

Bachelor circle: Making the Future Sustainable? The global governance of energy transition.

Supervised by

Prof. Dr. René Torenvlied

and

Prof. Dr. Ringo Ossewaarde

at the

Utwente Enschede

Bachelor thesis:

How did the discourses on the use and governance of geoengineering develop over the last two decades? What are potential benefits, dangers and uncertainties of the technology towards a sustainable energy transition?

Written by

Niklas Bexten

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1. Summary:

The aim of this thesis is to provide a systematic review on the implicit discourses perceived by scholars on geoengineering as an amplification station for the public perception of information processing, and ultimately its political governance. These amplification processes happen in-and outside of academic spheres, which shape those around them. Different opinions on the applicability of these kind of technologies in the context of a sustainable energy transition are going to be examined. The focus will be simultaneously on the dialectic between possible pros and cons in the use of geoengineering and their implicit connections towards their application in the context of energy transitions from an academic point of view. The discourse is derived from a selection of geoengineering discourse related articles derived from different fields of science. The possible implementation through, e.g. policy instruments for a sustainable energy transition is going to be discussed. A simple description of what can be found within the literature regarding to the existence of a dialectic between geoengineering proponents and opponents will be described. For better understanding of the potential gains and losses connected to geoengineering, some examples from the literature will be given, and later set in context to a sustainable energy transition and their

potentialities. A case for and against the use of geoengineering on a global scale with democratic institutions will be made in conjunction with a lookout on what future research could implement from these discourses presented and what factors perhaps may be dismissed or emphasized in future research.

1.1 Introduction:

The term Geoengineering (GE) or Climate Engineering (CE) is a rather new concept that has caught the attention from many different fields of science, such as political, social and psychological sciences. These concepts are commonly used to describe the technological, thus human, intervention in the anthropogenic generated climate change (Sikka, 2012, Keith, 1992, Macnaghten & Szerszynski, 2013...). In this paper, GE and CE are to be used interchangeably. Yet, the concept behind these terms reaches far beyond the mere intervention itself. As Keith (1992) pointed out in his paper “A serious look at Geoengineering”, there are three different main categories of human approach towards climate change: 1. Abatement of human impact by reducing the climate forcing. 2. adaptation to reduce the impact of altered climate on human systems and 3. deliberate intervention in the climate system to change the effect of anthropogenic forcing. Although GE aims towards mostly the third point, within this paper all three versions are implicit to the discourse and thus used as one measurement of the concept behind Geoengineering. Further theoretical assumptions on what GE entails will be given and explained in the theory section. The discourse around Geoengineering is from a scientific point of view a relatively young one (Macnaghten & Szerszynski, 2013) in the sense of anthropogenic large-scale interventions impacting not only local regions, but possibly on a global scale (Talberg, 2018). Nonetheless, the wish of humans for altering weather conditions is probably as old as human spirituality. Even the earliest documented civilizations tried to call for good weather by sacrificing whatever they deemed adequate to the gods, spirits, or whatever they found to be relevant (Powys Whyte, 2018). Success of these attempts are debatable, nevertheless these attempts are well documented (Freidel, Schele & Parker, 1993). With the technological changes and overall progress made in the last few centuries, especially after the industrialization, the human desire to control his or her environment was considerably more realistic in its efforts than ever before. It still is becoming more realistic with each new progress made in every scientific field connected to technological progresses. The sheer amount of information available, publicly as well as confidential, makes a proper assessment of what is possible and what is not a task at hand, which turns out to not easily being processed by an individual. Separating facts from fiction is not easy (Macnaghten & Szerszynski, 2013) when talking about exciting particles within the ionosphere to alter their environment (Eastlund, 1987, 2007). Within this paper the desire to cut down information regarding GE, its potential pitfalls, as well as its potential benefits are expressed in analysing different discourse analyses made by different scholars throughout the years. These have put a different focus on differing aspects and methods, yet all of them are in the context of geoengineering and its potential outcomes for humankind. Majority of positions happen to cover the full spectrum of a for and against, whilst some scientists seem to assume a strictly oppositionary role and others seem to be purely proponent. The non-existent consensus and the vast differences

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throughout the methods for GE, present a considerable issue for a proper selection of what is necessary to know, and what is not. With this thesis the goal of having a concise and proper dialectic of these discourse analysis is connected to the research questions:

- 1: What happened within the discourse on Geoengineering in terms of benefits and dangers?
- 2: Did the uncertainties of the past evaporate or increase?
- 3: Further, the pros and cons of GE might differ in perceptuality of scientific fields and their respective scholars. Is this visible, or even true?
- 4: Is the public aware of the possibilities connected to GE and its technological issues? Is this being analysed within the discourses?
- 5: Interlocking into the sustainable energy transition, the question of potential benefits and dangers will be argued in a critical analytical approach, according to the literature presented. Does science in general merits argue for or against it?

What seems to be missing throughout the discourses is a general applicability for a sustainable energy transition, since the main focus of GE is based on the three aspects mentioned above, instead of a symbiotic aim towards a sustainable use of such technological capacities (Keith, 1992). Analysis will show if there is indeed a lack of applicability, neglect or exaggeration of GE's importance towards that energy transition on a perceptual level, as well as on a consensual one.

1.2 Background:

The introduction should have shown that the topic of GE is to this day a hotly debated one, not only because of its infancy (Macnaghten & Szerszynski, 2013). Despite the rich body of literature, or maybe because of the it, in the world of academia there seems to be little consensus on which argument is outweighing the other. Whether it be the benefits or dangers to the large-scale implementation of GE. Uncertainties probably are to this day the strongest tone within the debate. Notably, most scholars refer to risks, because they perceive the dangers to be somewhat calculable (McGrail, 2013). In this thesis based on the analysis, one would argue against that, since the numbers are often being chosen only, at least hypothetically, based on physical reality and its agreed upon standards of physical laws and empirical evidences. Whilst some would agree, that the risks may not be as controllable as most proponents might try to convey (Macnaghten & Szerszynski, 2013). Especially, when deploying technologies like Solar Radiation Management (SRM) and Carbon-dioxide removal through oceanic storage. Macnaghten and his colleague (2013) for example refer to Ulrich Beck and his "risk society" (1992). In such a society, everything seems to be calculable and certain risks are being taken for a potentially greater gain. What could be problematic is that definite assumptions can only be made when deploying those techniques in a trial and error scheme by following epistemological patterns, which eventually produce empirical evidence and scientific objectivity. Irreversible effects make this approach rather problematic, since any fatal error could result in the literal end of the world we know to this

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day. In a chaotic system like the climate dynamics pre-emptive calculations seem rather impossible to foresee their affective behaviour towards long term environmental changes.

Potentially harmless technologies can, like the Butterfly effect, have devastating effects in the long run on not only local, but also global weather and climate dynamics (Powys Whyte, 2018). Arguably most of the scientists are indeed aware of those possibilities (Sikka, 2012, 2018, Keith, 1992, McGrail, 2013, Caillol, Liu, Ming & Richter, 2014, ...). What would be interesting to know is if the academics, perhaps, exaggerate or downplay these potential effects with aims to provide their individual position in the discourse. Societies around the world will be affected by the GE technologies without even coming in direct contact with them (Frumhoff & Stevens, 2018). Most of the time the poorest of the poorest will be affected the most, without having the monetary backup they would need to mitigate or adapt (Powys Whyte, 2018). Richer countries will be able to adapt their economies, local hotspots for disasters, and provide general prevention methods for such disasters. This could result in a reversed "free rider" problem, which in this thesis will be called "free-driver" problem (Weitzman cited by Harding & Moreno-Cruz, 2016). By disseminating information and dissecting that information, the academic community shares the responsibility to prevent false information spreading and providing the public with information about risks, dangers, but also benefits of advanced sets of technologies like GE.

The Paris treaty, Intergovernmental Panel on Climate Change (IPCC), with other global and local institutions. Their treaties are manifestations of the human wish to preserve the earth for future generations in a communitarian effort. Although, it seems that the desire for preservation is countered by the wish for growth. The German government for example had some of the highest aims in reducing the CO² depletion (Umweltbundesamt). However, the goals were not obtained yet, and are highly unlikely to be fulfilled (Tagesspiegel). Economic growth seems to prevail in the short run as the main priority of governments and their protected economies. GE may act as a supportive technique in maintaining growth, whilst simultaneously promoting the mitigation of anthropogenic climate changes (Keith, 1992, Sikka, 2018). Uncertainties about GE and its implementation are still prevalent in sciences and societies. Academia's purpose of hunting for the objective truth will be the most important instrument for governments, in their need for assessing the techniques and their possible gain for a sustainable energy transition, without losing eyesight to the potential drawbacks connected to the use of such technologies. Therefore, this thesis is trying to condense the literature and their content via a systematic literature review and its interpretation for the possible transcendence towards a sustainable energy transition.

1.3 Structure of the thesis

At first the introduction was given, and the status quo somewhat described. In the following, the background of the scientific need for further analysis of the discourse analyses was given. In the second part, the theory revolving around the discourse analyses and GE will be introduced. For this thesis specifically important aspects of it will be described. Main focus here will be the different approaches of the literature and their commonalities as well as their disparities for their respective theoretical assumptions. In the third part the literature and

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its selection as well as the research design for this thesis will be explained. After the examination of literature selection, the analysis of data will be done in the fourth part. In the conclusion and recommendation for further research, the approaches and different positions will be compared in connection to the sustainable energy transition efforts. This will be done in accordance with the current debates about energy transitions and GE as a supporting approach for countering the anthropogenic climate change, whilst simultaneously protecting not only the environment, but also the economy. Future research could focus more on prevention, than mitigation, since, as will be shown by some scholars, the detrimental effects of Greenhouse Gases (GG) and other effects, such as ocean acidification (Keith & Moreno-Cruz, 2013) can't be completely stopped by GE without risking the potentially negative side effects, that sometimes appear to be beyond calculable measurements

2. Theory section:

2.1 Discourse analysis

Since the primary goal of the thesis is a systematic review of several discourse analyses, the need for an abstract concept like discourse needs to be explained before it can be analysed. According to Foucault (1971) discourse can somewhat be described as “when it is manifested materially, as a written or spoken object; but also, uncertainty faced with a transitory existence, destined for oblivion.” What he means is the fear of failure being transposed from one individual or group onto another, and thus, evaluated within an argument between two or more people, which is manifested in a conversation, whether verbally or written. Furthermore, Foucault stressed the importance of power relationships within the discourse and their embodiment within contextual language. This exact anxiety towards failure and its transposition can be applied to GE in the sense, that it is highly probable that a large-scale intervention in the likes of Solar Radiation Management (SRM) or Sulphate Aerosol Injections could have serious side-effects when implemented. Also, that these effects may be irreversible. Discourse is theorization of problems, issues and sources of human anxiousness. But without the connection to the aspects of GE, the discourse is only a manifestation of “Angst”. No real progress can be made when one is only discussing the fears towards something, without a real frame of reference and grounding for solution-based thinking. In terms of GE, there has to be more to a discourse than just a manifested, whether written or spoken, conversation. Generally, discourse is not only applicable to academia (Sikka, 2018, Frumhoff & Stephens, 2018). Discourses are held throughout society on every strata and level. Whether it be at TV shows, broadcast shows, public debates, newspapers, or at home with friends and family. Foucault further states that “discourse is at once controlled, selected, organised and redistributed according to a certain number of procedures, whose role is to avert its powers and its dangers, to cope with chance events, to evade its ponderous, awesome materiality”. The discourses presented will show academia's perception of for instance public debates. The public discourses and their framings will be implemented implicitly, thus somewhat present throughout the analysis. Yet, they will not be analysed as public debates, but as theoretical assumptions made from the point of view of a scientist.

