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# HOW WOULD A RENEWABLE ENERGY TRANSITION AFFECT GLOBAL POWER STRUCTURES?

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A systematic mapping review



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## Abstract & Summary

This thesis discusses the effect a renewable energy transition would have on global power structures. This is done through a systematic mapping review focusing on quality over quantity. The field of research this subject belongs to is *the geopolitics of renewables* and is a novel and multidisciplinary field. Four pieces of literature were selected through the review and summarized, being *The Geopolitics of Renewables in Kazakhstan & Russia* (2021), *The geopolitics of renewables; exploring the political implications of renewable energy systems* (2016), *The Geopolitics of Renewables (book)* (2018), and *does renewable energy redefine geopolitical risk?* (2022). The literature was chosen with the purpose of creating a picture of a renewable energy future. The results show a fragmented picture, in which the markets are more competitive, the energy sector is electrified and decentralized, and a future in which rare earth materials will gain importance. Global power structures might become more decentralized as a result, becoming more *communal* as grids and markets become centred around regions and continents rather than *across* continents.

## Foreword

With this foreword, I would like to thank my thesis supervisor, Ellen Ravndal, for providing me with guidance during each step of the research and writing process. She has been an excellent supervisor, always immensely helpful and available when I needed her. I would also like to thank all my friends and family who have supported me through this long journey. I would also like to thank my mother, who passed away in the Spring of 2022 after a long battle against cancer. Thank you for always being so nurturing and supportive of me, even through all the pain of your sickness. I would have never gotten this far without her infinite strength and kindness.

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## 1. Introduction

In 2015, 196 parties entered a legally binding treaty on climate change, vowing to hold global temperature levels on an average of 1.5 degrees Celsius in order to limit global warming. This treaty is what we today call the Paris Agreement, established during COP21 held in Paris at the end of 2015, and put into motion in 2016 (UNFCCC, u.d).

COP27 was held in Egypt in November of 2022 to further discuss which measures have to continue to be taken in order to slow down climate change, but also to discuss and establish the historical operationalization of a loss and damage fund to prepare and aid those affected by the catastrophes that are taking place in countries such as Pakistan, between the months of June and November, experienced a devastating flood that affected all four provinces and has affected 33 million people, as well as cost the lives of 1,739 Pakistani citizens (Center of Disaster Philanthropy, 2022). Pakistan's Prime Minister Shehbaz Sharif states about the catastrophe "Pakistan has never seen a starker and more devastating example of the impact of global warming..." (AL JAZEERA AND NEWS AGENCIES, 2022). She describes this catastrophe as a "biblical flood poured down [on us], smashing centuries of weather records, challenging everything we knew about disasters and how to manage it".

UN Secretary-General António Guterres states at the COP27 and to all its member that "Climate chaos is a crisis of biblical proportions. The signs are everywhere. Instead of a burning bush, we face a burning planet" (United Nations, 2022). It is becoming clear right before our eyes, that the consequences of climate change, and the markets dependence of fossil fuels is surely destroying the planet, and more commitment is needed from other countries to implement low-carbon energy systems into their energy sectors to best combat global warming and climate change.

The Prime Minister of Pakistan states in their appeal for global support that "Nature has unleashed her fury on Pakistan without looking at our carbon footprint, which is next to nothing. Our actions did not contribute to this" (Center of Disaster Philanthropy, 2022), referring to the fact that Pakistan is hardly responsible for 1% of greenhouse emissions globally. The challenge and responsibility of mitigating climate change does not lie with one country, and they cannot make the change alone. Other countries' lack of action have resulted in this climate devastation.

Climate change has for decades been a known fact, not only through science, but now through real life examples with rising temperatures causing extreme weather phenomena and devastations such as the flooding in Pakistan. It has now become more important than ever to

cooperate in the prevention of further changes in the climate through implementing a system that is mainly reliable of renewable energies such as solar, wind, hydro and bio. This is a socio-technical transition that is already starting to develop on regional levels, such as the German Energiewende and the North Sea Offshore Grid, but there is yet too far to go in terms of technical developments and policy implementations. Such a transition must take place on a global level, which raises questions about international relations, rare earths, renewable energy technology and the global market that is currently dominated by conventional energy trade.

In this thesis, I pose the question: **How would a renewable energy transition affect global power structures?** To answer this question, there are several factors that must be considered, which is attempted in the course of this thesis. This is methodology-based thesis, meaning it has no theoretical basis. Although a dominant theoretical chapter is absent, the method does circle in on specific key-terms, such as geopolitics, international relations, and renewable energy. The method utilized is a systematic mapping literature review. The purpose of the thesis is, however, not to write a literature review, but rather creating an overview of the relevant literature, with the purpose of choosing four final pieces to summarize, analyse and discuss. In order to create this overview, a search had to be conducted, and for this search to be conducted, key-terms had to be put into place. I ended up with six key-terms that I applied to Google Scholars Advanced Search engine and collected a sample of 103 pieces of literature. Through this search, I documented the publishing year, genre, discipline, and whether the literature was peer-reviewed. The field pertaining to this research questions, the geopolitics of renewables, is rather novel in nature, and does not fall under a specific discipline, making it a multidisciplinary field.

Due to the multidisciplinary and novelty of this field, finding a concrete and failsafe answer to this question has proven to be a challenge. However, the four pieces of literature that were selected paint an informed picture of the changes one may expect from a renewable energy transition. In the discussion, I discuss the importance of language surrounding renewable energy and sustainability in non-democratic countries, geopolitical risk, political implications and expectations of the renewable energy transition by reviewing the four chosen pieces of literature. Global power structures are not affected by a single change in society, but several, such as changes in the market, energy sector and governance. This thesis will explore these aspects of the renewable energy transition, and analyse different scenarios presented by the authors of the chosen literature.

The topic of global power structures and renewable energy is important in the sense that the effects of climate change do not only affect certain countries through natural disasters, but it also affects national and local aspects of every day living. In a renewable energy future, the technology is built in the environment people live in, built by the people in power. The economy is largely affected by a transition to renewable energy, leaving fossil fuels exporters vulnerable. The decision to implement sustainable policies on a national level though, lies at the hands of the population. When decisions are made by the government, such as building a windmill park in a cabin area, the population complain about noise pollution, as well as complain about not being given a choice or channel in which to discuss possible challenges. This topic is important for the general population because it highlights that if these changes are going to happen, one might as well get a say in aspects such as location, density and practicality. It is also important in terms of knowing how a transition will affect the economy, and how to perhaps adapt or invest in technology. It may also make the population more politically aware of the governors they choose.



## 2. Method → Systematic literature review

The nature of the research question is of speculative and hypothetical nature, as there are currently few examples of renewable energy transitions on large scales, and the energy sector is currently mostly dominated by finite energy sources such as oil, gas, and coal. Although a shift toward a more green and clean energy sector is on-going, renewable energy is still nowhere near becoming the main, dominating source of energy. The research question is therefore speculative, and the results may therefore be speculative.

Despite the nature of the research question, there exists a great variety of academic literature that propose their own answers to this question. Fields such as economic, political, and technical studies all review and research different societal and technical factors that are important to consider when answering a broad research question like the one presented in this thesis. A review of this existing literature is a practical way to answer such question, as it would allow for the consideration of different factors. Such a method of research is referred to as a *systematic literature review*.

### 2.1. What is a systematic literature review?

Booth et. al. (2016) starts their book by referring to Fink (2005)'s definition of a literature review as a “systematic, explicit, and reproducible method for identifying, evaluating, and synthesising the existing body of completed and recorded work produced by researchers, scholars and practitioners” (p. 9-10). Persson (2021) defines a literature review in a similar fashion, as a “systematic review of existing research within a specific theme or field” (p. 13). When reading about the work that goes into a literature review, a word one often is met by is *systematic*. There is a reason why these two concepts are related to each other. Mulrow (1995) states that the literature review is “a search for the whole truth” (Booth et.al, 2016, p. 10). This makes a literature review a scientific activity that follows carefully crafted steps as to achieve accurate and thorough results to a specific question(s) within a field. This makes it a *systematic literature review*.

According to Gough et.al. (2017), a systematic review's purpose is to review already existing research and data by using explicit, accountable, and rigorous research methods (Gough et. al., 2017, p. 2). Systematic reviews are considered secondary research as it is based on already existing primary research. However, just as primary research takes on answering concrete questions, reviews can just as productively focus on answering a specific question rather than addressing topic areas (p. 5). Not only can reviews focus on answering a specific question, but

it can also provide a more comprehensive and wider picture of the research based on a variety of different studies, seeing as single and individual studies tend to be more limited to a single area of research (Gough et. al., 2017, p. 3).

## 2.2. Review method: Systematic mapping review

The review method chosen as the most appropriate and fit to answer the research question is a mapping review. A mapping review consists of delineating or ‘mapping’ out a field within a predefined scope and sample (Booth et.al., 2016, p. 44). Mapping comprises of characterising the sample through categories to later depict the percentages of these categories in either tabular or graphical form (p. 44). In this thesis, I focus on creating an overview of literature, presenting the results of these in graphs that present the popularity, novelty, quality and target audience of the field. I also choose four pieces of literature that appear representative on terms of political implications as well as energy security and a possible case.

## 2.3. Why systematic review?

Reviews are conducted during specific times by people with specific needs (Gough et.al., 2017, p. 45). This review seeks to find an answer to the research question, and serves as a tool to create an overview and show the importance of renewable energy on a large scale and small scale. When asking the question “How would a renewable energy transition affect today’s global power structures?”, there are many factors that must be taken into consideration, seeing as this question can be answered by scholars in different fields of study, such as engineering (technological), social (political, economic) studies. This thesis focuses therefore on the multidisciplinary. A systematic mapping review gives me the opportunity to expand within other fields by looking into their findings on this subject. This question, as expressed above, is hypothetical in nature, meaning there is no empirical answer to this question, only suppositions of conditions that have yet to manifest. Using this methodological approach aids me in identifying different patters from the literature and expand upon these, allowing me to hopefully provide a full and detailed answer to the thesis question.

## 2.4. Steps in a systematic literature review

A systematic literature review is often characterized by a planning process that explains in which manner the researcher(s) or author(s) have gone about performing and completing said literature review. This planning process consist of six basic steps, and the importance or weight of each step may vary from method to method. The steps consist of concretizing your theme and **questions**, conducting an **organized and structured search**, **sort** and create an overview of the existing literature within the theme or field of study, **synthesize the findings**, create an

**outline** of the work that is being conducted, and **systematise** the review by planning out what, how and why (Persson, 2021, p. 15-17). Systematise is the first, and one of the most important steps of a literature review, as it describes the entire process to the reader and serves as a guide to the writer.

#### 2.4.1. Theme and Questions

When conducting a systematic literature review, having a concrete theme and question plays an important role when the time comes to start the search for literature. The theme and question should preferably be within the writer's designated field of study, and it should be focused on a subject the writer is fairly interested in or curious about, as literature reviews are hard and time consuming (Persson, 2021, p. 29-30). Once the theme is decided, defining the question becomes another vital step of the process, as it usually involves a search within the theme that has been chosen. Through this process, one may stumble across interesting subjects and questions that may help the writer create and limit their research question in a rather creative manner (p. 30).

The way in which I proceeded to complete this step was through scoping through literature that was already a part of a study plan for a course I attended at the University of Stavanger called *The Geopolitics of the Energy Transition*. Through this course, I developed an interest toward international relations and how these were created and affected heavily by the state of the energy market. The exam for this course asked the question "Can renewable energy bring peace?", which inspired me to investigate a piece of work edited by Daniel Scholten called *The Geopolitics of Renewables* (2018).

#### 2.4.2. Conducting the search

After deciding which themes appear interesting and of relevance, and which question(s) you want answered within these, it is time to start planning out your search (Persson, 2021, p. 43). *Conducting the search* is perhaps one of the lengthiest steps of the review (and most important), as there are a few steps within this process that should be followed in order to complete a thorough review of the literature. In accordance with Booth et. al. (2016) there are five stages in this process, but one does not necessarily need to carry out each stage suggested to complete a successful review, although one should take the goal and purpose of the review into consideration before excluding any stages, as these can facilitate and lower the odds of missing out on relevant literature (p. 110).

The stages in question are scoping, conducting search, bibliography search, verification, and documentation. The purpose of *scoping* is to give the researcher a picture of what literature and research already exists on the subject, as well as aid in the process of defining key-terms and picking out which databases to conduct the search on. When *conducting the search*, one is to use the identified key-terms on the selected databases, together with search principles if necessary. Whilst doing this search, *checking study bibliographies* and reference lists could be important as to not potentially miss out on important reviews or research. After this, one could start a *verification* process, in which one addresses an expert and/or revise if the research strategies used in the search are correct to make sure you have not missed any important articles. Lastly, it is important to *document* a manner in which the research is conducted by recording details of your search, the strategies adapted in this search, and number of references for each search (Booth et.al., 2016, p. 110-125).

As previously stated, it is not necessary to include all these stages into a literature review, as they may not be required by the particular method being put into practice. In this paper, I have chosen to modify stage four *verification* as looking at indexes in databases can become lengthy and unpractical. Instead, I will make sure to only include literature that has been peer reviewed.

#### 2.4.3. Sorting the literature

The third step listed by Persson (2021) is *sorting* your literature. When conducting a wide search, even if one has narrowed down the research question and created some key-terms to search the elected databases with, one will be met by a great variety of research that may just not be relevant or useful to the review. It is therefore important to know how to sort through the results of your searches in order to properly determine which articles and/or books are of relevance to your review and which of these will provide an answer to your question/s. There are many ways to sort through literature, and this process also varies depending on the length and type of literature in hand as well as the purpose of the search. When reading an article, completing an overview of the contents might be simpler than over-viewing and sorting through the contents of a book. These processes are important when making a choice of what should be included in the review and what is not relevant.

