary roles with only a few connections. These actors are connected to the rest of the coalition through a single CON-D actor that is very collaborative. The outcome tells us that ENG actors are not strongly active in promoting a neutral stance on climate policy preferences.

In the Climate Tech coalition, the ENG actors are more central and have many connections. Albeit, this is the largest coalition and comparatively there is a higher chance of collaboration. The ENG actors are more integrated, and ENG_4 has very high centrality statistics making a case that it is a principal actor. ENG_3 and ENG_5 appear more in auxiliary roles just on the exterior of the most central actors. The ENG actors in the Climate Tech coalition also have the highest mean out-degree centrality, indicating that they are looking to collaborate the most with others in the coalition. They are collaborating with the more active organization types such as CON-D, GOV, and ENV to be able to promote their policy beliefs. While other mean centrality statistics are in the middle compared to other actors, the ENG actors are more commonly taking on auxiliary roles in their coalitions.

Finally, analyzing the collaboration network of the entire US climate policy subsystem, identified actor activity outside of their coalitions. With only one actor being central in this network (ENG_4), ENG actors are generally on the peripheral of the subsystem collaboration network and boast mid-tier mean centrality statistics. Although, ENG_4 collaborates with many actors between coalitions and likely takes on the role of a policy broker broke when needed. In the subsystem collaboration network, ENG actors are still behind ENV, CON-D and GOV actors in terms of mean centrality statistics.

The positions and centrality values of ENG actors within their coalitions and the network is not as significant expected. This outcome is surprising because the energy sector has spent the most money lobbying on climate issues and has a substantial stake in the outputs of climate policies. Any policies that push a transition to more sustainable energy, which is highly supported by both the Climate Tech and Climate Programs coalitions, would have a significant impact on the energy sector.

The ENG actors being less active than other organization types could be because they are channeling their resources elsewhere on climate issues. The US has stalled many times on impactful climate policy, forcing many companies, including energy actors, to make their own climate pledges or invest in climate technologies, despite policy. Traditional energy actors have even stated they are investing in cleaner energy production and other ways to reduce GHG emissions as customer and stakeholder demands for climate action increase (Bach, 2018; Kenner & Heede, 2021). Renewable companies are growing even with a lack in government funding. Energy actors are no longer disagreeing with climate policy as heavily as before, which is shown in this study with the no ENG actors in the Climate Opposed cluster. As auxiliary actors these actors can monitor the policy conversation while not paying the high cost to oppose climate and energy regulations. They can provide information and resources as needed while allowing policymakers and other environmentally focused actors to do the heavy lifting on pushing their policy beliefs forward.

Another reason for being less collaborative could be that other organization types are no longer relying heavily on the cooperation of energy actors to push climate policies. The energy sector is the main contributor of GHG emission and climate related risks are becoming more intense. Policymakers, government organizations, and advocacy groups have felt pressure to pass climate policy and collaborating with certain energy groups could make it harder to please all parties.

6. Conclusion

The objective of this thesis was to study what beliefs energy actors cluster around and how active they are in the US climate policy collaboration network by analyzing collaborative ties within the subsystem and their advocacy belief coalitions. Therefore, coalitions were built from actors' policy preferences and beliefs through a cluster analysis. Next, collaboration networks were constructed to analyze the connection between actors and identify activity levels based on organization type. Ultimately, the coalition and subsystem networks were evaluated using visual observations and Social Network Analysis. The overarching notion was that energy actors would be the most actively collaborative in the coalitions and take on roles that are invested to push their policy preferences forward.

Of the four identified coalitions, energy actors were only present in the Climate Neutral and Climate Tech coalitions. The position within the coalitions and mean centrality statistics of the energy type actors showed that they collaborated decently in the coalitions they resided in, although not as strongly as others. Energy actors were in a middle tier when it came to mean centrality statistics, rarely were they the highest but also were never the lowest. This lower level of activity may be caused by either energy actors not opposing climate policy as heavily or more central actors not utilizing energy actors as regular collaborators.

Furthermore, within the coalitions the energy actor types were mostly present as auxiliary actors, and only one actor showing that it was a principal actor. All energy actors had at least one collaborative tie within their coalition and multiple throughout the entire subsystem. This promotes, on an individual level, that all energy actors are actively collaborating in their own capacity to monitor climate policy outcomes.

Overall, Climate Tech was the largest, most active, and strongest coalition. This coalition was supported by the three most connected energy actors and endorses investing in climate research and CO_2 removal technologies. According to the ACF, this advocacy coalition has the more resources and best connection which is likely to lead to success in policy outcomes. Leading to the conclusion that energy actors are most active in supporting climate technologies and where they are most likely to see success.

This study and its unexpected outcome could be due to several limitation in this approach. First, only 64.5% of actors identified as part of the subsystem completed the survey, including only 55.6% energy actor participation. The actors that choose to not participate in the survey could be key actors who are more collaborative or support other coalitions, thus changing the results. Another limitation was the fact that the survey was deemed anonymous to increase participation within a highly polarizing topic and protect participants. The only identifier available was organization type which provides a look at how similar actors achieve policy success. Being able to use actor names would allow for more in-depth analysis on why certain actors take up their positions. A possible way to include these missing actors and actor names would be to use discourse network analysis on public statements from each actor. Using discourse network analysis to analyze public statement data would yield less tailored data, but it would not need participation from the actors or require anonymity. Future research could look at a different type of tie, such as using influence data to determine how influential energy actors are in the subsystem. Another interesting future project would be to look at energy actors' collaboration with smaller governments, such as a US region or state.

Acknowledgements

I want to thank everyone that has supported me through this process and aided in the completion of this thesis.

Firstly, to Prof. Dr. Karin Ingold for supervising my thesis and helping keep my ideas on track even when I couldn't. She has been amazingly resourceful and accommodating throughout this entire process, I could not have asked for a better supervisor. Next to Prof. Dr. Dana Fisher at the University of Maryland for including me in the CCP project and putting her trust in me during the interviews of policy actors. It was an incredible experience to work alongside her and get to know such an incredible and accomplished person. Finally, to my family and friends, thank you for supporting me through the process. You all have continually given me encouragement and ear when I needed it most, I could not have done this without you.

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Declaration of consent

on the basis of Article 30 of the RSL Phil.-nat. 18

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Bachelor ☐ Master ☑ Dissertation ☐

Title of the thesis: How active are energy actors in the US Climate Policy Subsystem?

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I declare herewith that this thesis is my own work and that I have not used any sources other than those stated. I have indicated the adoption of quotations as well as thoughts taken from other authors as such in the thesis. I am aware that the Senate pursuant to Article 36 paragraph 1 litera r of the University Act of 5 September, 1996 is authorized to revoke the title awarded on the basis of this thesis.
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