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For Tina Sikka (2012) critical discourse analysis (CDA) has several advantages. To her, CDA entails language being used as operating as a tool that is, “doing ideological work in a historical context”. In contrast to Foucault, she dissects the ideological, personal and emotional framing of the discourse to make individual beliefs, apart from the scientific approach of objectivity, visible. She does not focus on the anxiety and only partially on the hegemonial aspect that is present in Foucault. Although, she focuses her CDA on the monopolistic aspects of framing discourses by a sort of elite (Sikka, 2012). In the thesis similar attempts will be made. Since the academic world is main narrator of GE, and the potential benefits and dangers in using such technologies are its narrative, the framing is almost completely shaped by academic trains of thought. These are picked up by media and politics, thus amplified for the publics. Therefore, framings used in her and the other analyses are being summarized in the chapter 4.3 and to some extent manipulated in chapter 5 to answer the research questions for this paper. Her usage of Exceptionalism is crucial in understanding the narratives that allude to the benefits and dangers of GE and their applicability towards a sustainable energy transition. She describes Exceptionalism as a discursive construct, which is “deployed by experts and political advocates of Geoengineering to present it as the only option with respect to mitigating catastrophic global warming” (Sikka, 2012). This construct can be applied to the energy transition effortlessly, thus her definition will be used without any alteration of her concept. Exceptionalism in this thesis will have no connotation towards good or bad. Although, for Sikka it seems like a somewhat dead end when following the reasoning of GE being the only or, at least, the best approach to fight anthropogenic climate change, which I will explain in the Analysis.

The systematic review is necessary to comprehend the connection of discourses and different reasonings. Discourse can be viewed as a mere discussion or a complicated set of processes adherent to a certain consensual framework, which is used to stratify levels of analysis and discussion participants. Within the systematic review of this thesis, the discourses will be seen as a mixture of both, Foucault, and Sikka. The anxiety about GE and the framing of discourse is crucial for the systematic review to be processed meaningfully. Whereas discourses in themselves tend to be contradictory, the discourses of GE seem to be manifested contradiction traversing every aspect of social life and sciences. The discourse will be analysed for any consensus throughout the selected articles, as well as bringing the disparities up front. Anxiety about failure is a prime driver for avoiding mistakes when implementing large scale interventions connected to a sustainable energy transition and climate change. This is partly the reason why GE, to this day, is a hotly debated topic.

2.2 Climate change

Climate change is the main presupposition when asking what the discursive aims of GE are about. What is climate and how is it measured? When talking about the discourses on GE, the question of climate change is inevitably to be asked. Climate in general often is described as the average temperature on a global scale (McGrail, 2013). When referring to climate change, especially in connection to GE, climate entails way more variables than just average temperatures. One of them would be manifested in average precipitation on regional and global levels. Another would be the average solar radiation coming through the

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atmosphere and the ionosphere that lays beneath it (Frumhoff & Stephens, 2018). SRM especially has its focus on the latter by manipulating particles, injecting aerosols and other kind of technological interventions (Keith & Moreno-Cruz, 2013, Keller, Svoboda & Tuana, 2011, Caillol, Liu, Ming & Richter, 2013). But climate can also be understood in terms of streams within the ocean, such as the Humboldt stream or the famous Gulf stream, which not only impact the oceanic environments, but also the global weather and climate dynamics. Those are influenced by other factors as well, such as population density, energy consumption and such. Being able to calculate those contingencies and more seems to be inconceivable when science is disregarding chaotic theories. All the factors mentioned above tend to be included when talking about climate change from a scientific point of view. GE aims to improve, or at least alter, the above with different focus put on the variables. These different aspects are not completely separable. Carbon dioxide removal for instance when it is stored in the oceans, could impact the other factors, such as the streams mentioned above. Theoretically, the CO² would sink to the depths of the oceans where it could not “hurt” humans. Nonetheless, there can be no guarantee that the increased CO² concentration does not affect the environment on a scale not being thought of yet.

In this thesis, when referring to Climate Change, all the aspects mentioned above are relevant, to not exclude any form of GE and its aims, and to simultaneously leave the discourse surrounding it as open as possible. Thus, climate change refers to any kind of measurable change in temperature, precipitation, concentration of radiation and gases within the atmosphere, as well as dynamics that have been found to be connected to the former, such as the streams mentioned above. When reviewing the literature, there is no distinction between any of the aspects mentioned above. All of them refer to climate and its changes, some stress other aspects differently, yet all refer to climate as such.

2.3 Geoengineering

Now that climate change is defined, the next step towards the GE discourse analysis will be in elaborating on what GE really is in the context of this thesis. Generally, GE can be described as “creation and deployment of technical systems aimed at controlling and mitigating anthropogenic climate change via temperature reduction” (Sikka, 2012). Further, GE is a rather abstract construct used to describe any technological, thus human intervention not only concerning climate change, but climate dynamics in general. The urge to control not only the weather but climate overall is prominent in every GE approach (Keith, 1992, Sikka, 2012, Frumhoff & Stephens, 2017, Powys Whyte, 2018). The manifold technological differences of GE make it a loose construct used to describe vastly differing technologies with a common purpose that is traceable. In the thesis GE will remain as the loose concept to not exclude any approach presented within the literature. This leaves space for potentially new approaches as well as making the different approaches tangible under one term. Thus, it is argued that GE is the human technological approach to control climate dynamics and anthropogenic influence on those dynamics. GE is referred to by some scholars as a viable supportive solution in reducing the anthropogenic influence on the global climate systems (Keith, 1992, Anshelm & Hansson, 2014). Whether this is a display of exceptionalism will be examined in the analysis component. Nevertheless, GE at its current state is indeed a

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display of feasible approaches in supporting the wish for mitigation of human influence on earth's environment. The benefits and dangers resulting from it are as numerous as the approaches themselves. However, these can be summarized under the two sets of technologies named carbon dioxide removal (CDR), Solar Radiation Management (SRM) (Pumadère, Bertoldo, & Samadi, 2011).

Since the systematic review is based on Geoengineering discourses, the technological nature of the topic does complicate the process of evaluating GE purposefully, without being victimized by conformational biases or negligence in theoretical assumptions. Within the thesis GE is used as the loose concept described above to have a broad concept applicable to the review and to combine the vastly different approaches under one terminological concept. The concept, due to the numerous implications, bears not only good intentions, but also bad potentials. Thus, the benefits and dangers of those outcomes will be explained in the latter sections through the lens of the scientists and their articles.

2.4.1 Benefits of Geoengineering

What are the benefits and what are the dangers to the use of GE? To start off, benefits can be connected to anything that improve any situation or outcome of a process that could be improved. Benefits in the context of GE can be described as the successful intervention through GE. Thus, when the technological intervention could fulfil the desired outcome through successful implementation, it is considered to be beneficial. Evaluation of these processes is needed to arrive to the desired outcome, since not every outcome is beneficial. Beneficial in this context is not necessarily confined to the exact thought of outcome, but also to implicit beneficial improvements. One example of such would be a small-scale intervention of SRM improving the crops of a developing country. The improvement could possibly spread towards the processing industries of those crops. This would implicitly be a benefit scolded to the SRM intervention, despite not being measurable directly, but through the outcome of more crops coming to the processing sites. In accordance with that line of argumentation, benefits may not only be restricted to economic growth or stabilization, but also to social improvements for e.g. the farmers, security for living spaces, involvement of socially and economically disadvantaged regions.

Possibly, a growing agricultural industry would improve the accessibility to food for the poor, under the condition that these are not exclusively being produced for exports (Escobar, 1995). Benefits can also be gained politically, when thinking of an increase in the GDP, which would likely result in more political influence on the global stage, through more contributions being sent to the international institutions. Semi-democratic institutions like the UN are based on contributions made by its members. A country that stops to rely on disaster help, but instead is being able to contribute to the funds, would very likely, at least ideologically, increase its political influence on such institutions and would be viewed as more equal than before. Furthermore, at least theoretically, being able to control the weather would result in military strength. The Geneva Environmental Weather Modification treaties prohibit the military use of such technologies. Thus, the military use now is officially restricted to the theoretical assumption building (Fleming, 2012). Before the treaty there was

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an open interest in its military applicability, which prevailed to at least the late 90s (AIR WAR COLL MAXWELL AFB AL, 1996). In this thesis, benefits entail the broadest of its sense in terms of the political, economic, social and military aspects. Focus will lay on the potential benefits in the context of energy usage and transition, without losing the reference to the other benefits previously mentioned.

For a systematic literature review on GE it is crucial to understand what benefits are and how they can be measured. The term benefit is used as a conceptualization of positively intended outcomes being measured as a result of anthropogenic interventions. Since most proposals about GE are still theoretical, the benefits are theoretical as well. Nonetheless, perceptual benefits are being included into the review as benefits. Therefore, geoengineering being described as the “lesser evil” or its “naturalness” (Anshelm & Hansson, 2013), will be coded as a benefit for the later analysis. As it was shown, the term benefit often is being clouded by a blurry and not automatically measurable mist. This is due to the chaotic environment of climate dynamics and unforeseen side-effects, as well as the economic, social, and political indirect influences coming from GE. That is why the implementation and argumentation for and against its usage is rather difficult when confronted with scepticism about the real outcomes in the usage of GE and the benefits tied to it.