When reading research, one differentiates between reading for pleasure and reading to analyse. Whilst sorting through literature, one must evaluate the arguments, theories and data being presented by the author and their relevancy toward one's own means (Persson, 2021, p. 62). There exist different ways to execute such evaluation, both for articles and books. I will be using a figure presented by Booth et. al. (2016) (also referred to by Persson 2021) titled *the*

*process of selecting studies* (p. 143). This figure introduces a step-like structure, in which one commences by reading the title of a study and judging its relevance based on the title. If the study is not relevant based on the title, it can be discarded. The second step is to read the abstract of the studies with relevant titles and sift out the studies without relevant information in the abstract. After finding texts with relevant titles and abstracts, one is to do a full-text sift of these, and exclude any studies that ended up not meeting the criteria based on these steps, and document in which way and why these do not meet the inclusion criteria (Booth et. al., 2016, p. 143).

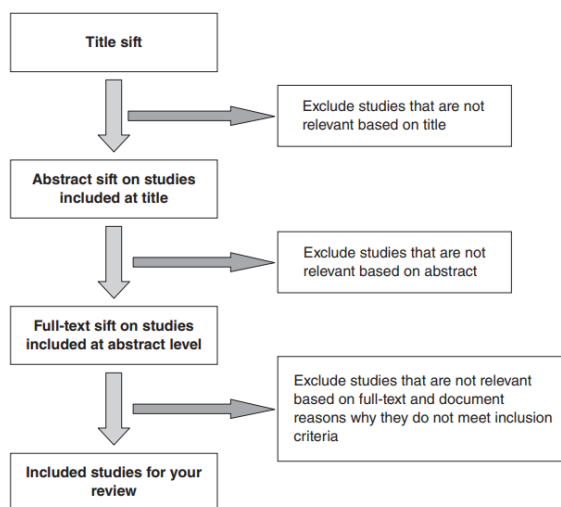


Figure 1: *Process of selecting studies* (Booth et. al. 2016, p. 143)

When going through this step, I used this model as inspiration. When conducting the search, I read both the title and abstract, and deemed from that point whether I would include them in my overview. When picking four pieces of literature, four factors were considered: novelty, popularity, and which area of the field they investigated.

#### 2.4.4. Synthesis

After combing and sifting through the literature and selecting which works are to be included in the review, one reaches the fourth step of conducting a literature review, *synthesis*. A synthesis is “not the mere process of assembling the raw ingredients of the review (...) but also includes (...) seeking pattern, examining for consistency, and identifying the divergent or disconfirming case” (Booth et. al., 2016, p. 207). Synthesis is about evaluating the different works of literature against each other and put them in the context of a question, statement and/or argument (Persson, 2021, p. 86). In this thesis, the synthesis makes up the discussion section of the paper, in which four different texts are selected during the sorting process and are contrasted in light of their similarities and differences, as well as which points each of them bring to the

table. This process is slightly distinct from that of an empirical paper, in which one is to compare your own findings against a theoretical base. This paper, however, does not have a theoretical base, but a methodological one.

#### 2.4.5. Writing and Systematizing

These two last steps of the literature review are perhaps the most important steps of the literature review. These are namely the process of writing down your findings and systematising this process. These cover documentation of ideas, thoughts, and findings, as well as how the writer went about planning the way in which the steps above were executed both in the timely sense and the practical sense.

The results of your review are shown through how you present these. All the work that has been done to conduct the search, sorting the findings, and combing through them, must appear clearly in the final paper. It is important to not only write what you have found in your search, but also *how* this has been done (Persson 2021, p. 114). To achieve a seamless, and hopefully clear overview of how the process of each step has taken place, Persson (2021) suggest creating a *research document* and a *report document*. These two documents share two different purposes, but one common goal. A research document belongs to the writer, and its purpose is to document the thought – and planning process the writer has in mind (p. 115). This document is a ‘place’ in which the writer can develop independent thoughts and understanding. A report document, however, has as its purpose to convince the reader of the writer’s arguments and thought process. This document is written with the reader in mind. The difference between these documents is the purpose they fulfil, but their goal is to create a most thorough and well written review (Persson, 2021, p. 117).

Booth et. al. (2016) highlights certain criteria the writer should keep in mind in the process of writing the review. These criteria go by the abbreviation CART, standing for *Clarity*, *Auditability*, *Replicability* and *Transparency* (p. 280). Keeping these criteria in mind will provide the review with legitimacy regardless of the target audience. Firstly, there’s *clarity*. Clarity concerns itself with the entire review, meaning the research question, methodology, presentation of findings, discussion of potential limits in evidence and/or method should all be clear in the paper (Booth et. al., 2016, p. 280). Next is *auditability*, meaning careful documentation of the different steps taken in the conduction of the review. This criterion is important, as it should “make clear evidence that supports each finding, where that evidence can be found, and how that evidence was interpreted” (p. 280). The semi-last criterion, *replicability* suggests that a good review is one that can be replicated, like a laboratory

experiment. By this, Booth et. al. (2016) states that if for instance, someone already wrote the same review I'm about to write, my results should come up almost the same (p. 280). This is, however, not completely plausible, as different inclusion criteria might bring to light different results. The purpose of this criterion is to make sure the writer uses proper research methods in order to ensure most accuracy. The last criterion is *transparency*. This criterion is linked closely to the latter because it is linked to the procedures of the review. Transparency is “typically attributed to the availability of supporting documentation (...)” (Booth et. al., 2016, p. 281). The transparency of my review has been shown in this chapter, as I have attempted to define the procedure my thesis will follow. If anyone were to wish to replicate the same exercise as me, it would be possible to follow the same procedure shown in this thesis.

Last step of a systematic literature review is to *systematise* your work. This step is ongoing until the review is completely finished, since systematising focuses on the documentation of the choices being made throughout every step of the review (Persson, 2021, p. 137). This step takes place at the very start, before your first search, and ends when you've written your last sentence. Part of systematising also means conveying to the reader how this process has taken place and making sure there are no coincidences in your structure.

### 3. Inspiration for theme and keywords

#### 3.1. Inspiration

Earlier in the method chapter, I briefly mentioned a course I attended at the University of Stavanger. This course was called *The Geopolitics of the Energy Transition*, and it was through this course I was introduced to the impact of energy from a geopolitical perspective. This course discusses geopolitics from a historical point of view, and from the perspective of International Relations, and how it seems to be developing in a world that is moving toward phasing out fossil fuels and creating a more diverse and green energy sector. It discusses the way in which energy and international relations are bound to each other, and how energy can create interdependence through pipelines that cross entire continents. Energy interdependence, in short, is the connection of producer, consumer, international trade and investment to potentially benefit the energy security of all parties (Wilson, J. 2021). This connection is important, because it shows that a transition would affect different parties and different societal sectors but could also create interdependencies.

This field of research is important not only for the academics or politicians, but for the general public, as the renewable energy transition would not be possible without their input and



knowledge. In democratic states, a lot of decision making happens from the bottom-up in local areas, since implementing renewable energy technology into society will in the most likely scenario be set up in the average citizen’s backyard. Being informed on how renewable energy affects our surroundings is the first step toward making what, for the moment, is hardly a reality in a select number of regions, to a global reality. The research question is an important one, because it is not only global powers and leaders that are affected by either climate change or shifts in power, but at a local level the decisions made at the top, usually drip down. It is important for voters to understand what the renewable energy transition will change about their society and lives. Per definition, regional and local actors are part of the geopolitics of energy, and there is a necessity to build the field around their perspectives.

3.2. Final key-terms and definitions

Every search should be based on an appropriate set of key-terms. These key-terms serve different purposes depending on the goal of your search. In this thesis, when conducting the search, I have prioritized quality over quantity, resulting in different key-terms getting switched out once it turned out they did not provide results that aligned with the research question. To achieve the desired results, I therefore had to go through a couple trial-searches, in which I used different key-term combinations.

The key-terms that were decided upon, and the combinations, are as the table below shows:

<b>Renewable Energy</b>	<b>Green Energy</b>	<b>Renewable Resource</b>	<b>Green Resource</b>
<b>Geopolitics</b>	<b>Geopolitics</b>	<b>Geopolitics</b>	<b>Geopolitics</b>
<b>International relations</b>	<b>International relations</b>	<b>International relations</b>	<b>International relations</b>

Table 1. Final key-terms.

Each key-term performed differently, but they all fulfilled their purpose. This purpose was pre-determined from the start, which was to provide me with an overview of pre-existing, quality literature about the subject at hand. One of the purposes of a mapping review is also to make sure no stone goes unturned when performing a search, which means not every search is meant to provide relevant results, but rather reassure the reader and writer that a thorough search was made. This is, however, not the purpose of this mapping review, but rather, as mentioned above, to provide an overview of the quality, peer reviewed literature on the subject matter.

The selection of these key-terms was not random. When picking out key-terms, it is important to know the nature of what you’re seeking an answer for, and which terms are popular in discussions of the subject at hand. What are we attempting to answer? In this thesis, the answer



to that question is “renewable energy” and “geopolitics”. One must be careful in the selection of synonyms, as some words might be believed to hold the same meaning, when in reality, their definitions are different. Using the wrong synonym of a term during a search can be a waste of time, as it will not aid you but rather mislead you.

An example of such a synonym is the definition of renewable energy vs. clean energy. Renewable energy “is energy that is derived from natural processes that are replenished constantly in a natural way and includes sources as solar, wind, biomass, geothermal, hydropower, ocean resources [tidal and wave], and biofuels, electricity and hydrogen derived from those renewable energy sources” (Scholten, 2018, p. 6). Clean energy, however, “is energy [derived] from sources not requiring the release of pollutants, including energy generated from recyclable sources which don’t emit greenhouse gases” (Barby, n.d.). Based on both definitions, one can state that renewable energy is a form of clean energy, but clean energy systems, although they may obtain their energy sources from nature, are not renewable in the same sense as wind, solar, hydro, and bio-energies. Instead of using clean energy as a key-term for the literature search, I have chosen terms such as green energy, renewable resource, and green resource, as these words all refer to the renewable and replenishing aspect of natural energy sources.

The next important key-term chosen is *geopolitics*, which is what I’m referring to when stating “global power structures” in my research question. Högselius (2019) generally defines geopolitics as “the interaction between geographical factors, politics and international relations” (p. 7). I use “generally” because this is a wide term that in newer times is also used to encompass not only nations, governments, and presidents, but also transnational corporations, international organizations, regional and local actors (Högselius, 2019, p. 8). An example of how extensive this term is, can be shown in Criekemans (2018) definition of geopolitics as “the scientific field of study belonging to both Political Geography and International Relations, which investigates the interaction between politically acting (wo)men and their surrounding territoriality (in its three dimensions; physical-geographical, human-geographical and spatial)” (Criekemans, 2018, p. 37). The term *geopolitics* has a long history, but according to Högselius (2019), it’s a term mostly used by the politically conservative to incite political action (p. 8). They also express the need for a definition that encompasses not only big international players, but also the perspectives of regional and local players.

The term geopolitics is tightly associated with the trade of energy, and historically this has been what we call fossil fuels. At some points whilst conducting the search, I would come to a stage

in which the literature appearing focused on the geopolitics of oil, coal, and gas. As the main objective of the research question pertains to renewable energy sources, these were quickly disregarded.

This thesis takes an approach that mostly focuses on the big players, as the research question focuses on global power structures and the bigger picture of the transition. However, regional and local levels of governance will be briefly touched upon, as they are still relevant to the bigger picture as well. This thesis focuses mainly on the possible impact renewable energy could have on international relations and political aspect geopolitics, as these are the concepts my research question is largely concerned with.

The key-term geopolitics turned out to be a good term to use in identifying the kind of literature needed to answer the research question, however due to the broad scope of the term, much of the literature centred on it did not necessarily speak of a transition to renewable energy.

Geopolitics is an exceptionally broad term, as mentioned above, and it falls underneath a field named *International Relations*. International relations are “the study of the relations of states with each other and with international organizations, and certain subnational entities” such as “bureaucracies, political parties, and interest groups” (Pfaltzgraff & McClelland, *Britannica*, 2022). In the field of International Relations, there are different perspectives on how to analyse geopolitics. There are many different perspectives and theories with which to analyse the geopolitical map, but for the sake of this thesis, I will be focusing on the (neo)realist perspective and the (neo)liberalist perspective. When thinking about global power structures, one imagines that different countries have different goals, and in terms of geopolitics and national security, energy plays an important role. A realist views international politics as a struggle towards security and survival (Smith-Stegen, 2018, p. 77). Neorealism attributes war and conflict to changes in distribution. In a liberalist perspective, interdependence is viewed as a condition that would create a pacifying effect on interstate relations (Smith-Stegen, 2018, p. 78).

The terms geopolitics and international relations are not interchangeable in the sense that they are identical in definition, but in the context of this thesis, as well as considering that geopolitics falls within the international relations field of study, they cover areas of research that are important when discussing the impact of renewable energy on different international relationships across borders.