2.4.2 Dangers of Geoengineering

Since now it should be clear on what benefits entail in the context of this thesis, their counterpart needs elaboration as well. Dangers, likewise, to the benefits, can be applied to climate change as well as GE, the need for a sort of limitation of the context within the thesis is crucial, when interpreting data accordingly. Most scholars (Keith, 1992, Macnaghen & Szerszynski, 2013, Sikka, 2012 & 2018, ...) within the literature refer to risks when talking about potential negative side-effects of GE applications. Risks are calculable to a certain extent. When talking about GE the calculability is, at least, debatable due to the lack of empirical evidence on experimental global implementations. Should for instance an experiment on a medium to large scaled intervention fail, the result could be an irreversible side-effect, that would affect the global weather and climate system, indefinitely (Cairns & Stirling, 2014). Usually risks and dangers are used interchangeably. Within this thesis, there is a deliberate distinction made between both later on in the conclusion. Risks in the main proportions of the literature are described and evaluated based on numbers expected by the scientists. Those expected numbers often are based on theoretical assumptions made by them. Those assumptions often are based on empirical evidence and their trajectory projections based on the evidence already gathered, which is very much limited. However, climate change and its contingencies are purely based on those theoretical assumptions, since the data that is being gathered and used for such projections, are not reproducible, yet. Nobody can guarantee that the patterns observed in the past may be applicable to the future. It is thus argued, that risks tend to deliver a false image of the dangers in the application of this kind of technology by basing assumptions on those patterns. Dangers are merely out of human control, thus way more threatening than mere risks (see Beck, 2006). Furthermore, promoting GE as a viable “Plan B” could lead to a diminishing importance of “Plan A”, namely reducing the GHG output in the first place (Corry, 2017). With a calculable risk one’s

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perception of threat is probably lowered, thus risk boldness is being increased. When talking about global processes like climate change, the risk boldness should be as low as possible due to the uncertainties of GE and their applicability in terms of nullification (Beck, 2006).

Nonetheless, risks and dangers are used interchangeably for the analysis to not confuse the reader of this paper and simultaneously being able to code the paragraphs purposefully. Therefore, the distinction between the two words will only be implemented within the conclusion. Dangers and risks, therefore, allude both to the negatively predicted outcomes by scientists within the literature. Anticipation of such negative outcomes could result in a more realistic approach as well as a more idealistic approach towards GE, depending on the mind behind that negative anticipation. Within the review it is necessary to understand the awareness of science towards risks/dangers and the anticipated calculability, or at least the perceived predictability, of such outcomes.

2.5 Policy Implications and public perception

Connected to the sustainable energy transition and the usage of GE as a potential instrument towards the government of both, are policies. Policy implications are any kind of legislative regulation made by a political and legal body on a (inter-)governmental level. Within policy structures are the regulations, treaties and statements connected to the political will of a country. Implicit to that is the democratic aspect of public will and engagement of that specific will, given a democratic based system. For the thesis any kind of explicit and implicit reference towards the government of GE was considered a characteristic of policy implications. This would allow the thesis to show to some extent the importance for the respective paper on governance, but also to gain a structural overview on the GE discourse and its need for proper regulation from a scientific perspective (Corry, 2017). Since one of the hypothetical assumptions being asked are about the public awareness and its incorporation into decision making processes, it would be important to ask about the relationship between governments and its publics. Thus, policy implications will entail not only the political frameworks provided by large legislative bodies, but also small-scale proposals such as local governments and publics debating about implementation of GE, through e.g. activism (Sikka, 2018).

Public perception's salience on the other hand is a concept inextricably rooted in social sciences and democratic societies. Thus, political implications gain in salience, when the public perception values topics as salient. The salience in itself is part of the public perception, since, statistically speaking, the salience is defined through the acknowledgement, thus perception of the majority of publics. When the majority of people are not interested in a subject, policy makers are tempted to perceive less salience to the topic on the one hand (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007), and presumably feel less compelled to distribute accountable policies on the other. Within the thesis, publics and their perceptions are scrutinized by some academics (Nerlich & Jaspal, 2012, Anshelm & Hansson, 2014), due to the, theoretical, direct influence and implicit affectiveness towards political actions.

2.6 Sustainability

GE and the sustainable energy transition are being connected by scholars regularly (Keith, 1992, McGrail, 2013, Anshelm & Hansson, 2014, Smallman, 2015). If something is sustainable it is often referred to being self-sufficient, to some extent. Similar to the famous concept of the 'perpetuum mobile', it is believed to be a way of being less energy consuming than producing. In the context of GE and energy transition, which will be explained in the next paragraph, sustainability mostly refers to the energy sources that cannot be depleted, or at least are able to be refilled over time. Solar energy for example is considered to be sustainable, since the sun is unlikely to implode anywhere in the near future. Also, hydropower is perceived to be sustainable, despite its limitations of availability overall, since the energy used is already being produced by nature and just drawn off by humans. In contrast to these approaches, unsustainable energy sources, such as fossil fuels and nuclear power plants, tend to not only produce energy by using limited resources, but also generating severe by-products, such as greenhouse gases and toxic wastes like radioactive and long-lasting severances. In this thesis the definition for sustainable is as following: Self-sufficient processes or technologies used by humans to mitigate or prevent anthropogenic generated negative impact on the global climate dynamics. Sustainability and GE can be viewed in a mutually supplementing relationship. GE, in theory, should be able to provide to some degree not only mitigating properties, but also possibilities to foster the sustainable energy transition against the "old ways" of energy production.

In the review of literature, sustainability is strongly connected to policy implementations. Energy production is closely connected to political regulation (Ossewaarde & Stegemann, 2018). Although the sustainable energy production seems to be a widely acknowledged approach towards mitigation of anthropogenic influences, its practical conversion into not only policy planning, but also economic transposition is widely seen as difficult to govern (Macnaghten & Szerszynski, 2013, Sikka, 2018, Frumhoff, 2017, ...). Within the many discourses on GE, it is crucial to connect its application to sustainability and the energy transition, because GE and the energy transition aim at the same goal, namely preserving earth for future generations. It may appear to be inherent, given the aims of GE to mitigate the anthropogenic influence, yet its implementation sometimes is aimed at mere temporal improvements (e.g. Sulphate Aerosol Injections), whereas sustainability aims at longevity. The sustainability in this context, therefore, is a concept of not only temporal improvements, but also long-lasting improvement of climate conditions for the European sustainable energy transition processes that will come to age in the future.

2.7 Energy transition

The need for action has been stated by a lot of governments through their participation and ratification of, e.g. the Paris treaties, the Geneva Conventions, and other treaties, concerning the environmental sustainability of worldwide economies. With the help of GE, the governments try to mitigate not only their CO² outputs but also, they try to keep the economy growing at the same time (Keith, 1992, 2010). Failures of the free market to do something about climate change and the resulting devastating effects of economies around the world, are often connected to political failures of governance (Frank, 2017). The aim for an economic shift towards a sustainable energy production not being fully followed, as well

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as the prevailing fossil fuel consumption is giving rising concern towards the course that most developed countries steer to (Amelung, Reichwein, & Wiertz, 2012). Not only is an increase of energy consumption an issue, since modern industries are still reliant mainly on fossil fuelled energy productions. The production itself is still problematic as well. Nuclear power plants are somewhat used as big sources of energy production, especially in France, nonetheless not main producer for the economic consumption (Iwada, Okata, & Samreth, 2010). What exactly is this so-called energy transition then? In this paper, the term is used in context of GE and its potential benefits and dangers towards the shift away from the “old” fossil fuels and nuclear power generating methods. The energy transition is aimed at producing the energy via sustainable sources, such as hydrogenic or solar power. Thus, the energy transition and sustainability are likely to be usable interchangeably in this context. However, there lays a small difference within both concepts which are interconnected, nonetheless. In contrast to sustainability, energy transitions generally have no connotation. It could be a shift from solar power to fossil fuels as well. That is why the term is being connected to the aspect of sustainability. Without it, there would be open space for misinterpretations of the benefits and dangers in using such technologies provided by GE. For the transition as a process and the discourses as their historicides connected to them. That is why the literature review is searching for not only energy transitions alone, but sustainable ones. The necessity of consuming less than being produced diminishes when replenishing is faster than depletion of the resources. With the help of GE, it should be possible to produce, e.g. more sunlight, more precipitation, less agricultural losses, and less by-products in the energy transition, unless the side-effects of GE can be successfully predicted, and the outcomes, thus, match the expectations.

Now that the concepts have been mapped out, the thesis will apply them to the discourse analyses, to be able to make distinct assumptions within the analysis about the concepts being used in the literature. Since the concepts and their definitions may differ throughout the literature, the concepts and definitions stated above will serve as a point of reference for the contextuality of the systematic literature review that has been done in the analysis part. Since most of the literature used, consists of discourse analyses on Geoengineering, their concepts are similar in shape and context. Nevertheless, differences in concepts will be made clear and visible in the analysis in the following. The political implications are inherent to the debate, since technologies that can affect the whole planet are necessarily subjugated to political regulations. In theory, all the concepts are connected to the political sphere in the context of regulation and implementation. The research design of a systematic literature review seems to be the most fitting, when trying to combine all the concepts into a systematic analysis of the discourse analyses selected for the thesis. In addition, a literature review of a literature review has its limitations and benefits. These will be explained in the next chapter.

3. Methodology

3.1 Research design

The theory and their theoretical assumptions suggested a close look at the contents of the literature that was used within the thesis. The aim of a discourse analysis of several

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discourse analyses is scolded to the vast amount of literature present about GE in general and the deeply interconnectedness between scientific fields on that topic. These bring up the urge for a comprehensive and concise selection of the literature of the present, by using a systematic literature review. It appears as an almost inevitable necessity for science's progress. Thus, the thesis adopted the PRISMA methodology as analytical framework for the analysis of the systematic review. PRISMA is a method to analyse "a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyse data from the studies that are included in the review" (Prisma-statement). Since this is the exact aim of the thesis, the statement and its form has been adopted into the methodological framework as an aide to be able to compare vastly differentiating discourse analyses without incorporating duplicates.

Within this paper, the literature was derived from discourse analyses that were being conducted throughout the last twenty years. The documents were downloaded from google scholar due to the simplicity and accessibility. Then they were implemented into ATLAS.ti for this thesis' analysis through coding. Since the discourse on GE and policies is still a relatively young one (Macnaghten & Szerszynski, 2013), compared to, e.g. personality traits in psychology, the time setting was chosen to represent the latest findings of scientific literature. Some of the literature already entails papers and positions from the years before, to recognize former positions and assumptions. By choosing the last twenty years as the setting, the thesis can compress information from that specific time frame and even beyond. Being able to give a point of reference on what was expected in the past about today, can help in improving the scientific groundings for GE and its applicability for a sustainable energy transition. The following conditions were set to limit the papers to be included:

1. GE is main subject of that paper.

This criterion was selected to guarantee a selection of articles explicitly using GE as their focus. Other topics could have been included, under the premise of GE being the dominant subject, in the hopes to find a paper that is directly connecting GE to a sustainable energy transition.

2. It must be a discourse analysis in nature, whereas the discursive frame is irrelevant.

What this criterion sought out to achieve was a summary of a summary. The body of literature is enormous and the task to make it somewhat sizeable as a bachelor student seems impossible. Therefore, the strategy to utilize summaries of others was formed to save time, energy, whilst protecting a broad basis of literature at the same time. Downside to that would be the informational loss in its transposition towards the thesis, since every summary is presenting itself as an informational downsizing, already.

3. Somewhat of a discussion of benefits, dangers, and uncertainties of GE's implementation must be explicitly included.

One of the hypothetical assumptions stated earlier assumed that there will be proponents and opponents of GE. The dialectic between both make up the discourse. Not having a discussion about both sides would result in a "fake" discourse analysis. Thus, this criterion was chosen

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to safeguard the scientific premise of strived objectivity. Further, it is expected that discourse analysis and their contents, as well as their authors, will not be dichotomous, but sometimes entail a blurred mix of both positions. Analysis in the latter will decide which side is dominating the other.

4. It should be published in an acknowledged scientific Journal.

Several papers that were found within the internet, especially in the past 5 years, that were fitting the former criteria, have not been published by scientific Journals. Overall, most of the literature is being published within a scientific Journals. Nevertheless, some doctoral thesis and master's thesis could have been implemented without this criterion. Therefore, to limit the body and the eligible documents on the one side, but also to be able to rely on scientific already acknowledged publications on the other, the criterion was implemented.

Another criterion that did not make it to the selection yet was crucial for the original assumption of the interconnectedness between GE and a sustainable energy transition, is the criterion of sustainable energy as connected topic within the paper. Unfortunately, it appears that, presumably due to the infancy of the scientific discourse, the direct connection between the both has yet to be made on a grand scale. As the search section will show, there are barely any papers about GE and sustainability. Only few paragraphs seem to connect both directly in a sense of symbiotic relationship, since GE is still being discussed mainly in terms of viability and applicability.

3.2 Search strategy

The literature was searched online through google scholar. Since google is the biggest provider of information worldwide, it was assumed to be able to find the most literature in there. Geoengineering turned out with 46700 hits on Scholar. Therefore, the first search was done with the following terms: “discourse analysis” “geoengineering” “benefits” “dangers”. Aim of this first search was to get a broad overview on what the discourse on GE is, what benefits and dangers perceived by the scholars are and how they are discussed in a discourse. The search turned out with 80 results on google scholar, excluding citations and patents (last accessed on July 2nd). From that search the following papers have been included: Anshelm & Hansson 2014; Nerlich & Jaspal, 2012; Sikka, 2018; Sikka, 2012. Several papers were interesting to the thesis yet dismissed due to the lack of time and capacities. For example, the graduate thesis of Zeller, 2017 would have been interesting to include since he discussed the frame disputes within the environmental movements over GE. But unfortunately, since it is a graduation thesis of 144 pages, the inclusion of such literature would have rendered this Bachelor thesis unfeasible.

Further, the search terms were extended to “discourse analysis” “geoengineering” “benefits” “dangers” “politics” “policy” “debate” “energy” “transition”. Since the literature that was found beforehand did most of the times only implicitly tied into the political sphere, thus the energy transition. Most papers were about policy structures concerning GE. In google scholar the turnout was at 37 documents without patents and citations. One could see that GE is not necessarily connected to the political sphere, since the amount of literature decreased

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drastically. Out of those 37 documents none was a discourse analysis solely on GE and the political implications, which lead to the dismissal of that search and its terms. One paper would have been interesting to include but was dismissed because it failed to fulfil the first criterion. The paper was written on the green growth discourse from a Neo-Gramscian perspective by Ossewaarde and Stegemann (2018). Geoengineering is only partly mentioned, so it was dismissed from the analysis. Green growth and GE both seem like a myth waiting to be fully undiscovered from the dusts of uncertainty. Since the literature already included was insufficient for a proper analysis, the effort towards a third search strategy has been made.

In the third strategy the following terms were included: "discourse analysis" "geoengineering" "politics" "administration" "environmental" "uncertainty" "benefits" "dangers" "risk" "policy". The aim was to get a further connection between the GE discourse and the political and environmental aspects in conjunction with the uncertainties. Of the 35 results none were fitting all of the criteria set up earlier. It seems that Geoengineering and the connection to a sustainable energy transition is, not yet, fully being included into academia. There is a lot of discussion on GE and policies, separately. Yet, there seems to be a lack of connection of those two fields in a symbiotic relationship. When searching with those terms, expectations were to find a lot of literature providing information on how GE can be used to develop and support the sustainable energy transition. Nonetheless, it does look like the infancy of the discourse is responsible for the lack of interconnectedness. Therefore, a last attempt of searching for further discourse analysis has been made.

The last search was purposefully chosen broadly by using the following terms: "discourse analysis" "geoengineering" "benefits" "dangers". Scholar showed 83 results, citations and patents excluded. Out of those 83 results the following literature was included; Macnaghten & Szerszynski, 2013; Frumhoff & Stephens, 2017, Powys Whyte, 2019, McGrail, 2013, and Corry, 2017. These discourse analyses represent the main criteria chosen and make use of the diversity inherent in the GE discourse. Unfortunately, out of the 83 results none were specifically connected to the energy transition, like in the other searches. Some could have been included into the analysis, such as the article written by Horton and Peterson in 2017, given another criterion. Unfortunately, it does not entail GE as primary concern, but the energy transition and stakeholder hegemonies. Thus, this paper was dismissed as well. The literature and its approaches that have been included are as diverse as GE approaches prominent and yet to come. So are the scientific fields of the Journals and Universities that published those articles and their respective impact factors. The impact factors are provided by ResearchGate and used to provide the reader with a general concept of the frequency of reads and citations. They are calculated by the average number of published articles being cited in the year of publishing, which then are divided by the number of cited articles of the previous two years. The Journal that published the articles used in this thesis are as followed (without hierarchical structure on the impact factors):

Global Environmental Change; Ethics, Policy & Environment with an impact factor (IF) of 10.427 in 2018

Critical Discourse Studies; Capitalism Nature Socialism with an IF of 0.72 in 2018

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Journal of Future Studies with an IF of 0.05 in 2018

Philosophical Transactions of the Royal Society A with an IF of 3.093 in 2018

Mathematical, Physical and Engineering Sciences with an IF of 2.818 in 2018

Security Dialogue with an IF of 2.295 in 2018

Environmental Humanities with an IF of 0.98 in 2018

Metaphor and Symbol with an IF of 0.77 in 2018.

Ethics, Policy & Environment with an IF of 1.00 in 2012

What already can be seen is that no Journal was represented twice, despite some authors making a recurrence. The conclusive thought of this was a confirmation of the previous presupposition that GE and its researching scholars are spread out across many scientific fields and their approaches are exuberantly manifold. The vast differences in scope and context suggest a closer look on the topic of GE and the discourses that are entailed, especially when trying to connect it to the sustainable energy transition within Europe and across the globe. Overall, a disproportionately amount of literature had to be excluded. The apparent focus of science is aimed either at GE itself, or at the energy transition and so-called “green growth” or sustainability. To my knowledge there are only few mentions of GE’s applicability towards improving the sustainable energy transition (Sikka, 2012, McGrail, 2013, Anshelm & Hansson, 2013). Nonetheless, the discourses selected were analysed and evaluated according to the criteria set up in the next chapter.

3.3 Operationalization

By systematically reviewing the data that has been collected on google scholar, the thesis aims to provide a concise overview on the multiple discourses held around GE. The PRISMA methodology was used to systematically collect, and review the literature. Further aim was to be able to compare several papers despite their differences in approach and research interest. Since GE entails not only technological aspects, the units of analysis and settings vary throughout the literature and would not be able to be compared meaningfully without any systematic analysis. Overall, there have been nine articles been included as primary sources. Secondary sources were chosen to underline arguments, deconstruct dichotomies or contradictions within positions and arguments made within the articles. From a social scientist point of view, the context and the setting of that specific context are crucial in understanding their purpose and function within the discourse on GE. The focus in this paper was set out on the academic discourses on GE. Nonetheless, some of the literature discusses the public discourses concerning GE. Since these were written by academics, their positions will be counted as academic positions, despite their research focus on the public. As primary sources the discourse analyses will be used, with aims to make the attempt to compare positions and lines of thought towards a somewhat dialectic. Having multiple discourse analyses within the thesis, made the attempt to grasp the debate going on in academia as broad as possible, given the limited time and productive capacities. Thus, the modus operandi for the thesis is confined to the systematic literature review and its analysis

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on the applicability towards a sustainable energy transition. The literature was read and coded for this analysis in ATLAS.ti. By using the program, the literature was categorized into the following groups: 1. strong influence on discourse (Authors) 2. Mild/low influence on discourse (Authors). Influence was measured by comparing reads, citations of the documents and impact score of the Journals publishing the articles. This was done to have a rough overview on reach and impact of those articles. What can already be said, is that it does seem like the literature and its audience are still confined to a marginal proportion of the overarching scientific community.