3.3. Initial key-terms, adjustments, and definitions

One of the most important things when conducting the search has been to have proper key-terms in order to achieve the desired results, creating an overview of the available quality literature to find research that aids in answering the research question *how would renewable energy affect global power structures?*

When planning a search, one must account for any possible unexpected changes along the way, as one discovers certain key-terms may not serve the expected purpose or hold a specific meaning in different fields. Previously, it was discussed that in order to determine the final key-terms that would be used to conduct the search, a few trial-searches were performed to investigate whether the term would be effective in its search. This has served as a process of elimination, in which terms that do not yield results, can be put aside. For the search to start, one must have a set of priorly chosen key-terms that align with the question one desires an answer to. During the first trial search, it was discovered that the term *global power structure* did not yield relevant many results. It was discovered that this term appeared to be used in relation to electrical power structures, which is not the subject at hand. Although this phrase is used in casual discussion of international relations in social studies, academically speaking it was not of relevant use. This simple trial-search helped me find a key-term that had more accuracy. The first arrangement of key-terms and searches were as following:

Renewable energy	Green energy	Renewable resource	Green resource
Geopolitics	Geopolitics	Geopolitics	Geopolitics
International system/order	International system/order	International system/order	International system/order
Global system/order	Global system/order	Global system/order	Global system/order

Table 2. *Initial key-terms.*

Two key-terms that appeared to be useful at first glance, and were considered before International Relations, were *international/global system/order*. An international system is “concerned with the structure of the system, the interactions between its units, and the implications for peace and war, or cooperation and conflict, of the existence of different types of states” (McClelland, 2022). An international *order* is defined as “[international order] entails some level of regularity, predictability, and stability in the ways that actors interact with one another” (Lascurettes & Poznansky, 2021). These are similar definition wise, and all contain characteristics pertaining to International Relations, yet they did not turn over well in context to the research question.

At the start of this search, it quickly became apparent that the keywords “system”, “global” and “order”, although they gave several results, few, if any, were relevant based on title and/or abstract. It appeared that the word “system” is often used in context to electrical systems, and the word “order” only appeared in sentences such as “in order to” and “the order of...”. The word “global” did not bring forward any ‘hidden gems’, or any relevant literature for that matter, and even in combination with “relations” it did not perform as expected. This discovery resulted in the replacement of “International/Global order/system” with “International Relations”, which acted as a good replacement. These adjustments and setbacks are not in vain, as they aid in perfecting the search terms, which in turn provide better and more accurate results. It also contributes to a better understanding of which terms are often used in academic literature and research about this topic.

## 4. The search and statistics

As the search has been conducted, I am left with some data considering the novelty, genre and disciplines of the pertaining literature. In this section, I will be going through the results of the search and attempting to find connections between the data and the development of society in trying to prevent climate change. These will be portrayed in graphs created with excel.

### 4.1. Key-terms performance

The purpose of using key-terms in this expansive search was to locate literature that expanded upon the subject at hand. The purpose of this search was to find relevant and high-quality literature, by considering factors such as novelty, number of citations and peer reviewed literature. By applying different search terms in the lookout for relevant literature that could eventually aid in the conclusion of our research question, one is procuring that the literature focusing on this area of research does not fall through the cracks. This is not to say that each key-term gave a fountain of relevant results, quite frankly some of the key terms turned out to be “fruitless” in the sense that they did not provide with any relevant literature.

I use the word “fruitless” vaguely, certainly because although these terms did not contribute in the expected manner, which was by providing relevant literature, they did create a picture of which terms are popular to use when discussing matters of energy transition and global political relations. The purpose of a literature review is to conduct a thorough search of literature, and in this thesis, the search has served as a tool to find relevant, high-quality literature within the field of geopolitics and renewable energy. In a mapping review, the key-terms become an even more important and effective tool, as one is supposed to be attempting to create a ‘map’ of the

applicable and available literature within a field or area, through vigorous searching aided by relevant terms and synonyms. Finding that certain key-terms did not perform as expected is an interesting discovery in itself, as it points toward an academic consensus on certain terms, which in this case seem to be “renewable energy” and “geopolitics”. The majority of results from the search came from this concoction of terms. In the latter searches, many of the results from the first search appeared as well. This indicates a consensus on terms such as “geopolitics”, “renewable energy”, “green energy” and “international relations”. Search terms such as “renewable resource” and “green resource” did not yield a whole lot of relevant results, but they provide reassurance in the search process.

#### 4.1.1. High-Quality literature and peer review

Throughout the search, I have focused on picking out literature that, based on the titles and descriptions, appeared to be relevant literature of a certain standard. The way ‘high-quality’ is utilized in this thesis, is literature that not only expands upon the subject at hand and has a good number of citations (in comparison to the publishing year), but it is also important that the literature has gone through what is called a *peer review*. A peer review is defined by the Merriam-Webster dictionary as “a process by which something proposed (as for research or publication) is evaluated by a group of experts in the appropriate field” (Merriam-Webster, 2023). Verifying whether a work of literature or a piece of research has been exposed to peer review removes the doubt of whether the information being consumed is valid and of quality. It has therefore been a requisite when I have chosen four pieces of literature to analyse, that these are peer reviewed.

When applying the key-terms to the Advanced Search engine on Google Scholar, there have often been pages and pages filled with different works of literature. A way in which I judged the quality and popularity of a piece of literature, was if it could be found within the first 10 pages of the results. Usually, the higher quality literature is the one with the more citations, yet it has been important during this search to make sure that I looked beyond that, as there are less popular works of literature with the same quality, and they were often newer as well. However, limiting it to the first 10 pages was a way to make sure the search did not go on forever, but also to make sure it was in depth enough to call a mapping review.

## 4.2. Results of the search

The main purpose of this thesis is to answer the research question *How would a renewable energy transition affect global power structures?* I have decided to answer this question through a systematic literature review, and this review has had two purposes. The first purpose has been to create an overview of the available high-quality literature. It is through this overview that I answer the question of how novel and diverse this field is. The second purpose of the review has been to select four pieces of literature that create a representation of the challenges this field discusses, and through these, find an answer to the research question.

The literature in this field is relatively new and arguably relevant when referring to present day's climate change developments. The search was conducted by selecting a handful of key-terms and running them through google scholar's advanced search engine. After conducting the search, the literature was documented using excel. Excel is an excellent tool not only for documenting numbers, but also for organizing patterns. The particular reason excel was chosen for this task was to create a cleaner overview of the totality of the literature that had been localized in an organized manner. The total number of literatures concerning geopolitics and renewable energy ended up at a total of 103 pieces of literature. The aspects of the literature that were documented that will be discussed in this section were the publishing year, genre, peer review, and the discipline it belongs to. Other criteria were also documented, such as key-terms, relevancy, case-studies and/or experiments, but these were documented as a tool that was to aid me in the pursuit of choosing the literary works that would be further analysed in this thesis. The aspects that will be discussed and elaborated upon in this section are the ones mentioned prior, as they can not only help provide a picture of rising popularity through the years and which discipline(s) appear to be dominating the field.

These aspects are important to discuss, as the field is currently still developing. The documentation of the different criteria such as publishing year and disciplines aid in creating a picture of how long the field has been actively developing and which field is currently leading and dominating this research.

### 4.2.1. Peer Review – Quality vs. Quantity

Throughout the thesis, I have discussed the main purpose of the literature review, which has been to find an answer to the research question *how would renewable energy affect global power structures?* The review type was decided to be a systematic mapping review, meaning I would conduct a search with the purpose of creating an overview of the general literature in the

field. However, the goal of this thesis has always been to find an answer to the research question, and whilst conducting the search is part of this, there was a big focus on relevance and quality when documenting the literature. A way in which the quality has been measured has been through the number of pages I went through on google scholar, but the main aspect of a quality literature is whether it has gone through a peer review or not.

A peer review is, as mentioned previously, “a process by which something proposed (as for research or publication) is evaluated by a group of experts in the appropriate field” (Merriam-Webster, 2023). To determine whether a piece of literature had gone through a peer review, I used a search tool called “Norsk Senter for Forskningsdata” or NSD. The way this engine functions is by finding the name of the journal or the publishing company of the work in question, and writing it into the search engine. Here, it will determine whether the research is reliable by using a measuring point system from 0 – 2; 0 meaning it has not been peer reviewed and it is not scientifically reliable, 1 being peer reviewed and scientifically reliable, and lastly, 2 meaning peer reviewed as well as considered one of the most reliable scientific works on the database (NPI, 2023).

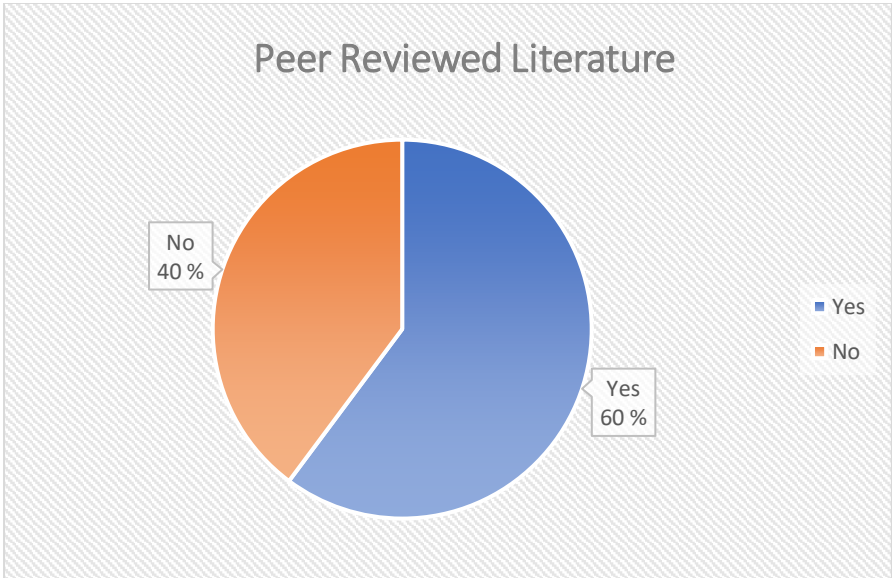


Figure 2. Percentage of Peer Reviewed Literature

In the graph above, the percentage of literature that was or was not peer reviewed, is displayed. For it to be considered peer reviewed, it had to be at least a level 1 based on the NPi (Norsk publiseringsindikator). One can observe that 60% of the literature found, had gone through a peer review, and was therefore considered to be scientifically reliable. The other 40% of the literature, however, had either not gone through a peer-review, or it did not show up on the database. If a journal or publisher did not show up on the database, I would still read the

requirements that had to be met for an article or book to be published on their channels, and if peer-review was not mentioned, it fell under this percentage as well.

#### 4.2.2. Publishing year – rising popularity?

One of the main purposes of this mapping review has been to create an overview of the available quality research about the subject at hand. The factors I have chosen to document have been published year, genre and discipline. In this section, I'll be discussing the years in which the most literature was published, but also when the topic at hand started gaining popularity.

One may ask oneself the question: why is it necessary to know anything about the year these pieces of literature were published? The answer to this is simply because viewing these years in correlation to each other tells a story in itself. The period these works were published helps us find a trend, and helps us answer one question: when did renewable energy and geopolitics start becoming an important topic to discuss, at least amongst academics?

Figure 3 paints a picture for us, that shows how much literature was published about this subject per year between the years 1992 – 2022. In the last 30 years, one can observe a growth in publications about the subject, but it isn't until around the turn of the decade that we observe the numbers increase, with the exception of a small dip between year 2013-2015 and in 2019. From that point on, we count an increase from 7 works of literature to 11 in 2020, and from 11 to 27 from 2020 to 2021. As per October 2022, a total of 16 works had been published, and although it is a decrease from the year prior, one can still observe that the interest in geopolitics and the renewable energy transition is only growing and become more relevant.

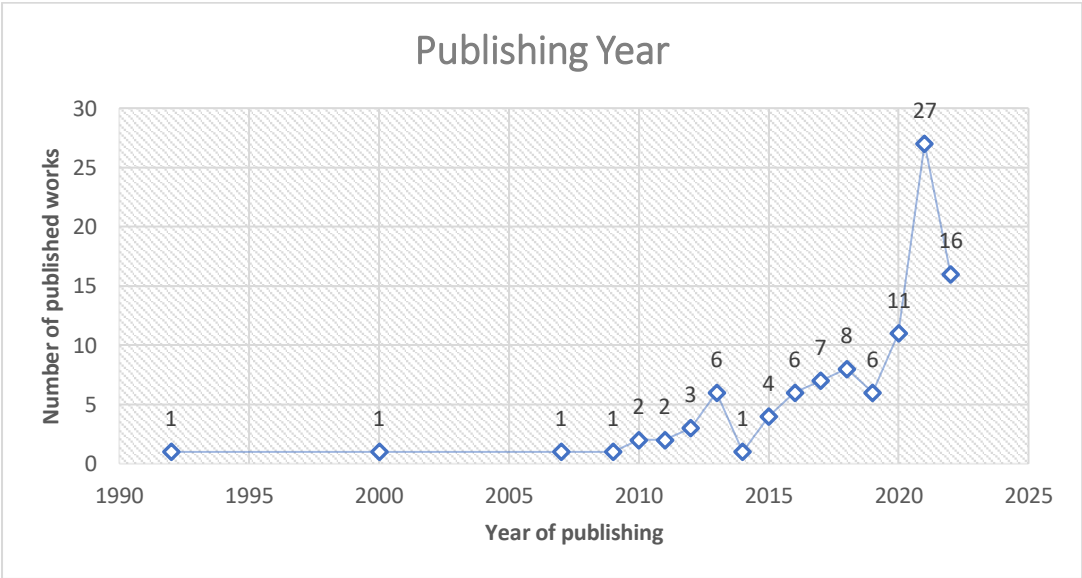


Figure 3. Publishing Year



Another question one can ask is whether there is a specific event or news that are tied to this spike in interest. We can observe that it is around the turn of the decade that the number of literatures being published starts increasing, so let's start with the time period leading up to 2010. In 2007, the IPCC released a synthesis report, stating that “evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases” (IPCC, 2007, p. 2). Around 2008, the UK parliament introduced legally binding targets to reduce CO<sub>2</sub> emissions by 80% by 2050 compared to 1990 levels. These targets go under the name the *Climate Change Act* (ClientEarth, 2021). In 2009, the NASA documents this as the second warmest year of the decade, with 2005 being the first (NASA, 2010). However, we find that NASA research finds that 2010 tied for warmest years on record (NASA, 2011). This research finds that the global surface temperature this year increased with 0.63 degrees Celsius compared to temperature levels from 1951 to 1980. The report proceeds to state that “The record temperature in 2010 is noteworthy, because the last half of the year was marked by a transition to strong La Niña conditions (...)” (NASA, 2011). “La Niña” is the name given to the phenomenon of unusually cold ocean temperatures in the Equatorial Pacific (PMEL NOAD, 2022). This creates a picture of the speed temperatures are rising, so much that an event that usually has its impact on the environment took place and the average global temperature still rose. Other events that took place within this period that were significant toward climate change was several areas around the world experiencing heat waves, some of them experienced record high temperatures never recorded before (Kenward, A. 2010). Although factually checking whether these events caused a spike in interest or necessity to research the impacts of renewables on global power structures is not immediately possible, one can draw the conclusion that the continuing heating of the world and an increase in extreme weather, and the IPCC urging world leaders to lower their emission has created an urgency around developing this area of research in multiple fields. It is said that the first decade of the century was the warmest decade on record, and this would explain the sudden spike in interest surrounding renewable energy and geopolitics.