Within the thesis, only the authors of the nine primary sources will be coded accordingly, because their selection and their approach has been read wholesome. Literature within these sources implies these distinctions as well. Nonetheless, they have been classified by the authors to a small extent. Since it is impossible to read every paper presented within their analysis, double-checking is an impossible task as well. Also, it would be interesting to know whether the academics position themselves directly or indirectly to GE and its usage. The codes used in the analysis are: 1. dangers (referring to any kind of risk, danger or drawback connected to GE). 2. Benefits (referring to any kind of benefit, whether economic, social, political or ideological) 3. Political implication (as a mean to measure the academic perception of policies/politics towards GE). 4. Uncertainties (as a measurement for the perceived insecurities and undefinable contingencies that come along when altering global weather dynamics). The last code used for the thesis was Energy Transition, since the thesis' original aim was to connect the discourse to the energy transition desired by the world through, e.g. the Paris treaty, Geneva convention on weather modification and others. The program was used to count the mentions of these codes within the papers and to build a comprehensive comparison between the positions within the discourse in terms of occurrence, overlapping and diverging. The intent was to be able to gain not only an extensive overview on how the discourses are framed, but also on which aspects they tend to put their focus on. If a paper about public perception towards GE has a lot of paragraphs about benefits, it could be a sign of a positive attitude towards the technology, despite a negative language throughout the paper.

The thesis is aware of the limitations that come along when analysing an analysis. Therefore, multiple discourse analyses were used to provide a meaningful average of the discourses on GE throughout the years. Atlas.ti was also used to provide the analysis with a word count to provide the reader with an average of buzzwords throughout the discourse analyses. Conclusively, the analysis and coding were done manually, since the program may not be able to provide sufficient capacities in analysing for example subliminal messages conveyed in the text by the authors. Specifically, the selection of articles for the different discourse analyses cannot be grasped by the program, which will play an important role in explaining motivation and context of the respective discourse analysis. Some discourses may overlap, but most of them differ in units of analysis, context and selection. Whereas Sikka focused her analyses on present people and their perceptions (2012, 2018), Whyte focused on the geoengineering discourse in the context of indigenous people. The differing approaches were

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analysed and compared to each other with aim to provide a feasible access to differences and common grounds. The analysis and its interpretation will be shown in the following chapter.

4. Analysis

	3: A critical...	4: Activism a...	5: Frail_clim...	6: Legitimac...	10: 101Ansh...	11: Metapho...	12: corry	Summe
	39	32	35	41	43	45	62	
◇ Benefits	15 18,29%	11 18,97%	1 2,63%	6 8,33%	17 23,29%	27 36,49%	22 15,83%	112 16,47%
◇ Dangers	15 18,29%	15 25,86%	9 23,68%	30 41,67%	18 24,66%	18 24,32%	40 28,78%	178 26,18%
◇ Energy tra...	5 6,10%	7 12,07%	2 5,26%	1 1,39%	3 4,11%		1 0,72%	24 3,53%
◇ Policy imp...	24 29,27%	10 17,24%	6 15,79%	18 25,00%	14 19,18%	5 6,76%	37 26,62%	163 23,97%
◇ Uncertainti...	23 28,05%	15 25,86%	20 52,63%	17 23,61%	21 28,77%	24 32,43%	39 28,06%	203 29,85%
Summe	82 100,00%	58 100,00%	38 100,00%	72 100,00%	73 100,00%	74 100,00%	139 100,00%	680 100,00%

The literature that has been read has been coded via ATLAS.ti, to have a general overview on tone and occurrences of codes. The most prominent code that has been identified per paragraph was uncertainties with 203 mentions. Dangers had the second most occurrences with 178 paragraphs, which was followed by Policy implications with 163 mentions. Benefits were only mentioned 112 times within the literature that has been analysed. The sustainable energy transition was only being mentioned 24 times within the literature, whether explicitly or implicitly. These numbers allow for some first further theoretical assumptions about the discourse on GE:

1. Dangers seem to be more prominent than Benefits
2. Uncertainties are the most prominent code within literature
3. Policy implications (Governance) of GE are very important within the discourse
4. Sustainable energy transition is only partially mentioned, almost no reference is being made for using GE as a promoter of that specific transition.

4.1 Summaries

Macnaghten & Szerszynski: An analysis of public discourse on solar radiation management and its implications for governance, 2013

	1: Discourse...	Summe
	40	
◇ Benefits	2	2
◇ Dangers	12	12
◇ Energy tra...		0
◇ Policy imp...	22	22
◇ Uncertainti...	24	24
Summe	60	60

Table 1

The first discourse analysis that has been read and analysed was of Macnaghten and Szerszynski (2013), which was published by the Journal Global Environmental Change. Macnaghten does appear frequently throughout the literature and is mentioned within some of the other documents, which will be introduced in the latter. Overall, his name popped up 30 times within the literature that has been analysed (titles and references included). This pattern suggests that he has a fairly high impact and influence on the discourse about geoengineering and its implementation. Therefore, he was categorized to the first group: 1. strong influence. The approach used by the two authors here was to restrict the GE technologies to the specific set of SRM techniques. They explore through discussion groups, which were set up as vastly differentiating representatives of a broad spectrum across the social strata, thus, the public. They asked about their opinions and perceptions about GE and its policy implications. The focus was set on the debates revolving around GE (SRM) and its political governance through policy measurements, as well as taking the public perception about the subject of GE and its policy implications connected to it, into consideration. Further, they point out the distinctiveness of SRM in contrast to the previously dominant approaches of GE, like Carbon-dioxide removal techniques. To them it is distinct insofar that it is “bringing planetary systems under human control and the “making” of new climates”. In contrast, carbon dioxide removal represents the approach of human influence being softened instead of altering the whole climate accordingly. The process of “making new climates” is bound to a certain amount of uncertainty, which they evaluate to be high. They express their concern by referring to Ulrich Beck's “risk society” (1992) and the stochastic processes that are used to calculate that risk. These are used to estimate the probabilistic side effects connected to the probabilistic intervention “into an earth system which is highly chaotic and in a constant process of formation” (p.2). This chaotic system is subdued to patterns, contingencies and an infinite number of variables influencing the correlation between SRM effects and the environment.

Their approach to research was to conduct a discussion group with several focus groups, ranging from Gardeners, outdoor manual workers, and outdoor enthusiasts. In the other groups were engineers and managers, mothers of young children, men working in the public sector with a certain interest in the topic of GE and its legislation. Each discussion group had eight participants. The three hours of discussion were carried out in three different cities within the UK and had a control group each. By dividing the participants into socially structured groups, they tried to “explore whether shared lifeworld experiences would structure responses to geoengineering: for example, would the engineers be more favourably disposed to a ‘technical fix’ for climate change; would the public sector professionals engage collectively with the politics; would the mothers be sensitised to the kind of future that solar radiation management would bring into being” (p.6). Their findings show that the public perception is not one-sided at all. Participants showed a considerable amount of flexibility in terms of own perception and influencing each other throughout the discussion groups. Results of the evaluation showed, that some of the hypothetical assumptions were confirmed, whilst others were repudiated. One example of confirmation was that there indeed is a general concern on GE and SRM. One repudiation was that the perception of the focus groups would

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be static. This was not confirmed, since they found that several subjects were able to change their opinion towards uncertainties, political responsibilities and such (p.12).

A word count with ATLAS.ti was used to gain a rough overview over the paper and what keywords are used. The most prominent key word with 114 occurrences was management. Since their design was about policy implementation and public perception, it confirms the importance of management when governing democratically. Since they analysed publics in the UK, the hypothetical assumption of democratic governments and policy measurements being connected to public debates emerges. The public debates and their transposition are embodied by engagement. Democratic institutions and their constituency provide legislative frameworks which can be applied and must be negotiated beforehand. The process of negotiation can be defined as engagement. In the context of Macnaghten and Szerszynski, engagement can be considered to have a reciprocal relationship. Their approach and their findings confirm this assumption (pp. 3,4,6,8,15). All the pages listed contain at least and 6 mentions at maximum for the word engagement. Public engagement is according to Macnaghten and Szerszynski :“The role of public engagement is to incorporate public views and values into governance arrangements . However, these numbers imply for Macnaghten and his colleague a rather high importance for engagement on the one hand, but also clarifies the importance for the relationship between the public and its government within a democratically organized system on the other. They mention the infancy of the discourse (p. 2) about GE and its governance, which is partially scolded to no international treaties covering all the techniques and technological possibilities that are available yet.

The coding of the text turned out with 3 paragraphs connected to potential benefits. One example would be that an “assumption manifests in the beliefs that meaningful research into the feasibility of these techniques can be carried out before deployment, and that this research will help ensure that any future deployment would be less likely to involve major surprises” (p.1). Here they refer again implicitly to predictability and stochastic measurements as a basis for risk-boldness. One reference to potential benefits made by them on page two, is the argument that proponents of e.g. SRM could be able to implement the technique successfully with relatively ease in terms of economic effort and without having to invest a great amount of time, when compared to mitigation techniques, such as GG reduction. The lack of institutional framework is according to them one of the key issues about the government of GE. However, GE is already being discussed on a political level by national and international governmental structures, such as the UN (UN Convention on Biodiversity,2010). Macnaghten and his colleague point out that these treaties are not legally binding, yet they show the desire and need for a proper legislative regulation by politics. Overall, in the document are 24 paragraphs connected to the code “Policy Implications”.

Overall, the paper concluded that within their sample Macnaghten and Szerszynski “there were no clearly opposing ranks of supporters and detractors.” Public opinions therefore are shaped within discourses, since they further could show, that not only did participants that were opposing in the beginning were moderated. In addition to that, supporting participants were moderated as well. Another result stated by them was that “the more people knew about SRM and its technicalities the more they appeared to become sceptical” (p.12). That

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conundrum which reveals itself through, what appears to be a dichotomous relationship, shows a first support for the assumption that GE is marked with uncertainties throughout the discourses.

Kyle Powys Whyte: Indigeneity in Geoenengineering Discourses: Some Considerations, 2018

	2: Indigeneit... 46	Summe
◇ Benefits 112	11 13,10%	11 13,10%
◇ Dangers 178	21 25,00%	21 25,00%
◇ Energy tra... 24	5 5,95%	5 5,95%
◇ Policy imp... 163	27 32,14%	27 32,14%
◇ Uncertainti... 203	20 23,81%	20 23,81%
Summe	84 100,00%	84 100,00%

Table 2

Second discourse analysis that has been adopted into evaluation of the general discourse was written by Whyte in 2018. His approach was aimed at the role of indigenous people within the world of GE and its political and social applicability towards predominantly less advantaged social groups. It was published in the Ethics, Policy and Environment Journal. He appears only in his own paper and is therefore being categorized in group 2. low/mild influence. Nonetheless he depicts an important part of the general discourse on GE. His approach towards the inclusion of socially and politically disadvantaged groups is mentioned within the literature, but the frequency of that topic is relatively low, since in this thesis only Tina Sikka (2012, 2018) mentioned the indigenous people directly within her analysis. However, indigenous people have been proven to be some of the first Geoenengineers and are more likely to have a more naturalist approach than their and counterparts, due to their connectedness with nature and their belief systems being set up around the well-being of the earth (Powys Whyte, 2018). Since these groups have been suppressed in the past in almost every Weberian sphere imaginable, their impact is rather low to this day. Nonetheless, according to Powys Whyte, their importance and their rights to participate in solution findings have increased over time and even despite being suppressed were able to have a “long track record of taking leadership in addressing environmental issues” (p.1). He focused his discourse analysis on the “ethical and justice issues pertaining to some geoenengineering research and (potential) influences” (p.1).