#### 4.2.3. Genre – who is the audience?

One of the things documented during the literature search was the genre the literature was written within. Although it does not provide much in context to the novelty of the topic or inform us much of the disciplines that dominate the field, it paints a picture of the type of literature one is more likely to find when conducting a search. The genre of literature also tells

us as readers something about who it was written for, concerning the specific prestige of the literature.

The literature found during this search came, as presented by Figure 4, came most frequently in the shape of scientific articles published in scientific journals. One could say this is because this is a considerably novel topic. There are also a good number of literature reviews, appointing to this field being one with abundant literature despite its novelty.

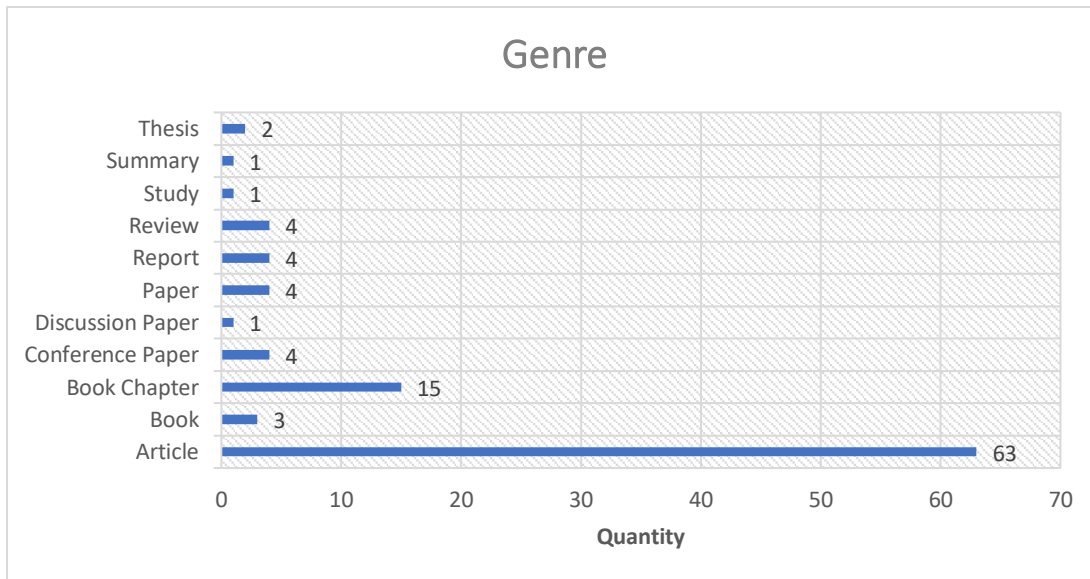


Figure 4. Genre

Articles seem to be the genre most authors gravitate toward, and I believe this is because of the velocity in which this field is developing as new questions and problems arise, as well as articles being deemed to be more prestigious within academia than other genres. Concerning the question about who these articles were aimed at, the answer falls somewhere between policymakers, academics and students that are well accustomed to deciphering data of either qualitative or quantitative nature. It is also observable that there are a good number of books found in the literature search, but not nearly as much compared to the number of articles.

With a field as new and fresh as this, one can only expect it to keep expanding as the world and research pursues to acquire answers and solutions to these issues. Universities will also start introducing courses that focus on this topic, allowing the next generations that will be faced with these challenges to also participate in the expansion of this academic field. One comment for future researchers and scientists, would be to perhaps write more articles that can be shared with the general public, as they play an important role in mobilizing the renewable energy transition.

#### 4.2.4. Disciplines – which dominates the field?

Lastly, one of the more interesting aspects of the search to document was which disciplines each piece of literature belonged to. It is through this that one can attempt to determine which discipline dominates the field concerned with the research question *how would renewable energy affect global power structures?*

It is worth noting, that assigning a *single* discipline to most of the works of literature was a challenging task, as many of the literatures often elaborated on more than one subject at hand, and rarely kept themselves to a single discipline. I have, however, done the best I can to identify the main discipline the literatures are written within, in order to create a more fragmented picture. For the literature that has been too mixed to decipher a single discipline, I have taken the liberties of labelling them ‘multidisciplinary’.

The discipline that dominates the field reveals certain aspects of the literature to us as readers and researchers. This implies that often most of the literature focuses on specific impacts of different changes of the transition. When it comes to the renewable energy transition and its possible impacts on global power relations, one sees a dominance pertaining to social science fields such as international relations, economics, and political science.

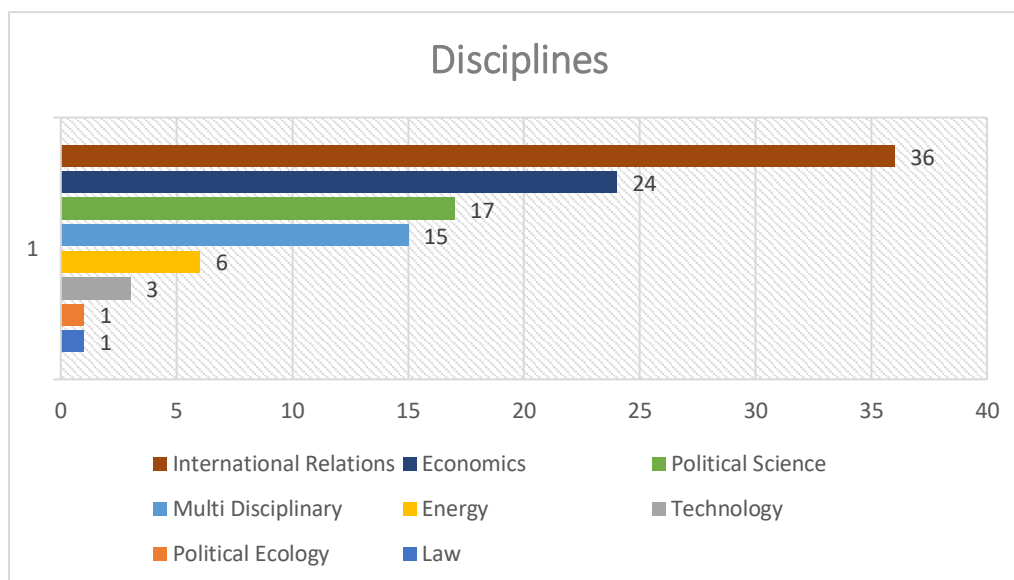


Figure 5. Dominating disciplines

As mentioned above, one can observe on figure 5 that a vast majority of the literature is written within the field of social science. However, one can also see that there is a good portion of the literature that falls under the category *multidisciplinary* meaning “combining or involving more than one discipline or field of study” (Merriam-Webster, 2022). One noteworthy aspect of the

classification process of this search has been determining when a piece of literature belongs to a specific field or is dominated by research pertaining to said discipline or field. A good part of the literature is therefore classified as multidisciplinary, as it discusses not only aspects of policy and foreign affairs, but also technological developments and rare earth material.

This field of study is, however, dominated by social sciences, mainly *International Relations*. What does this piece of information provide to us as readers and researchers? To answer this question, one ought to look at the field in question. Historically speaking, much of the geopolitics of energy has been centred around the field of international relations, as it focused on how fossil fuels affect foreign and domestic affairs across borders (Scholten & Bosman, 2016, p. 274). Many researchers who have taken interest in the growing field of geopolitics and renewables have attempted to create scenarios by replacing fossil fuels with renewable energy and imagining what such a *society* would look like. One can therefore draw the conclusion that this is *why* the geopolitics of renewables is currently dominated by the social sciences.

On the other hand, figure 5 also paints a picture of a field growing toward the multidisciplinary. The geopolitics of renewable energy propose questions and problems that cannot be solved by one field alone, questions concerning the market, policies, technology, materials, relations, and environment. Much of the literature found, although mostly dominated by research and discussions focused on policy, relations and markets, all pose questions to the infrastructural developments of renewable energy technologies such as battery storage and the acquirement of rare earth materials. As a reader and researcher, it is therefore important to keep in mind that this field leans more toward being multidisciplinary in the future, than pertaining simply to one field such as social science.

## 5. Summarized literature

The geopolitics of renewable energy is a diverse and multidisciplinary field, with a great variety of interesting and enlightening literature that explains different effects of a renewable energy transition on different levels. The search that has been conducted has aided in narrowing down a list of peer reviewed literature that explores several aspects of the renewable energy transition and its impacts on a geopolitical sphere. The purpose of this search, and the classifying of literature into different categories has been to create a picture of quality literature that has provided insights on these effects, but its purpose has also been to find an answer to the research question presented in this thesis: *“How would a renewable energy transition affect global power structures?”*.

For this purpose, I have chosen four pieces of literature to aid me in the process of finding an answer. The literature has been chosen through some criteria, such as number of citations, publishing year and the discipline it corresponds to. It is important to remember, as mentioned previously in section 4.2.3., that categorizing each individual article, book or chapter within a specific field has been a challenge, as this field has grown to develop into a multidisciplinary field, the answers to the questions being asked do not exist within one single discipline. The challenges presented by a transition to renewable energy extend from politics to engineering through governance, state rhetoric, interstate relations, technological developments, rare earths, trade routes, smart grids, centralization vs. decentralization, a changing market, energy security, interdependence, and geopolitical risks.

In this section, we will summarize these four pieces of literature and identify the main arguments, which will lay the grounds for a discussion. The four pieces of literature have been chosen as they each narrow into several of these topics, since the geopolitics of renewables and all the challenges presented above contribute to the potential alteration of global power structures. It is also worth noting that the different pieces of literature have attempted to define the geopolitics of renewables in alignment with their own contributions because, as previously touched upon, it is a wide and multidisciplinary field, but they do not all define geopolitics. The methodologies used in the literature to analyse the subjects will be mentioned to provide context for their analytical standpoint, but not be discussed, as I trust the authors expertise within their corresponding fields.

### 5.1. The Geopolitics of Renewables in Kazakhstan and Russia (2021)

*The Geopolitics of Renewables in Kazakhstan and Russia* by Koch & Tynkkynen (2021) presents the cases of two countries with troubled reputations, and their approaches toward lowering their emissions and applying renewable energy into their energy mix. The authors take an interesting approach, by analysing their rhetoric surrounding words such as sustainability, as well as their actual initiatives to lower their emissions. The purpose of this article is to provide a different perspective to the geopolitics of renewables, factoring in language and rhetoric as a tool authoritarian states use to maintain legitimacy on a global scale.

This article considers the case of two countries that are not considered to be at the forefront of the renewable energy transition, namely, Kazakhstan and Russia. These are two countries that do not appear in a rush to re-invent their economies and have troubled reputations regarding environmental policy, mostly due to their position as traditional hydrocarbon fuel markets. The methodology used to do this comparison is not mentioned directly, although the authors analyse public discourse, leaning into discourse analysis, but what is clear is that the study is qualitative in nature. In regard to how the authors define geopolitics, it is seen in the light of being “as much an issue of domestic politics as international politics” (Koch & Tynkkynen, 2021, p. 522). It is not, per se, a definition, but rather a general statement about the field, which aligns with the nature of the arguments presented in the article.

Koch and Tynkkynen (2021) write that while there are efforts to “promote” a transition in the corresponding countries, these efforts are often short-lived, small-scale, and flashy, referring to Kazakhstan hosting a second-tier world fair with the theme “Future Energy”, EXPO-2017, and Russia labelling 2017 the “Year of Environment” (p. 522). Kazakhstan and Russia are what can be considered authoritarian regimes, in which democracy is not fully exercised and public discourse surrounding environmental issues is void.