His methodology is based on his personal experiences with indigenous people and their relationship with governmental structures. He recalls his works and the works of others to

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illuminate this relationship and to ethics and justice. For example, he cites Holly Jean Buck's question of "whether it is possible to imagine geoengineering being driven by a desire for social change, as means to transform society?" (P.16). His conclusion is that "Indigenous voices should be involved in scientific and policy discussions of different types of geoengineering." (p. 16). But this finding does come at a premise to be fulfilled: trust between the parties participating must be somehow guaranteed. As Powys Whyte demonstrates on the pages nine to 13, Indigenous trust has been exploited throughout history, thus made the "Western" accountability complicated. The desperation he mentions in the likes of Gardiner's text of 2013, is referring to the fact that "neither the consent nor the self-defence interpretations clearly licence geoengineering, and they may even count against it" (p.16). Since Indigenous people are less likely to have political power or influence (p.15), their consent may not be realistically represented through majoritarian vote systems, despite their obvious interests in a healthy living planet, which often represents their respective deity. Further, since most indigenous people are not only politically disadvantaged, they often times are so economically as well (p.4). Therefore, he argues that "Ethics and justice issues pertaining to geoengineering perhaps emerge most clearly when we question how it came to be that some people see the best path forward as involving the weighing of different perspectives, beliefs, values, and interests" (p.16).

The analysis with ATLAS.ti showed 11 paragraphs referring to "Benefits" and 21 paragraphs referring to "Dangers". This is almost twice the amount of references with a negatively tone towards GE than a positively one and represent 25% of the paragraphs marked in the text. This is presumably scolded to the topic that Whyte connected to GE within his analysis. He showed how indigenous people have been disadvantaged throughout history and how they fought for acknowledgement. Their resentment towards a "oppressor-based" form of political government of geoengineering results in a relatable scepticism towards such technological issues. Five paragraphs have been marked with the code "Energy transition" which represent only 5,95 % of codes within the document. In the chapter Framings of Geoengineering I will try to show that this is still a relatively high account, when comparing it to the other papers. What is problematic, is that the sustainable energy transition is barely mentioned implicitly. For example, in the sentence on page seven: "Other transformations occur as an unintended side effect of resource use, such as the mass extinctions of indigenous fauna by early hunters in Australia and the Americas or the more recent threat of climate change caused by our use of fossil energy' (Keith, 2010). I coded it under sustainable energy transition, because, as mentioned within the theory, unintended side effect of resource use is implicitly making the case for an alternative approach of energy production and consumption techniques. "Uncertainties" connected not only to GE itself, but also to the discourse on indigeneity and governance were counted with 20 paragraphs, which make up 23,81 % of total codes. This shows that uncertainties and dangers are up to par with each other and are only outnumbered by the code "policy implications" with 27 mentions (32,14%).

Since indigenous people always were subjected as "other" in a conquered homeland, their relationship with governance and hegemonial power struggles seems to be immutable in their existence, at least in the short to mid run (Escobar, 1994). This is the reason why Whyte

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argues for a real indigenous consent towards a cooperative governance between all citizens and their governments, because “forces of domination render even the most well-intentioned solutions ineffective” (p.16). In conclusion, this shows his scepticism towards hegemonial institutional power structures and their former relationship with indigenous people. In contrast to that stands his firm belief of crucial importance of impact value on policies, which are manifested within the indigenous community.

Tina Sikka: A critical discourse analysis of geoengineering advocacy, 2012

	3: A critical... 39	Summe
◇ Benefits	112 15 18,29%	15 18,29%
◇ Dangers	178 15 18,29%	15 18,29%
◇ Energy tra...	24 5 6,10%	5 6,10%
◇ Policy imp...	163 24 29,27%	24 29,27%
◇ Uncertainti...	203 23 28,05%	23 28,05%
Summe	82 100,00%	82 100,00%

Table 3

This article was published in *Critical Discourse Studies* and is concentrating on the framing of GE and its discourse. Sikka is the only scholar being present twice within this thesis. As a writer of the primary data I wanted to be able to at least somewhat depict the direct change of a chosen scholar over a considerable amount of time. This was done on purpose for several reasons. The first was an attempt to not only capture a general evolution of the discourse, but also be able to draw possible individual progresses into the consideration. She also appears in the text written by Anshelm and Hansson, 2014, which will be summarized after her second text. She researched the “framings of the market and (the concept of) exceptionalism” as an indicator for influences on the construction of the GE discourse” (abstract). Her goal was to be able to map out the multiple framings that are being used in that process of construction, and perhaps destruction.

She applied her construct of framings and exceptionalism to the statements and positionings “made by The American Enterprise Institute, The Climate Response Fund and The Climate Institute” (abstract). She chose critical discourse analysis for several reasons, which she derived from Fairclough and Wodak:

Power relations are discursive.

Discourse constitutes society and culture.

Discourse does ideological work.

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Discourse is historical.

The link between text and society is mediated.

Discourse analysis is interpretive and explanatory.

Discourse is a form of social action. (1997, pp. 271–280)

In the context of geoengineering this means: Through the lens of critical discourse analysis, GE is “such a complex scientific and technological field, dominated by experts and the so-called experts, it tends to make public interventions into the debate extremely difficult” (p.5). The aim of her work was not only to make discursive framings visible, but also a clash of interests between public and private forces in their struggle for hegemonial leadership in governance of GE. Through the application of the concept "exceptionalism", she explores the discursive construct which is used “to present it (GE) it as the only option with respect to mitigating catastrophic global warming” (p.6). This representation is to her a misrepresentation in the sense, that not only it “can imbibe technologies with a kind of transcendent and reconstructive socio-political and economic power” (p.6). In other words, this means that if GE is described as the only or best solution, dangers of moral hazards like less efforts towards general CO² reductions and other emission cuttings. If these can be “mitigated”, they can be dismissed as negligible and controllable side-effects. To strengthen her point, she refers to an article of the Herald Tribune, published in 2010, which cited Ken Caldeira (18 counts within literature: 1. Strong influence), who stated that “We’d better try to understand if there is something we could do, because there’s no other way to realistically stop the Earth from warming during the course of this century” (p.1). To her the language of Caldeira is “persuasive because of the pragmatic function such kind of discourses have” (p.1).

The analysis with ATLAS.ti showed out of 82 paragraphs an even distribution of “Benefits” and “Dangers” with a count of 15 (18,29%). Her analysis was a language-based analysis of pro and contra argumentations and statements. These numbers show that her desire to have a critical approach was, at least superficially, successful. “Policy Implications” counted for 24 paragraphs (29,27%) and “Uncertainties” for 23 (28,05%) of the coded paragraphs. In chapter 2.1 I discussed the hegemonial power struggles inherent to discourses. In democratic systems most hegemonial powers are going out from the form of policies. Since her aim was to reveal power struggles between governmental actors and private ones, political implications are prominent throughout the paper. Additionally, a strong pattern of uncertainty is forming out of the papers that have been introduced up to this point and those that will be introduced shortly. “Energy transition” was mentioned within five paragraphs (6,1%). The market and the political sphere are intertwined due to predominantly neoliberally setup economies around the western world. Since her critical discourse analysis is set up in the “Western Hemisphere”, western power structures are prominent throughout. A pessimist could view the government to tend to protect the economy more than the environment, at least in the short run, since private actors, like Bill Gates and Richard Branson, are advocating for this set of technologies and funding it considerably (p.10). This could lead to a clash between private

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investors, private citizens, and governments, which in turn would render GE's application useless due to in capabilities of proper governing those techniques.

The critical discourse analysis (CDA) by Sikka showed, that "special interests, including private corporations, conservative think tanks and scientists affiliated with both have drawn on a variety of discursive frames to limit, shape and mould the current debate surrounding geoengineering" (p.12). This is being done not only through exceptionalism, but also through market and economic framings. These framings lead to "the fact that it (GE) fails to address the root cause of climate change" (p.12). Further, she showed that the legislative framework of international law is to that day (2012) not sufficiently being ratified and acknowledged by the nation-states of the world. The argument of power struggle with academics as their hegemony within the discourse is strengthened by the argument Chantal Mouffe made in 1998: "The longer the chain of equivalences set up between the defence of the rights of one group and those of other groups ... the more difficult it will be to neutralize certain struggles".

Tina Sikka: Activism and Neoliberalism: Two Sides of Geoengineering Discourse, 2018

	4: Activism a... 32	Summe
◇ Benefits 112	11 18,97%	11 18,97%
◇ Dangers 178	15 25,86%	15 25,86%
◇ Energy tra... 24	7 12,07%	7 12,07%
◇ Policy imp... 163	10 17,24%	10 17,24%
◇ Uncertainti... 203	15 25,86%	15 25,86%
Summe	58 100,00%	58 100,00%

Table 4

The second article provided by Sikka has been published six years after her CDA. This discourse analysis is going a step deeper into the previous topic of general CDA. Her interests in power struggles has not been changed. In this paper she researched the relationship between activism and neoliberalism, which is a stratification of her previous paper. She argues that "Arguments in support of this approach to climate remediation are quintessentially neoliberal and can be found in discourses that fetishize entrepreneurialism, support a market driven ideology, and amplify creative destruction" (abstract). In contrast to that stands activism with their objective to "engage and unpack the discursive frames [...], [and] map out the practices and sites of resistances to climate engineering" (abstract). By

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making that distinction she splits up the traditional oppositions of left and right into the categories stated above.

In her methodological approach no big changes were made. CDA is still her main tool of operation, for basically the same reasons she pointed out in her paper of 2012. Therefore, these are not to be mentioned again. What is new is her distinction between pro GE and con GE into Neoliberalism on the one hand as representative of the pro side, and Activism as a representative for con on the other side. She acknowledged the hegemonial power inherent to big corporations that sometimes have more revenue than the GDP of some small to medium countries on the one hand and small activists trying to contest the framings provided by the big players. She has done “through a close reading of selected policy statements, media reports, position pieces and academic articles made publically available by each side of this issue” (p.4). For example, Bill Gates makes his recurrence as subject of observation again as representative of the neoliberal side, whereas people like Naomi Klein and Vandana Shiva are positioned on the activist side. Her emphasize is on the “dialectical relationship between language and society, [...], and the role language plays in maintaining power relations” (p.4).