Considering the prior statements regarding public discourse, the battle of remaining legitimate and align themselves with a ‘globally-dominant narrative’, Koch & Tynkkynen ask: “Who is promoting renewable energy?” (p. 527). It has been established that Kazakhstan and Russia are states in which policy is processed in a top-down manner, leaving small room to practice democracy. This leaves the promotion of renewables to the state. Kazakhstan’s president opened EXPO-17 by stating that Kazakhstan is actively switching to renewable energy, and through ‘Strategy-2050’ the energy being produced would be 50% from renewable energy sources, a somewhat daring statement considering most of their energy (87%) is generated from

hydrocarbons (Koch & Tynkkynen, 2021, p. 525). The authors describe it as counter-intuitive, but flashy enough to draw in foreign investors. For Kazakhstan, it appears that at the centre of their ambition lies a more immediate motive, which is to stand out as legitimate and forward-looking in the eye of Western audiences (p. 526). Kazakhstan's most important asset and financier in the pursuit of transforming its energy sector is the European Bank for Reconstruction and Development (EBRD), which has aided in (attempting) to establish a legal framework that later got deemed insufficient, as well as financing large-scale projects such as the first wind power project, and two solar projects in cooperation with the Clean Technology fund (Koch & Tynkkynen, 2021, p. 528). The diversification of Kazakhstan's 'green' portfolio has drawn in, as meditated by government elites, multiple investors.

Yet, when interviewed at the EXPO-17, the ambassador of UAE is asked concretely about prospects for cooperation in the field of renewable energy sources, to which his response focused on the importance of technology transfer and original expertise, and Kazakhstan's role in supplying the UAE with uranium (Koch & Tynkkynen, 2021, p. 531). This reply suggests that discussions about renewable energy serve more as a way to maintain and promoting a friendly relationship between both countries, but no real agreements were made.

In the case of Russia, their involvement in the geopolitics of renewable energy have been even smaller, as the re-election of Putin in 2012 resulted in any kind of environmental legal framework being dropped, turning the focus on business as usual, and with a highly biased energy sector, it becomes difficult to promote renewables through the institution of the state, with bioenergy as an exception. Despite of the potential to employ and expand their bioenergy sector, Russia seems set on expanding gas-pipelines. Russian rhetoric is careful with using words such as sustainability and would rather use words such as *environment* and *pollution*, as they view sustainability to be much a societally and socio-economically-loaded term.

This article brings forward that Russia and Kazakhstan are actively mobilizing "their discursive hegemony to narrow the contours of the conversation to focus on a limited – and politically palpable – set of issues" (Koch & Tynkkynen, 2021, p. 535). "While some changes are clearly underway, the cases of Russia and Kazakhstan suggest that, for now, the geopolitics of renewables is still a geopolitics of oil and gas" (p. 535). This article suggests that inter-state relations can arise as ways to promote green growth in the market, but that in authoritarian states which do not subscribe to the idea of sustainability, language is a powerful tool used to maintain a globally acceptable appearance, whilst in a practical context, not much is being done to achieve a transition to renewable energy.

## 5.2. The geopolitics of renewables; exploring the political implications of renewable energy systems (2016)

The article *the geopolitics of renewables; exploring the political implications of renewable energy systems* by Daniel Scholten and Rick Bosman was published in the journal 'Technological Forecasting & Social Change' in 2016. The purpose of this article is namely as the title states, to explore the political implications of renewable energy systems.

Scholten & Bosman (2016) define geopolitics by looking through a multitude of studies that discuss it in relation to oil and gas. They describe the concept of geopolitics to be "basic in nature" (p. 274), and that "it usually equates to 'politics, especially international relations, as influenced by geographical factors' usually through politicians that act upon geographic considerations" (Scholten & Bosman, 2016, p. 274). It is worth noting this definition "barely scratches the surface" (p. 274) in relation to the potential of a transition toward more renewable means of energy.

The article highlights that there is currently little academic research on the topic (as of 2016) of how the abundance of renewable energy sources might affect global energy relations, intermittency, the possibility of a decentralized energy sector, and the electric nature of renewables with focus on transportation and storage and the challenges of trade and energy security. The method utilized in this article is of qualitative nature, a thought experiment, as it "enables (us) to set clear research boundaries, unhindered by questions of likelihood, allowing (us) to focus solely on the link between geographic and technical features of renewables and their political implications, leaving other considerations out" (Scholten & Bosman, 2016, p. 275). A thought experiment is well suited for areas or fields that are new (such as the field of the geopolitics of renewables), thus hard to empirically observe (p. 276). The authors create a three-step reasoning framework, in which they consider (a) geographical and technical features, (b) structure of energy markets; trade patterns, and (c) strategic realities and policy considerations. These are based upon some known truths, such as prime locations for renewable energy production are dependent on weather-reliable locations, as well as geology dependent in terms of rare earths (Scholten & Bosman, 2016, p. 276). The structure of the market will change, together with whom become consumer countries, producer countries, and transit countries. This will also create new dependencies and system boundaries. Depending on what type of country you are, they will have varying concerns in mind in context to their status as consumer, producer or transit country. Consumers will be concerned with security of supply and stable prices, producers might want to maximize energy revenues in order to fuel their own



economy and yield for security of demand, and transit countries will be interested in maintaining this position in order to extract fair rate services and create political leverage (Scholten & Bosman, 2016, p. 276).

Based on this reasoning, Scholten & Bosman (2016) develop three steps to better investigate the geopolitics of renewables, namely, (1) The geo-infrastructure ensemble of renewables, (2) Energy market structure of renewables, and (3) Strategic considerations of renewables (p. 277-280). *The geo-infrastructure ensemble* of renewables is characterised by renewable energy being abundant in contrast to fossil fuels, that are geographically bound and scarce. They are intermittent, meaning they are weather dependent and not always available on demand. Renewable energy technology (RET) often takes up less space, again, in contrast to the unrenovable counterparts, decentralizing the energy sector and opening the possibilities for anyone that owns land or a roof to become an energy producer. Renewable energy generation technology is dependent on rare earths, creating the necessity for importing these for states that do not have local access to these, and lastly, as renewable energies such as solar and wind, are “easiest convertible to electricity” (Scholten & Bosman, 2016, p. 277).

Secondly, there are five major implications in the *energy market structure* of renewables. One can expect there will be changes in power relations between consumer and producer countries, as renewables become more decentralized, the potential number of producers in the market rises. Production will shift to countries with the adequate weather conditions, and the ‘left over’ countries will stand before a ‘make or buy decision’ (Scholten & Bosman, 2016, p. 277). Given the fact that electricity doesn’t travel well over long distances, grid sizes will likely shrink, resulting in an energy market constrained by its size. However, the larger the grid, the number of sources and or productive capacities may be included. A large grid would also signify “more geographical fluctuations in availability of renewable energy sources can be exploited” (Scholten & Bosman, 2016, p. 278), but also increase the levels of vulnerability in context to disruptions and the consequences of these disruptions. Electricity being the main form of energy being produced also implies a change in the market, as countries are going to have to choose between centrally or decentrally produced electricity (p. 278). This decision will decide whether the market becomes locally oriented, or a larger entity. Switching to renewable energy will likely change the way we use transportation, predicted to split the market between electric vehicles and biofuelled transportation (p. 279). Lastly, due to the intermittency of renewables, electricity prices will likely be unstable, creating a market that is dependent on storage in order to maintain stability.

Lastly, the strategic considerations of renewables present two extreme scenarios, this being the continental scenario and the national scenario. The continental scenario is based upon a collaboration between the countries have optimal weather conditions and the predicted sizes of the grids, which connect producing, transit, and consuming countries. This interdependency will lead, according to Scholten & Bosman (2016) to so called ‘grid communities’ (p. 279). Power struggles will be centred around the grids ownership rights, decision making and management. The connection shared between grid communities will make it easy for one part to affect the other, meaning they share “equal stake in the well-functioning of the electricity grid” (Scholten & Bosman, 2016, p. 279-280). In this scenario, the strategic positions are held by producer countries. The national scenario is based on a country or community becoming prosumers, by “having the opportunity to internalize all functions” of transit, consumer and producer in order to become self sufficient and cover most of their energy needs (p. 280).

This article’s purpose has been to provide a hypothetical picture of how a system purely based on renewables would affect global power structures through geographical and technical factors, market structures and strategic realities. The authors conclude this article by stating that the likely outcome will be a mixed picture between the continental scenario and the national scenario, “in which countries will source a strategic share of their energy locally and exploit the efficiency gains international trade offers” (Scholten & Bosman, 2016, p. 281).

### 5.3. Does renewable energy redefine geopolitical risk? (2021)

The article *Does renewable energy redefine geopolitical risk* written by Chi-Wei Su et.al. (2021) explores the causal relationship between geopolitical risks and renewable energy. It seeks to study the impact of renewable energy on geopolitical risks in comparison to fossil fuels and investigates whether there is negative or positive causality between the two factors, by looking through the time periods of 2000-2020, as this has been an important and more recent period in renewable energy development in many regions. Whilst this article is not *directly* concerned with defining what it means by geopolitics or the impact of a renewable energy transition on inter-state relations, it elaborates on the subject of geopolitical risks. “The development of renewable energy can shape the situation of interaction, alliances and war” (O’Sullivan et.al., 2017).

The goal of this article is to determine the causal relationship between geopolitical risk and renewable energy. The method used to investigate this is quantitative, based on the classical production model. The authors perform a variety of tests such as the bootstrap full-sample

causality test, parameter stability test, and sub-sample rolling down window test in order to measure the different variables presented by this subject (Su et.al., 2021, p. 3-4). The data sample collected spans from the time period 2000:01 to 2020:12, which is from the beginning of the century until the last month of 2020. This time period appears to have been chosen based on the rise of countries investing in renewable energy technologies in the early 2000's as their ambitions to climb higher in the international political system grew (Su et.al., 2021, p. 4).

Su et. al. (2021) state that the rise technological developments within renewable energy were mainly driven by oil prices and environmental issues (p. 4). This was around the time in which geopolitical risk incidents resulted in many fossil-fuel producing countries to tighten their oil supply whilst the demand rose from emerging economies. Although the rising trend of renewable energy technologies has continued to grow, geopolitical risks seem to be at a low level (Su et. al., 2021, p. 5). Per this observation, there seem to be little, if not any, causal linkages between renewable energy and geopolitical risk.

By investigating sub-samples, meaning data from a specific time within the full sample, one can observe that geopolitical risk plays a crucial role in the development of renewable energy, and could also encourage collaboration between regions, but it could also be the source of geopolitical rivalry (Su et. al., 2021, p. 6). This indicates that the relationship between geopolitical risk and renewable energy can be observed to have negative as well as positive impacts.

Furthermore, an observation of these sub-samples also show that there is a causal link running from renewable energy to geopolitical risk (Su et. al., 2021, p. 7-8). This is due to an observable rise in interest in renewable energy in the global economy that is likely to affect relationships between state interactions, alliances, and geopolitical interests (Su et. al., 2021, p. 8). One can for example observe that in the sub-sample period of 2002:01 to 2002:10, there was a rise in renewable energy investment, but mainly driven by energy security concerns, which could challenge the polarity of the global power system (p. 8).

It becomes clear, through the observations carried out in this article, that the causal linkages between geopolitical risk and renewable energy are mutual, although it only became apparent by observing sub-samples, that meaning at the link between an incident in a specific time frame and its impact within that sub-sample. An important take away from this article, is that renewable energy has the potential to alter the global power structure system through

minimizing geopolitical risks in countries that resort to oil and gas as a weapon (Su et. al., 2021, p. 9).

The purpose of this article was to establish whether there was a causal link between geopolitical risk and renewable energy. Through observing data samples, it was discovered that there is a mutual relationship between the two that can both benefit states and negatively impact them. It has also been established that renewable energy can be used as a tool to forge collaboration between states as well as to fortify energy security and reducing geopolitical risks.

#### 5.4. The Geopolitics of Renewables (2018) (book)

*The Geopolitics of Renewables* (2018) discusses a rather novel topic, that of how renewable energy would affect inter-state relations. The topic of geopolitics has for the last decades focused on the geopolitics of fossil fuels, and how these affect political decisions, rather than on a transition. A renewable energy transition implies a change and a re-definition of energy markets and systems (Scholten, 2018, p. 9). The purpose of this book is to provide the reader with a comprehensive overview and understanding of what these changes imply, as well as putting a subject that has for too long flown under the radar, on the map (p. 5). Scholten (2018) defines geopolitics as referring to “politics, especially international relations, as influence by geographical factors” (p. 8). They also use Criekemans (2011) definition: “geopolitics investigates the interaction between [political actors] and their surrounding territoriality in its three dimensions: physical-geographical, human geographical and spatial”. The definition of geopolitics is, as mentioned earlier in the paper, quite vast and wide, and it implies many areas of research, which is why the field of the geopolitics of renewable is multidisciplinary.

In order to provide a comprehensive and understandable overview of the geopolitics of renewables, this book is divided into twelve chapter, from which 2 through 11 “showcase the various ways in which the transition toward renewable energy is reshaping energy systems, markets, and politics” (Scholten, 2018, p. 17). These are also divided into three levels of analysis, namely (2-4) the emerging global energy game; winners and losers, (5-8) regional and bilateral energy relations of establish and rising powers, and (9-11) infrastructure developments and governance responses.

These are three important areas of research and provide insight into how different actors might be affected by the energy transition. The chapter stresses as well that although there is some data and cases to go off, this is still mostly a field in the making. This field is multidisciplinary in nature, with contributions from engineering, economist and social scientists. The field draws

from International Relations, and it focuses therefore heavily on the effect of a transition on a transnational level.

The book bases its research on a set of expectations related to the effects of a transition toward renewable energy. These expectations are touched upon in the different parts, in some more than others. What the authors of *The Geopolitics of Renewables* (2018) believe we can expect from a worldwide transition to renewables are; (1) shifting away from oligopolistic markets focus “shift from strategic leverage of producers to many countries having leverage” (Scholten & Bosman, 2018, p. 308), (2) a shift from centralized facilities to more decentralized energy production, giving birth to new business models and revolutionizing the market, (3) rare earth materials gain importance in the clean tech race, and (4) an electrified energy system.

#### **5.4.1. Part I**

Each section of the book discusses these expectations in regard to the topic of discussion. Part I – The Emerging Global Energy Game; Winners and Losers – mostly concern itself with the first and second expectation, meaning they discuss the ways in which the energy market can potentially become more competitive due to the decentralization of energy systems from big companies to potentially locally driven grids. Chapter 2, *Geopolitics of Renewable Energy Game and Its Potential Impact upon Global Power Relations* by David Criekemans and chapter 3, *Redrawing the Geopolitical Map: International Relations and Renewable Energies* by Karen Smith Stegen, seem to allude to the fact that renewables have the potential to operate in smaller facilities in contrast to their conventional counterparts, fossil energy sources (Scholten & Bosman, 2018, p. 309-310). Criekemans (2018) also aims plenty of focus toward the technologizing of the energy sector, claiming that “the transition towards more renewable energy in countries and regions entails more than a mere change in the energy mix” (Criekemans, 2018, p. 42). This is what the author has chosen to label an *Energy Technology-Revolution*. Criekemans (2018) cites Daniel Deudney by using the term *geotechnical ensemble*. This term is used to explain that “the new technologies that are developed together with the geographical opportunities and limitations of certain geographical areas, will determine the new geopolitical context within which countries, regions and territories will be able to operate, create welfare and wellness, and develop a *power base* – literally but also figuratively” (Criekemans, 2018, p. 42). This means that the earlier states invest in developing the technologies and the related standards, the better positioning will they have to create a power base (p. 43).

Regarding ‘winners and losers’, the general hypothesis presented in chapter 3 states countries that are fossil fuel net-importers will be considered the winners and net-exporters have a higher likelihood of being the losers in a renewable energy future (Scholten & Bosman, 2018, p. 310). However, Smith Stegen (2018) concludes chapter 3 by stating that “in a renewable energy world, many states will be able to supply a far greater share of their own energy needs” (p. 92), referring to the abundance of renewable energy and how most states in the world have some form of renewable energy source, whether it be sun, wind, hydro or bio, that they can extract energy from. Due to the decentralized nature of renewables, and their abundance in nature, it is likely that most states, although mainly as importers of renewable energy, will have the possibility to produce some of their own energy.

The issue of rare earths is mentioned in relation to China, which has taken the lead in the clean-tech race, as they appear to have large reserves of rare earth elements (Scholten & Bosman, 2018, p. 310; Freeman, 2018, p. 191). The fourth expectation, the topic of electrification, is mentioned briefly in chapters 2 and 3, through the discussion of smart grid technology and HVDC power lines (Scholten & Bosman, 2018, p. 310).

#### **5.4.2. Part II**

Part II, which discusses the regional and bilateral energy relations of established rising powers, focuses on the first expectation, the shift away from oligopolistic markets to a more competitive market, and the third expectation, rare earths, and the clean tech race. The authors discuss the cases of present day (and upcoming) major economies, the US, China, Germany, and India. However, the dominating expectations discussed in this part of the book are concerned with the competitiveness of the energy market, and which one of these countries can gain momentum and/or maintain their current position as a global superpower.

In the case of the US, it appears to be lagging in the renewable energy transition, much due to damage the Trump Administrations inflicted by pulling out of the Paris Agreement, and their focus on national energy production (Sivaram & Saha, 2018). This does not mean, however, that they are losing geopolitical status, as they most likely will continue to have allies around the globe (Sivaram & Saha, 2018, p. 155). Regional relationships such as to its neighbours, Canada, and Mexico, could be strengthened through interconnected grid and increased cooperation (p. 156). On the other hand, as mentioned earlier in this section, it appears that China current appears to be in a leading position in the transition to renewables, as well as having a monopoly on rare earths, such as gallium, tellurium, indium, neodymium, and dysprosium, giving them the upper hand in the clean tech race (Scholten & Bosman, 2018, p.

310; Smith Stegen, 2018, p. 90). Based on this observation, many of authors seem to believe that China will be a force to be reckoned with and will be almost impossible to sidestep in a renewable energy clean technology future (Scholten & Bosman, 2018, p. 310).

Chapter 6, *The International Reverberations of Germany's Energiewende; Geoeconomics in the EU's Geo-Energy Space*, Sattich (2018) presents the case of Germany, and how their strategy to lower their carbon footprint, Energiewende, although ambitious and good natured, has created some tensions across borders, to its neighbouring countries, seeing as Germany made this decision without much consultation from these countries (Sattich, 2018, p. 163, 172). The intermittent nature of renewables plays part in these tensions as well, considering the unreliability of energy supply connected to this characteristic, causing economic reverberations across Europe (Scholten & Bosman, 2018, p. 310-311; Sattich, 2018, p. 173-174).

Concerning the third expectation on rare earth materials, it is conveyed through this part of the volume that China's strong position in the clean tech supply chain and their dominance on rare earths is perceived as a threat to the U.S. and their position in the renewables race (Scholten & Bosman, 2018, p. 311). Regarding electrification, it appears that in the cases of these countries, it seems that renewables will induce electrification and regionalization of the energy infrastructure, although electrification will increase the risk for cyber-attacks (p. 311).

It is also worth noting that in this part of the volume, there is some focus on the rhetoric of the states in question. Whilst India's motivations come from lowering their emissions and preventing climate change, China's government has expressed little interest in the climate action aspect of renewables, but rather focused on the economic and market-based aspects of the renewable energy transition.

### **5.4.3. Part III**

Whilst part I and II have been concerned with the geopolitics of renewables and energy relations on a global level, part III aims its focus toward infrastructure developments and governance responses. Chapters 9, 10 and 11 focus on challenges and conflicts of the renewable energy transition, visions of future renewable energy grids, and the case of the Pentalateral forum and its impact on the transition in Western Europe.

Chapter 9 and 11 highlight the importance of changing the energy systems from the ground and up, as the opinions of the local population play an important role in furthering the renewable energy transition. These changes can happen through microgrid or super-grid possibilities, and through spaces in which citizens can safely have dialogue with the local government. These

chapters also show how all these factors affect “local, regional, national, and continental communities, infrastructure operations, energy policy, and energy institutions” (Scholten & Bosman, 2018, p. 312).

Regarding the four expectations, the competitiveness is very briefly discussed in context to the energy market, but as a way to provide energy security at a local level, and chapter 11 highlights how the market liberalization in the EU has been essential in breaking up existing oligopolistic markets rather than implementing new renewables, but it is not mentioned much beyond this point (p. 312). Instead, this part of the volume aims its focus at the decentralization of the energy sector, and the new actors that may come to play due to this development. As mentioned previously, these actors range from everything between households, entrepreneurs, and intermediaries (Scholten & Bosman, 2018, p. 312). The Pentalateral Forum, consisting of Germany, France, Luxembourg, the Netherlands, Belgium, and Austria, was created as an alternative and sub-EU-level energy governance to “informally discuss energy issues, such as interconnections and standards” (p. 312) and as a way to deal with geopolitical frictions caused by the transition. This forum is an example of how interstate relations might work in the future of renewables (Handke, 2018, p. 279).

The third expectation, rare earths, is vacant in this section of the volume, as it seems irrelevant to discuss in context to local governance. Electrification, however, is discussed in chapters 9 and 10, with options for electrical heating and electrical vehicles being drivers (Scholten & Bosman, 2018, p. 312). Through interconnections, there is also “ample opportunity for mutual benefits with distributed smart systems with a centralized backbone as a promising venue” (p. 312). In all, it appears that the steps being taken to promote the transition within Europe are taken at a national level (Scholten & Bosman, 2018, p. 313).

To conclude, this book discusses the geopolitics of renewables, a rather novel field, by investigating the effect of renewables on states both on a national and global level, as well as discussing the potential winners and losers and the future of the energy market. This is done through pre-established expectations concerning the shift from an oligopolistic market to a more competitive one, the decentralization of the energy sector, the use of rare earth materials to build clean tech equipment, and the electrification of the energy sector. The authors state at several points throughout the book, that although some of the effects of renewables can be observed today, it is still only a fraction of the full picture. In context to the research question presented in this thesis, it is apparent that the effects of a renewable energy transition are many,



but they are uncertain as per the present. In the next section, a discussion and overview of these will be carried out.

## 6. Discussion

Throughout this thesis, I have established that the subject of renewable energy and geopolitics is a rather novel topic, that has gained popularity during the last two decades. I have observed an increase in interest from several disciplines through an increase in the quantity of quality literature published about the subject. One can therefore safely say this field is ever growing into a multidisciplinary field and will possibly gain more popularity with the impending threat of climate change.

The purpose of this thesis has been to establish the effects of a renewable energy transition on global power structures. To do this, it deemed itself practical to perform a literature review in order to gain perspective over what quality literature exists concerning the subject, through the usage of key-terms and synonyms to find said literature. Through this method, I decided to pick out four main pieces of literature, chosen with consideration for the answers the research question seeks. The pieces of literature chosen focus on a case, geopolitical risk, hypothetical scenarios, and observations based on the developments of renewable energy in the real world. The main arguments presented through these pieces of literature, are the following. *The geopolitics of renewables in Kazakhstan & Russia* by Koch and Tynkkynen (2021) present two countries with authoritarian ruling systems, one expressing their interest in developing a greener economy, and the other in the environment, but both with little initiative or resolve to promote a renewable energy transition within their own respective states. *The geopolitics of renewables; the political implications of renewable energy systems* by Scholten & Bosman (2016) presents a hypothetical picture of how a renewable energy transition would affect global power structure through socio-technical factors and presents through these, two hypothetical scenarios in an attempt to predict how society might look in a renewable future. *Does renewable energy redefine geopolitical risks* by Su et.al (2022) establishes a causal relationship between renewable energy and geopolitical risk, meaning that these share a relationship that can both benefit states, but also impact negatively. Scholten's (2018) book *The Geopolitics of Renewables* is a collection of contributions from different authors, divided into three parts that each discuss a set of four expectations, these being (a) shifts from oligopolistic markets to more competitive ones, (b) the decentralization of the energy sector, (c) rare earth materials and the importance of clean technology, and (d) the electrification of the energy sector. The book also

discusses how these expectations might affect inter-state relations, national and regional governance, and infrastructural development.

These pieces of literature all present important arguments in consideration to the research question: *how would a renewable energy transition affect global power structures?* In this section, I will be attempting to answer the research question by merging the main arguments of each work of literature, being how non-democratic states act in context to promoting renewable energy, the hypothetical picture vs. the expectations laid of by Scholten & Bosman (2016) and Scholten (2018), and the impacts of renewable energy on geopolitical risk.

### 6.1. Authoritarianism and the transition

During the last two decades, the urgency of promoting a renewable energy transition has been made clear through treaties, conferences and reports all discussing the imminent threat of climate change. It is, however, important to note that the promotion and development of renewable energy; whilst it is significant that it is expressed on a global level, often happens at a national and local level, and initiated by the politicians and/or representatives of the area. When speaking of politicians, it is of relevance to discuss rhetoric, and what is being said to promote and essentially ‘sell’ the idea of renewable energy to the national and/or local population.

Rhetoric is “language that’s carefully constructed to persuade, motivate, or inform the reader or listener about the speaker or writer’s position” (Kramer, 2022). Rhetoric is often used by politicians or people within public speaking, and it is meant to appeal to the targeted audiences’ feelings, intellect, and to strengthen the speaker or writer’s credibility. During elections in democratic states, politicians will often employ rhetoric in their speeches as a way to persuade the audience to see them as best fit to rule by appealing to their feelings and worldview. In democratic states, promoting the transition to renewables is encouraged from the bottom-up, as the changes implemented on a national level often end up affecting those on a local level, and it is therefore important to establish dialogues to minimize contempt toward low carbon initiatives. This also due to the decentralized and competitive nature of renewables, as stated previously in the thesis, energy providers can range from everything between a company, landowners, or individuals. However, this dimension largely focuses on democratic states, such as Germany, The Netherlands, Austria and so forth. Koch & Tynkkynen (2021) bring up the cases of Kazakhstan and Russia, two countries that do not fall under the category of being democratic states. China, one of the predicted future frontrunners of the renewable energy

transition, is also not considered to be a democratic state by Western standards, as it is “organized along unitary rather than federal principles” and “operates from the top down” (Dull, J.L et.al., 2023). Koch & Tynkkynen (2021) ask a question that is very defining for authoritarian states and the transition: who is promoting renewable energy in these states? (p. 523).

The answer to this question is ‘easy’, but not simple. The actors that would be promoting renewable energy in these states are the governments. An authoritarian government is defined as a state that “denotes any political system that concentrates power in the hands of a leader or a small elite that is not constitutionally responsible for the body of the people” (Britannica, 2022). Authoritarian states are, therefore, often operated from top-down governance, meaning all the decision-making is done by the party or individual sitting in a power position. These states do not have a channel in which the body of the people can exercise their freedom of speech.

In recent times, especially during the current climate change crisis, a shift happened in how energy companies portray and sell themselves to the public. An example is the Norwegian ‘Equinor’, which used to go by the name ‘Statoil. This company re-branded itself into a more sustainable light, meaning that, whilst they continue extracting fossil fuels, they are also investing in the development, implementation and production of renewable energy and renewable energy systems. One of the purposes of this re-branding is to maintain their legitimacy as an energy provider that is not bound by the restrictive nature of fossil fuels, and maintain legitimacy as an organization. This concept can also be applied to states regarding whether they take climate action through their policies. States need to maintain legitimacy in relation to the global narrative, and international organizations in order to continue trade and cooperation amongst themselves.