"As a set of neoliberal technologies, geoengineering is designed to transform capitalism, with state support, in pursuit of increased capitalist accumulation that is structurally opaque and unaccountable to the public” (p.6). Therefore, the quintessence of GE in a neoliberal world is to be a mere tool to prevent economic damages at the cost of public accountability and scrutiny. As one of the explanatory concepts she depicts Schumpeter's Creative Destruction as justification for this exclusive approach. In creative destruction “there is an incessant entelechy of innovation built into capitalism wherein new technologies create sufficient disruption so as to create new opportunities for market, profit, and economic growth” (p.6). Old technologies get replaced by more efficient ones. In the case of GE this means that it is to be perceived as a “natural evolution” of technological innovation. This locks into the exceptionalism argument of the paper before, since it depicts GE as sort of the most desirable solution to environmental destruction. In exceptionalism by being the only one, in creative destruction by being the “newest”. This bears some difficulties under the lens of neoliberal economics, because “what is different, however, is that under neoliberalism the state is used specifically to aid in the transformation of social life and institutions in accordance with market logic rather than to provide public services and strengthen social institutions” (p.10).

On the other side of this particular discourse are the activists, who are using concepts like the ethics of care, danger and risk, and framings of a slippery slope to make their point salient. Since neoliberalism and its instruments tends to think in quarters of a year, due to the quarterly stockholder meetings, the intragenerational planning seems to be rather difficult to reconcile with each other. Like Macnaghten and Szerszynski (2013), she refers to Ulrich Beck (1999) and his risk society. The uncertainties connected to such behaviour are used as arguments by movements like Hands Off Mother Earth (HOME). These organisations to a large extent view GE as part of the risk and reward culture that is aiming to maximize profits by taking calculated risks. Slogans like “Our home is not a laboratory” are being used as a mean to convey this message. Experiments may fail in a laboratory, but Mother Earth is none (p.13). The slippery slope is an extension of that previous argument. If an experiment in a

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laboratory fails, the project can be shut down and the next experiment can be set up with alterations and modifications. When an experiment on a global scale would fail, the effects could be irreversible, thus a slippery slope. To underline this argument, Sikka cited the ETC Group and a statement made by them in 2009: “Once governments opt for a techno-fix to the climate change quagmire, it will be very difficult to refocus attention and resources on the need to cut emissions in wealthy countries” (p14.).

Overall her conclusion to the discourse analysis is that there are several dominant frameworks used by not only the neoliberal side of the discourse, but also by the activist side as well. Both parties are using moral and ethical justifications based on their ideological conviction. Whereas neoliberals tend to view the free market and its mechanism of creative destruction and entrepreneurship as main driver for innovation, thus technological superiority over the climate in the long run, whilst maintaining the economic accumulation stable. Activists on the contrary use framings of danger and risk as main argument to prevent the slippery slope down to the Mariana Trench. “Finally, it is important to note that many of these debates will continue to take place online which, if scepticism of large-scale techno-fixes is to prevail, will have to, perhaps ironically, capitalize on one revolutionary technology to forestall another” (p.15). This means that the scepticism that was fostered by an environment like fake news and political lies, could lead to a halt in proper engagement with the topic of GE and finding quickly a long-term solution, due to the dichotomous sides of activism and neoliberalism.

Stephen McGrail: Climate Change and Futures Epistemologies: Tensions, Trends and Possibilities in Climate Discourses Epitomised by Three Prominent Climate Experts, 2013

		1: Discourse... 40	Summe
◇ Benefits	112	2	2
◇ Dangers	178	12	12
◇ Energy tra...	24		0
◇ Policy imp...	163	22	22
◇ Uncertainti...	203	24	24
Summe		60	60

Table 5

The paper provided by McGrail is a discourse analysis between three scholars that he views to be important to shaping the discourse around GE. His units of analysis are James Hansen, Mike Hulme and Joachim Schellnhuber. He puts his focus “on ways of knowing climate futures and evolving relationship between science, politics and society. He depicts the “tensions in the expectations and practices of (climate) science, ...” (abstract). In his methodology he used Inayatullah’s framework of futures epistemologies, “that is

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predictive-empirical, interpretive-cultural, critical-post structural, and anticipatory action learning” (p.1). He seeks to reconstruct the scientific progress made by each scientist and by analysing their work he wants to picture the tensions not only within the discourse, but also within the very scientists themselves.

The analysis with ATLAS.ti resulted in 38 paragraphs being coded, which is a relatively low account of codes. This was due to the nature of the analysis. A good proportion of his analysis was to explain the path of the three scientists. The analysis was aimed at GE in the context of academic development in the first place and less on GE as a set of technologies being implemented. However, his analysis provides a good overview on personal tensions encountered by three individual scientists throughout their careers. The most paragraphs that have been coded were “Uncertainties” with 20 (52,63%) paragraphs. “Dangers” were coded nine times (23,68%), which was followed by “Policy implications” with 6 (15,79%). “Energy transition” has been coded with two paragraphs (5,26%) and Benefits were counted with one paragraph (2,63%). These numbers suggest what the formerly analysed papers were foreshadowing, namely that Uncertainty is the most dominant factor within discourses on GE. Even when comparing only three different scientists, uncertainty even within their own works are prevalent throughout

To McGrail the careers of these three are respected within the scientific community, as well as their own approach distinct from each other. Mike Hulme evolved from “predictive-empirical to interpretative, to critical” (p.2). These positional transitions are scolded to the academic transitions made by Hulme throughout the years. As he quotes Hulme on the switch from predictive-empirical as a geographer, to interpretative as a climate scientist: “during these 12 years in the Climatic Research Unit, I came to see myself no longer as a geographer, but as a climate scientist” (Hulme cited by McGrail, p3.) Further, Hulme dedicated his works to the “growing unease about some of the ways in which climate science was being presented and deployed” (Hulme cited by McGrail, p.4). This depicts the transition to critical research as his new interest in the discourse. James Hansen’s approach towards climate change and GE is described as from “predictive-empirical to post-predictive” (p.5). “Hansen has sought to balance modelling with alternative approaches. [...] Additionally, perhaps more importantly, Hansen has gradually been radicalised over the past two decades. This conclusion shows that Hansen has changed his already relatively critical view on climate change has been radicalized over the years. In contrast to the climate scientists Hulme and Hansen, Joachim Schellnhuber is a Professor for theoretical physics at the University of Potsdam. According to McGrail, his trajectory can be described as “towards better prediction and control of non-linear phenomena in climate and social systems” (p.8). His approach is to dedicate his research towards “learning from the future and acting in accordance with the precautionary principle” (Schellnhuber cited by McGrail, p.9).

In his conclusion McGrail states that: Hulme has moved towards “interpretative and critical paradigms, following greater exposure to climate modelling and policy and to issues of ‘epistemological limits’, whereas Hansen and Schellnhuber have a ‘predictive-empirical’ focus, and have gradually become more frustrated and radicalised by responses to climate change” (p.14). The tensions of the pro- and counter arguments surrounding the

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implementation of GE and the contingencies that come along pose strains not only on scientific branches, but also on scientific individuals. These tensions are expressed in “learning about the future” and “learning with multiple futures” (Wilkinson cited by Mcgrail, p.14). In line with Schellnhuber and Hansen he further quotes Wilkinson that “we now rely too heavily on model-based forecasting and prediction to justify future-minded action” (p.15). The trajectories made by the three scientists may be transposed to others as well, when analysing their progress on a specific time frame. Nevertheless, this will be not part of this thesis.

Frumhoff & Stephens: Towards legitimacy of the solar geoengineering research enterprise, 2013

		6: Legitimac... 41	Summe
◇ Benefits	112	6 8,33%	6 8,33%
◇ Dangers	178	30 41,67%	30 41,67%
◇ Energy tra...	24	1 1,39%	1 1,39%
◇ Policy imp...	163	18 25,00%	18 25,00%
◇ Uncertainti...	203	17 23,61%	17 23,61%
Summe		72 100,00%	72 100,00%

Table 6

Legitimacy and societal salience are focus of the works by Frumhoff and Stephens in their paper written in 2013 and published by the Royal Society. Since “experiments without meaningful societal engagement could galvanize opposition to solar geoengineering research from civil society” (abstract). The authors point out, that without legitimate involvement of the public, a democratically based form of government could not hold up its claims of democratic values. They seek to reinforce legitimacy by highlighting the “distinctive responsibilities of researchers and research funders to ensure that SRM research proposals are subject to legitimate societal review” (abstract). ATLAS.ti showed 72 paragraphs being coded, out of which 30 (41,67%) were coded with “Dangers” and only six (8,33) with “Benefits”. Only one (1,39%) paragraph referred to the “Energy transition” and almost evenly distributed were “Policy implications” with 18 (25%) and “Uncertainties” with 17 (23,61%). Important to note here is the fact that dangers were not only subjected to GE, but also to the societal dangers of illegitimate actions by governments and private actors against publics.

They compare different opinions, mainly by academics, because “increasingly, scholars across disciplines are wrestling with the risks, uncertainties and implications of the potential deployment of both suites of technologies [7,8,15–17]” (p.1). To them these uncertainties are

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the epitome of the discussion of a for and against GE field research. They bring up David Keith, as a proponent of GE and his “ethical case” for SRM, which would result in less economically advantaged people being beneficiaries of such technologies, since they do not have the resources to adapt towards mitigation. Since small-scale testing is already being done, the discussion about implementation is about large-scale interventions. One of the arguments against the field research of SRM is the previously introduced frame of the slippery slope and the power struggles. Further, moral hazards of slower adaptation by the economy is being mentioned. As a mean to increase legitimacy they bring up the need to “provide a platform for collaborative dialogue over, and assessment of, proposed field experiments in the context of researcher and stakeholder perceptions of multiple, competing risks” (p.4). The problem with existing platforms is to them the fact that most research in “their approach could be interpreted as implying that the desired outcome of stakeholder engagement is societal consent and endorsement for an ongoing, expansive solar geoengineering research programme” (p5.).