A way to maintain legitimacy in a global market that is increasingly becoming more and more environmentally conscious and shifting its focus toward sustainability, is to use rhetoric. The energy sectors in Kazakhstan and Russia are still dominated by fossil fuels, yet, according to Koch & Tynkkynen (2021), the governments have expressed the importance of lowering emissions. The language used by the respective actors, however, hardly focuses on renewable energy. The Kazakhstani government has, however, during EXPO-17, stated that they plan on moving their energy sector from 1% renewable energy to 50% renewable energy by 2050 (Koch & Tynkkynen, 2021, p. 525). During the same event, however, when asked concretely about cooperating with the UAE in the field of renewable energy source, the Kazakhstani president “offers a vague reply about the importance of ‘technology transfer and original expertise’” and

“the peaceful use of nuclear energy” (p. 531). Koch & Tynkkynen (2021) write that this reply might suggest that discussions about renewable energy are “convenient means of narrating a friendly and progressive relationship between Kazakhstan and the UAE” (p. 525). This can be interpreted as a way of using renewable energy as a rhetorical tool to entice investors, maintain relations with other countries, and create a public, and international image of a state that is moving toward a greener economy, as well as become a part of the global narrative, yet the efforts are often diffuse, short-lived, small-scale, and flashy” (Koch & Tynkkynen, 2021, p. 522).

In the case of Russia, the use of the word ‘sustainability’ is not popular, and they have opted for using the term ‘environment’. Koch & Tynkkynen (2021) comment on the issue connected to this concept in Russia, concretely the communal aspect of giving a voice to the local communities (p. 525). This is a liberal and democratic ideal, two of which are “at odds with the authoritarian power structure”. Here, the narrative focuses on the *environment* and *pollution* (Koch & Tynkkynen, 2021, p. 526). In the case of both Kazakhstan and Russia, the language used in regard to renewable energy has a specific purpose, this purpose being to align themselves with the current narrative about promoting renewable energy and transforming their economies into ‘green economies’, yet essentially one may go as far as calling these initiatives attempts to ‘greenwash’ their images in order to appear more “modern and investment-friendly” (Koch & Tynkkynen, 2021, p. 527).

The case of China brought up by Freeman (2018) is somewhat different, and this is because China is an important actor in the global geopolitics of renewable energy with an abundance of renewable energy sources (Duncan, 2018, p. 187). As of present times, it appears that China is taking the lead in the transition toward renewable energy and might be one of the global key players in the future. However, the main motivation behind the deployment of renewable energy in China is not so much focused on geopolitics, but rather “the technologies, industrial processes, markets, trade and investment that enable this to occur” (p. 189). In other words, China prioritises economics over geopolitics, seeing as China historically has not aimed focus onto geopolitics, neither in academics nor official discussions (Duncan, 2018, p. 188). In the fossil fuel arena, China has mainly been an importer of energy, creating dependencies to other states, but when it comes to renewable energy and rare earth materials, China stands in a relatively strong strategic position.

From the beginning, China has stated that one of their main reasons of exploiting renewables is to mitigate climate change, as well as admitting the positive impact this deployment would have

on the economy and local environment (Duncan, 2018, p. 193). As mentioned briefly, China's geopolitical dimension when it comes to energy is still largely absent, aside from briefly touching upon global cooperation and the international dimension of the transition, geopolitics is left out of the conversation (p. 194). The fundamentals of renewables in China are industry policy and economic development, thus "the global distribution of renewable energy resources is less important than the development and control of technology, production and markets" (Duncan, 2018, p. 194). Based on these facts, it is safe to assume that China will have a geopolitical upper hand, regardless of whether they discuss or apply this dimension publicly.

In this section we have discussed how authoritarian states with top-bottom governance approaches to the geopolitics of renewables by focusing on three authoritarian states: Kazakhstan, Russia and China. Currently, maintaining legitimacy in the international picture is essential for the states' future prospects for trade and investments. In an age where the consequences of climate change are threatening the environment as it is known today, this legitimacy is obtained through the implementation of green policies, green growth, lowering CO<sub>2</sub> emissions and promotion of sustainability globally. One can observe that in countries such as Kazakhstan and Russia, language is used carefully, as the concept of sustainability is liberal in nature, which strides against the values of the respective governments. They use words such as *environment* and *pollution* and initiate renewable energy projects that, whilst flashy, are small-scale and show little promise. In China, however, whilst they embrace the climate change narrative, their priorities are to empower the countries economical and industrial sector, with global deployment and promotion of renewable energy appearing to be an afterthought. Koch and Tynkkynen (2021) write that whilst it is observable that the attempts toward implementing renewable energy systems often fall short, they are real nonetheless (Koch & Tynkkynen, 2021, p. 522). The prediction I choose to make based on this, is that many countries with authoritarian governing styles might mobilize their energy sectors toward using more green and clean sources, but it will be under the pretence of *business as usual* and not to entice social awareness or mitigate climate change, but to develop their markets and attempt to gain a geopolitical upper hand. Renewable energy would, in this instance, perhaps create relations between countries with similar motivations of *business as usual*.

## 6.2. Thought experiment & expectations

The research question at hand; *how would a renewable energy transition affect global power structures*, does not have a simple answer. There is, namely, an entire field dedicated to answering such a question. The purpose of the literature search was to find literature that would provide an answer or several answers to this question, to which I found several pieces of literature focusing on the different aspects of and effects of a renewable energy transition. From all the literature, two of the works that stood out were Scholten & Bosman (2016) and Scholten (2018). These stood out because they succeed in presenting which impacts a renewable energy future could bring. Scholten & Bosman (2016) focus mostly on the thought experiment, and Scholten (2018), a book with contributions from several authors and academics, dives into aspects such as economics, infrastructure, governance, technology and so forth. The nature of these works is multidisciplinary, and although this thesis seeks to find the answer to one aspect, namely, global power structures, it is important to understand that to affect these structures, other factors come at play, such as international relations, regional governance, economic developments, trade, and the energy market, as well as technological developments and innovation. These works, however, state early on that the findings discussed are, in Scholten & Bosman (2016), *hypothetical* and in Scholten (2018) they are based on *expectations*. In this section, the hypotheticals written by Scholten & Bosman (2016) and the expectations by Scholten (2018) are discussed in context to each other, as a way to create a collected picture from the thought experiment, and the expectations based on observations from different countries with a more multidisciplinary approach. By the end of this section, I aim to provide an answer for which scenario proposed by Scholten & Bosman (2016) appears more likely based on the different observations. These scenarios are the continental scenario and the national scenario.

As explained in the summaries, Scholten and Bosman (2016) base their hypothetical thought experiment upon three steps, these being (a) the geo-infrastructure ensemble; characterized by an abundance in renewables, intermittency, decentralization of the energy sector, dependence on rare earth materials and electricity-based energy sector, (b) energy market structure; characterized by the changes in power structures caused by the market such as rising number of producers, consumer vs. prosumer countries, grid-sizes, make or buy decisions and change in transportation, and lastly, (c) strategic considerations, these being the (i) the continental scenario; characterized by collaboration between countries with optimal weather conditions and the formation of grid communities, and the possible power struggles over grid-ownerships, and

(ii) the national scenario; characterized by prosumer nations or communities that are self-sufficient, meaning they produce most of their own energy (Scholten & Bosman, 2016, p. 277-280). It is important to note, that this article bases its arguments on a thought experiment that places renewable energy as the main energy source, whilst maintaining other factors equal.

In Scholten (2018), one is presented with some real-world dynamics of countries that currently dominate the energy market, most of these being fossil fuel net-exporters. This book therefore considers how fossil fuels affect the development and deployment of renewable energy, as these are still the energy sources that dominate the energy sector. The four expectations presented in this book are (1) a shift from oligopolistic markets to more competitive market, (2) a shift from centralized energy sector to a more decentralized energy sector, (3) rare earth materials gain importance in the clean tech race, and (4) renewable energy is best converted to electricity, meaning an electricity-based energy system is likely to arise in the future (Scholten, 2018, p. 19-23). At first glance, one can pick out the similarities between the three steps presented by Scholten & Bosman (2016) and Scholten (2018). It is important to take into consideration that the expectations presented in *The Geopolitics of Renewables* (2018) take inspiration from the thought experiment conducted by Scholten and Bosman (2016), which explains the similarities.

Although there are similarities between these, one can still ask: what picture do these similarities paint? The geo-infrastructure ensemble shares the same characteristics as expectations (2), (3) and (4), painting a picture of a decentralized energy sector dominated by electricity as a carrier for energy, and an infrastructure sector that is dependent on rare earth materials to develop renewable energy technology. The energy market structure focuses on the shift from centralized energy to decentralized energy as well as the first expectation, being the shift toward a more competitive market. These are characterized by Scholten (2018) as trends we might see in a renewable energy future, but how would these affect global power structures?

As mentioned earlier, in order to determine what will affect global power structures, one has to examine a sequence of different factors and trend, many of which fall within a socio-geographical or technical category such as economy, governance, international relations and technological advancements in the energy sector. It has been made clear that when it comes to geopolitics, energy plays an important role in controlling the market. Historically, if a state has had access to large fossil fuel reserves, they would be considered important (political) players in the international energy market. Scholten (2018) takes into account this fact, that present day key-players in the energy market got to where they are because of these large reserves. If one takes this observation, and applies the steps of thought experiment, one can conclude that the

states with optimal weather conditions, giving them an abundance of renewable energy sources, could obtain the same position in the international energy market as the state with large fossil fuel reserves. This is what Smith-Stegen (2018) refers to as “geopolitical winners”; “those states with high potential for generating renewable energy combined with a high degree of socio-political support and a weak or non-existent hydrocarbon lobby” (Smith-Stegen, 2018, p. 80). Smith-Stegen (2018) also highlights that, due to the decentralized nature of renewables, states that achieve self-sufficiency in supplying their own energy, might be considered the ‘winners’ of the renewable energy transition, and one could base on this observation assume that these states would have a higher chance of attaining the geopolitical upper hand in the future (p. 85). Based on Smith-Stegen’s (2018) research, the ‘winners’ could turn out to be smaller states, but there is doubt surrounding whether they’d gain much in terms of playing an important role in a global stage in a renewable energy future.

The energy market structure proposed by Scholten & Bosman (2016) focuses on the factors discussed above, but it also focuses on how the economy, and the market will be affected by a more decentralized energy sector in which anyone that owns land can become an energy producer. The decentralization of the energy sector can bring about new modernized business models that adapt to the reformed sector, and the same goes for the distribution of this energy. It has previously been stated through expectation (4) that renewable energy translates best into electricity, resulting in a future energy system mainly driven by electricity. This is a big change from present day’s conventional energy system. Today’s grid systems are built to expand across continents, as the energy produced by fossil fuels can travel over long distances without much content being lost, due to the fact that they are transported as raw materials in liquid, solid or gaseous states. The nature of renewable energies such as solar, wind and hydro are that they cannot be transported in the same manner, as electricity is the main energy carrier (Scholten, 2018, p. 22).

The shift to an electrified energy sector will result in changes within the infrastructure that is used to transport energy sources. As previously touched upon, such a shift is likely to decentralize the energy sector, and states will be met with a make-or-buy decision, and whether they want more centrally produced energy or decentralize the sector into smaller grids (Scholten & Bosman, 2016, p. 277). The sizes of these grids will not only control the market, but they will also in turn determine the relationships between the consumer, producer, and/or transit countries. These trends align with the energy market structure proposed by Scholten & Bosman (2016) and expectations (2) and (4) presented by Scholten (2018).



Based on these trends, which scenario appears to be the more likely to manifest in the future? The Continental scenario bases itself on the idea of a future of collaboration between states with optimal weather conditions to produce renewable energy. These states could, as a result, form grid communities that would connect producer, transit, and consumer countries alike. This also has its possible set of tensions, such as power struggles over grid-ownerships and vulnerability of sabotage and cyber-attacks from states connected to the grid (Scholten & Bosman, 2016, p. 280). The National scenario, however, is based on the idea of states becoming prosumers, meaning they produce and satisfy most of their own energy needs, making them self-sufficient.

Scholten & Bosman (2016) conclude in their article that the most probable answer would be a mix of both scenarios. To determine which of these scenarios could be more likely, one could predict that perhaps a scenario similar to that of conventional energy is the more likely outcome. In the previous section, in which I discussed the importance of rhetoric in context to maintaining a legitimate image in the global picture, it could be safe to assume that much of the future global power structures will function under similar *business as usual* pretences as we see today. Although there might be a high probability of countries becoming prosumers and self-sufficient, it is doubtful that they will remain something ‘other’ or independent in the geopolitical picture, simply because of the political benefits that result from trade, and not from the necessity of trade. I believe, based on the observations made by the contributions in Scholten (2018) and the thought experiment performed by Scholten & Bosman (2016), that there is a high likelihood the future of global power structures will remain to be one of collaboration between states, but with new inter-state relations based on regions rather than cross-continental relations, alas a more decentralized global picture with regional grid communities. An example is brought forward in Scholten (2018) in chapter 11 by Handke (2018), *Renewables and the Core of the Energy Union: How the Pentalateral Forum Facilitates the Energy Transition in Western Europe*, in which one is introduced to the *Pentalateral Forum*, created by seven European countries, these being Belgium, the Netherlands, Luxembourg, France, Germany, Austria and Switzerland. “This forum is an example of how inter-state energy relations are transformed by the low-carbon energy transition” (Handke, 2018, p. 279). We might also experience a shift from focusing on relations with overseas states to nourish and create stronger relations and better trade in states based in the same continent, such as relations between the U.S., Canada and Mexico (Sivaram & Saha, 2018, p. 143). This might result in global power relations that are interconnected on a continental basis. I would therefore, like to conclude this section by stating based on this analysis, whilst there will be prosumer states in the future, these will

however not change the desire for trade and interconnection between nations, creating a Communal Scenario, in which states form communities either regionally, continentally or locally.

### 6.3. Geopolitical tensions and global power structures

Lastly, a point that is important to discuss is the potential of geopolitical risks in a renewable energy future, and whether these would affect global power structures. Su et.al. (2022) established a causal link to geopolitical risk and renewable energy, concluding that although looking at a full sample of trends of geopolitical risk and renewable energy show no causality, looking at individual events (sub-samples) paints a different picture, one where geopolitical risk plays an important role in the development of renewable energy, creating means for collaboration, but also “nodes for rivalry” (Su et.al., 2022, p. 6). Interdependencies create room for collaboration, but these may as well create energy security threats. In this section, I will discuss some examples of these presented by the summarized literature, as well concluding with whether geopolitical risks can be predicted to be lessened or magnified in the future.

Caldara & Iacovello (2018) define geopolitical risk as “the risk associated with wars, terrorist acts, and tensions between states that affect the normal and peaceful course of international relations”. In accordance with this definition, possible geopolitical risks would be disruption of electricity flow to other countries, cyber attacks or any threats to the corresponding states energy security in a renewable energy future.

In the previous section, grid communities were briefly mentioned as part of the more likely outcome in a renewable energy future, in which producer, transit and consumer countries would be interconnected through cross-border High-Voltage Direct Current (HVDC) transmission lines. However, it is crucial to be aware of the fact that, although grid communities are based on collaboration and trade relationships, cross-border transmission lines still run the risk of being disrupted and manipulated. Smith-Stegen (2018) explains how this can happen by the hand of at least two actors: supplier states (producers) and/or transit states (Smith-Stegen, 2018, p. 88). Furthermore, it is stated that this would happen if the supplier state interrupted the electricity flow as a way to exert pressure upon consumer states, or if a transit state manipulates supplies to pressure their state of choice, perhaps as political leverage (p. 88).

Scholten & Bosman (2016) state that the larger the interconnections of a grid are, the more vulnerable the grid becomes to disruptions (p. 278). Reusswig et.al. (2018) makes light of China and their ambitious Global Grid Vision (Reusswig et. al., 2018, p. 248). A grid of this magnitude

is seen as a technological possibility by the Chinese government, and they believe this plan “will help mitigate climate change, [to] create millions of jobs and to bring peace to the world by 2050” (p. 249). This grid is viewed to be a real possibility in the future through technological advancements, as well as through cross-border inter-state collaborations to make it happen, yet the question of geopolitical tensions still stands. Although the chance that geopolitical tensions might lessen in an interconnected world, it is highly likely these will only shift from overseas to more regional geopolitical tensions (Scholten, 2018, p. 24). A global grid would re-define energy security as we know it and would probably be based upon mutual trusting relationships and higher levels of national security (Reusswig et.al., 2018, p. 2018).

Smith-Stegen (2018) proposed two ways in which states could mitigate the risks of manipulation. “First, they could negotiate that the HVDC lines are designed to be constantly ‘on’. This would mitigate against manipulation, but would not, of course, mitigate against destruction of the line. Second, the importer could negotiate that its electricity supply is connected to the exporter’s grid, if technically feasible” (Smith-Stegen, 2018, p. 89). There is, however, little historical data of such manipulations, and the existing ones have been connected to Russia. One can perhaps interpret this as meaning that these tensions might not pose too much of a threat in the future of renewable energy. It is, however, important to take into consideration that it could be likely that interconnected grids may form around great powers, who these great powers will be is for time to tell. Nevertheless, states are unlikely to enter interconnected grids with their ‘rivals’, and perhaps based on this observation alone, it might be possible to maintain a history in which interconnected states are less likely to sabotage each other.

To conclude, one cannot with certainty say that renewable energy will lessen geopolitical tensions, but rather shift their focus. A likely scenario is that rivalries will shift in unison with the global power structure, rather than global power structures being affected by these rivalries, although the opposite could happen as well. Nonetheless, present day rivalries might affect future global power structures, as mentioned previously, states are less likely to form interdependencies with rival states (Scholten, 2018, p. 24). One can also draw lines to the previous topics, such as *business as usual*, and how states could attempt to sabotage others for political gain, but there is yet to be a significant amount of observations registered for this to even become a likely outcome of renewables. Tensions could also arise in the rare earth clean tech race, but these appear to be evenly dispersed around the globe, making it unlikely that these tensions become any graver than those in the conventional energy present. The common

consensus appears to be that renewable energy systems and interconnected grids are more likely to bring about collaboration between new actors rather than an increase in geopolitical risks.

## 7. Conclusion

Throughout this thesis, I have explored the different implications of a renewable energy transition. The thesis was introduced by presenting the research question, the importance of this topic, and why it should be more widely available to the public. It was briefly mentioned that although we as individuals can aid in mitigating climate change, but at the end of the day, this mitigation lays at the hands of international leaders and policymakers. The condition of the world and the climate has only continued to worsen, an example presented being the floods in Pakistan, taking 1739 lives as of November 2022, and affecting around 33 million people. Implementing change is no longer a matter of opinion, as we are now seeing the consequences of not taking action when these catastrophes were preventable. A transition in the energy sector, is undoubtedly needed in order to lower carbon dioxide emissions globally, something that will affect the geopolitical map, causing a shift in power. Therefore, in this thesis, I have asked the question *how would a renewable energy transition affect global power structures?*

I have chosen to make this thesis twofold. In the first part of the thesis, a systematic mapping review is conducted in order to create an overview of the relevant, peer-reviewed literature within this field of study. A search was conducted, in which aspects of the literature such as publishing year, genre, peer-review and discipline were documented. Documenting these factors has aided in creating a picture of the field of the geopolitics of renewables as a rather novel field, gaining popularity around the period of the first decade shift, the early 2000's, and with most works published within the last five years. Another important and interesting discovery is the multidisciplinary nature of the field, with contributions from social sciences and natural sciences. It has become well known in the last years that to mitigate climate change, changes in society and in the technical sector will have to happen to create a smooth and safe transition to renewables.

One of the main purposes of creating an overview of the relevant literature within the field was to find 4 pieces of literature that could be considered representative in context to the subject at hand, as well as the field itself. The literature was chosen through a few inclusion criteria, this being the number of citations, novelty and scope. *The Geopolitics of Renewables in Kazakhstan and Russia* (2021) touched upon the novelty of the field, and contributed with their article that sustainable development is considered a liberal concept, and in authoritarian states such as

Kazakhstan and Russia, their attempts to maintain legitimacy within the global narrative are part of business as usual, and often happen through short-lived but flashy methods. Koch & Tynkkynen (2021) write that most liberal countries are being forced to coexist with ‘illiberal’ states, but all of them face the same amount of calls for environmental intervention (p. 523). This article highlights the importance of language and how it’s used in illiberal, authoritarian states to, in the case of Kazakhstan, attract investors and appease their relationships with other countries. In the case of Russia, sustainability is generally seen frowned upon, as it focuses on the community and the people, so they stick to the word ‘environment’ and aim to reduce their emissions through natural gas and nuclear rather than to implement renewable energy. *The geopolitics of renewables; exploring the political implications of renewable energy systems* (2016) presents two scenarios, the continental scenario, and the national scenario, in which one materializes a future where states with optimal weather conditions will enter what Scholten & Bosman (2016) refer to as *grid communities*. The national scenario, however, proposes a future in which most states will be prosumers, meaning they will likely be able to provide and satisfy their own energy needs. *Does renewable energy redefine geopolitical risks* (2022) proposes the conclusion that renewable energy and geopolitical risk share a mutual relationship in which one affects the other. They conclude by stating that renewable energy would increase interdependency amongst states, which in turn would decrease the geopolitical risks associated with conventional energy. Lastly, I chose a book that I judged to be representative of the field of geopolitics of renewables, *The Geopolitics of Renewables* (2018) by Scholten. This book consists of contributions from other academics and their research on the geopolitics of renewables. It is divided into three parts, which focus on the winners and losers of the emerging global energy game, regional and bilateral energy relations between rising powers, and infrastructure developments and governance. This book bases its research on four expectations for the renewable energy transition, these being (1) a shift from oligopolistic markets, (2) the decentralization of the energy sector, (3) rare earths gaining importance in the clean tech energy race, and (4) the electrification of the energy sector.

All these works of literature provide part of the answer to a bigger puzzle that is yet to be solved. It has been important to establish that this field of research is rather novel, and therefore certain factors of the transition can only be speculated. The research question poses a statement with a similar nature, none of the literatures provided a fire-sure answer to what *exactly* would happen to the global power structures if a transition towards renewable energy took place. The literatures did, however, paint a picture of a possible future.

Earlier in the thesis, I have punctuated that for global power structures to experience any kind of shift, many factors within society would have to change first, and this is what the literature has focused on. In the discussion, I present how Scholten (2018), and Scholten & Bosman (2016) elaborate on some societal changes, focusing on the market, decentralization, rare earth materials and electrification. It is presented through this research that the more likely future appears to be one in which countries form grid communities around the great power's neighbourhoods, and although some countries might become self-sufficient and become independent, these might still become part of grid communities, not out of necessity, but due to the benefits of cross-border trade and international relationships. Through Koch & Tynkkynen (2021) we can observe that although illiberal states seem to prefer to stick to *business as usual*, their green initiatives, although small, are still initiatives and cannot be ignored. These are also connected to maintaining interstate relations. One may predict that in the future, these initiatives might become bigger realities as major states transition to renewables, further fortifying the current green global narrative.

When it comes to rising powers, Scholten (2018) identifies four countries that will continue to rule the international stage, and some that may take the place of current leaders. These countries are China, the U.S., Germany, and India. These are some of the biggest economies in the world today. China was briefly discussed in context to the case of Kazakhstan and Russia and is one of the countries that has taken leaps to make the renewable energy transition happen domestically. They also have an abundance of rare earths, which will make it difficult for other countries to evade China in a renewable energy future, as they are necessary for developing renewable energy technology. Germany has *Energiewende*, and although there have been some controversies surrounding it, one could imagine it being part of the European grid, together with the North Sea Offshore Grid. The U.S., Canada and Mexico could have the North American Grid. India is an up-and-coming power, prioritising a renewable energy transition as a way to mitigate climate change and green their fast-growing economy. The U.S. might be left in the dust, or it might catch back up in the renewable energy race, it all depends on who's in charge. Under Trump, the U.S. took several steps back in mitigating climate change, one of these steps being signing the U.S. out of the Paris Agreement in 2018, and the decision to focus on domestic energy production.

These four countries are the cases that Scholten (2018) focuses on. In chapter 3, however, Smith-Stegen (2018) shifts focus onto states that have potential regarding the weather conditions. This paints a more fragmented picture, one in which smaller states that have not had

much of a position in the geopolitical map under a conventional energy rule, appear to have something to bargain with in the future. With the decentralized nature of the renewable energy sector, a future with many small producing states is likely possible.

So, how would a renewable energy transition affect global power structures? The answer is multifaceted. One may consider Scholten's (2018) expectations as a way to lead us to an answer. In a world in which the market is more competitive due to the increase in producers, one could say that the power would lie with those who can generate and create the most dependencies to themselves. In a competitive market, the winners would be those who can produce their own energy and export it, and the losers would be those who cannot cover their own energy needs and become dependent on imports from other countries. This could create a picture in which the power and markets belong to several smaller states, instead of the current global picture created by conventional energy in which a few big states control the market. Smith-Stegen (2018) points out that whether a state has a strong or weak hydrocarbon lobby is another aspect that factors into who will 'take the stage' in a renewable energy future.

A decentralized and electrified energy sector would indicate as Scholten & Bosman (2016) present it, a Continental Scenario. Countries with high potential for generating renewable energy would come together and form grid communities, likely surrounding the 'main' energy exporter. Conflicts in these communities would be linked to energy security and preventing manipulation by exporting states and transit states, yet according to Smith-Stegen (2018), these geopolitical risks can be avoided by building a grid that affects everyone equally, yet these risks are judged by several authors to be highly unlikely. This would in turn, increase interdependence between states. Since electricity does not translate well across large distances, these grid communities would have to be tight, hence the name, continental. Global power structures would, in such a scenario, still be quite centralized, but simultaneously more dispersed. Markets might become more decentralized globally, as they are centred in the region the grid resides at.

In consideration to rare earths, it is likely that regardless of each scenario, much of the market and technology regarding renewables will circle around China. As mentioned by Freeman (2018), China has strategically large rare earth reserves, something that will likely make them hard to avoid for states that are lacking in materials. One may say that China will become an important player in the renewable energy future, as they have in many ways taken the lead in terms of furthering the renewable energy transition within their borders.

Global power structures will in the future perhaps be rather fragmented, *communal*, if you will. A world in which countries form grid communities and become inter-connected, a great power might be the owner of this grid, meaning each community might have their own great super-power. A world with self-sufficient states will be even more fragmented, yet as stated by Scholten & Bosman (2016), they will reap the benefits of trade, not as a necessity, but as a way to cultivate relationships to their neighbours. In a renewable energy world, one may see relationships between countries form not out of necessity or dependence, but rather due to the benefits of trade and good relations across borders.



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