In the paper the public dialogue on SRM is marked by uncertainties and lack of legitimacy (p8.). According to the authors scientific research is urgently needed, but not at the cost of democratic and public legitimacy. They partially cement their argument with the help of Stirling’s three different intentions when advocating for participatory processes: “(i) the normative intention that it is the right thing to do, (ii) the operational intention that the participatory process will enable a goal to be achieved, and (iii) the substantive intention that recognizes the value of integrating diverse perspectives into the outcome” (Stirling cited by Frumhoff & Stephens, p.8). These are addressed accordingly by both: “Normatively, engaging a broader constituency in developing solar geoengineering research norms and guidelines and striving for legitimacy is the right thing to do. Operationally, proceeding with atmospheric field experiments at any scale without first establishing a legitimate collaborative process of research co-design and co-production with stakeholders could jeopardize responsible societal consideration of solar geoengineering as an approach to reduce the risks of catastrophic climate change. And, substantively, integrating diverse perspectives and expertise into the consideration of whether and how solar geoengineering research should proceed will surely strengthen the design, quality and capacity to equitably inform diverse societal goals of any solar geoengineering field research programme that might or might not—legitimately ensue” (p.8). In their view, SRM field tests should only be applied when legitimacy is strengthened.

Anshelm & Hansson: The last chance to save the Planet? An Analysis of the Geoengineering Advocacy Discourse in the Public Debate, 2014

	10: 101Ansh...	Summe
	43	
◇ Benefits	112	17
◇ Dangers	178	18
◇ Energy tra...	24	3
◇ Policy imp...	163	14
◇ Uncertainti...	203	21
Summe		73

Table 7

In “The Last Chance to Save the Planet? Anshelm & Hansson try to illuminate the public debate about GE. They analysed 1500 articles published from 2005 to 2013, out of which they constructed “four coherent storylines that represent most of the geoengineering advocacy in the public discourse in mass media” (abstract). They found that the narratives are merely based on “objective truth claims of the natural sciences and does not promise a better world” (abstract). Analysis with ATLAS.ti turned out that out of the 73 paragraphs being coded, there was a rather even distribution amongst the codes. The Benefits were coded with 17 (23,29%), “Dangers” with 18 (24,66%), and Uncertainties with 21 (28,77%). “Policy implications” were coded with 14 (19,18%) and “Energy transition” with 3 (4,11%). This analysis showed the low attention towards a sustainable energy transition.

They argue that “in mass media, constituting a general discourse favouring more research into and testing or deployment of geoengineering” (p.2). Further, they argue in line with Clark that “geoengineering is currently the most obvious example of humanity’s trespassing on the thresholds of global earth systems” (p.2). They analyse discourses and storylines to analyse the articles chosen by them. As a result, they came up with four storylines:

1. Double fear:

This storyline refers indirectly to the concept of exceptionalism used by Sikka, since one is destined to either “inactively wait for the catastrophe or to explore the final option: geoengineering” (p.7).

2. The failure of politics and cynical industrial fatalism

Politically crippled actions, which do provide a legislative framework, nonetheless, do not provide it with enough legitimacy. “This argument emphasizes that researchers believe that they must develop geoengineering because politics has failed and can no longer reverse the situation” (p.10).

3. Pure technology: a bridge to a sustainable future

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“This view of technology is dependent on the commonly proclaimed idea that it is possible to test, study, and identify the environmental consequences of geoengineering in advance” (p.12). By implementing “technological romanticism” it is tried to convey that GE only needs proper testing to be an effective measurement in aiding the sustainable future transition.

4. Just mimicking nature

In this storyline the frame is set into context of GE being a copycat of nature itself. For instance, Sulphate Aerosol Injections are similar to the outbreak of a Volcano (p14.). The line of argumentation is: When nature does it, why should we not?

The advocacy discourse on GE is for Anshelm and Andersson “dominated by natural scientists and engineers” (p.15). However, it is not easy to find “pure” advocates, and storylines promoting geoengineering may also include the severest critiques of its deployment” (p5.). To them “the public debate is permeated by an unusual degree of critical reflexivity” which even opponents of GE perceive to be a salient topic (p.15). Further, in line with Clark they argue, that “there is a risk of retreating from the political” (p.15). This could not only hinder the public debate about GE, but also the proper governance of GE as a long-term project. Political failure is one of the primary sources for the advocacy of legitimate governance and serves the argument of exceptionalism and double fear. The discourse is marked with uncertainties and if GE is “depoliticized and inherently bound to democratic deficits and knowledge gaps” this in turn would likely lead to the question of “why interfering with the global systems if outcomes seem to be unpredictable?” (p.16). Humankind is facing several dilemmas in context of GE and all its side-effects. This “inevitably entails either our or other species’ survival” (p.18).

Nerlich & Jaspal: Metaphors We Die By? Geoengineering, Metaphors, and the Argument From Catastrophe, 2012

		11: Metapho... 45	Summe
◇ Benefits	112	27 36,49%	27 36,49%
◇ Dangers	178	18 24,32%	18 24,32%
◇ Policy imp...	163	5 6,76%	5 6,76%
◇ Uncertainti...	203	24 32,43%	24 32,43%
Summe		74 100,00%	74 100,00%

Table 8

This article was published in the Journal Metaphor and Symbol in 2012. The analytical approach was to dissect the frameworks in terms of metaphors and symbols used to describe the for and against of GE. The metaphors and symbols being used are similar to the framing used by Sikka, Anshelm & Hansson and others. Their argument is, that we as human

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beings are using metaphors to either “live by” or “die by”. This in turn means that they found about three “conceptual master-metaphors”, which I will explain in the latter. First, the analysis with ATLAS.ti turned out that out of the 74 paragraphs that were coded, 27 (36,49%) were referring to the code “Benefits” and only 18 (24,32%) to the code “Dangers”. This is the first paper that has a quite astonishing ratio of “Benefits” to “Dangers” wherein “Benefits” seem to outweigh the “Dangers”, at least superficially. “Uncertainties” were coded with 24 (32,43%) and “Policy implications” with only five (6,76%) paragraphs. “Energy transition” was not being mentioned at all within this paper. This finding hardens the assumption, that “Energy transition” has not yet fully arrived within the discourse as a potential prime correlation with GE. Uncertainties once again do occur relatively often in contrast to either “Benefits” or “Dangers”, which also suggests that “Uncertainty”, although not the most coded, still is inherently urgent to the scholars and media attention.

Their methodology was to search through a database called LexisNexis, which resulted in 103 Articles being selected for their analysis. These were published between 1988 and 2010. After that, they divided the articles into the three conceptual master-metaphors to make a distinction between metaphors and symbols visible throughout the data that was being analysed. The master metaphors identified were as followed: “THE PLANET IS A BODY”; “THE PLANET IS A MACHINE”; “THE PLANET IS A PATIENT/ADDICT”. Similarities between framings and the mainframes prominent throughout the discourses will be explained in the next sub-chapter. When referring to “THE PLANET IS A MACHINE” the authors categorize metaphors and symbols used by the newspapers referring to GE as a tool to fix a broken machine (p.6). They cite Caldeira from an article published in the New Scientist in 2009, wherein he refers to GE as a sort of “parachute”. Caldeira therefore stated: “You sure don’t want to need it, but if the case of a crash happens, you certainly would want to use it” (p.8). “THE PLANET IS A BODY” represents the metaphorical approach of the globe as being the patient or under medical conditions, that need to be treated. Thus, they link both master metaphors closely together (p.9). GE appears in the newspaper articles which were categorized as either of the two metaphors as the “medical fix”, which can be applied to cure the “illness” of climate change. Underlining this argument, the authors cite David Keith: “It is like chemotherapy. No one wants to have it [...] but we all want the ability to do chemotherapy and know its risks should we find ourselves with cancer” (p.10). This shows the common belief of proponents of GE, that it may have nasty side-effects, but if they come with the trade of the globe surviving a few more years, we should seize the opportunity.

In their summary they state that the “master argument” of GE being the only option in avoiding a “planetary catastrophe”, is linked to two of the main metaphors, namely “THE PLANET IS A MACHINE” and “THE PLANET IS A BODY”. These tie in with “THE PLANET IS A PATIENT” and all refer to GE as cure, or at least best “Plan B” (p.12). On the contrary, metaphors and symbols are used to oppose GE implementation. Framings of irreversibility through “Playing God with the elements” (Fleming cited by Nerlich & Jaspal, p.13). Further, they disclosed that the “substantive content of metaphors remain the same, their social functions evolve” (p.13). This means that throughout the articles remained similar

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in their goals, these were just aimed differently, e.g. medical discourses, ethical ones and so on.

Olaf Corry: The international politics of geoengineering: The feasibility of Plan B for tackling climate change, 2017

	12: corry 62	Summe
◇ Benefits	22 15,83%	22 15,83%
◇ Dangers	40 28,78%	40 28,78%
◇ Energy tra...	1 0,72%	1 0,72%
◇ Policy imp...	37 26,62%	37 26,62%
◇ Uncertainti...	39 28,06%	39 28,06%
Summe	139 100,00%	139 100,00%

Table 9

Corry's paper has been published in 2017 by the Security Dialogue Journal. His approach is locking into the framing of GE being a Plan B and its feasibility towards large-scale interventions and their governance through political processes. His focus nonetheless is specifically aimed at the "security hazard" (abstract). This security hazard is being extrapolated to the political sphere, which ultimately will be responsible in governing GE and the potential pitfalls when aiming for "Plan B", which eventually would lead to "negatively affect prospects for "Plan A". His claim is that "geophysical risks have eclipsed geopolitical ones" (p.2). To him, this is not the fault by the climate scientists, but the political failure of detecting security issues that do come along when it comes to the application and governance of GE (p2.). He too refers to the danger of "moral hazard", which for him, goes hand in hand with the "security hazard". The moral hazard of Plan B being preferable to Plan A (mitigation) is underlined with the master argument by Nerlich and Jaspal from the previously analysed text.

The analysis with ATLAS.ti showed that out of 139 paragraphs which were coded, only one (0,72%) was referring to a renewable energy transition. "Benefits" were coded 22 (15,83%) times and "Dangers" were coded within 40 (28,78%) paragraphs. This is the highest amount of codes within the paper, which was closely followed by "Uncertainties" with 39 (28,06%), and "Policy Implication" with 37 (26,62%). These numbers suggest that not only dangers are the most prominent topic, alongside with uncertainties, but also that from a security perspective, political implications are inevitably crucial to the discourse of governing GE. Since the renewable energy transition is mentioned at least one time, the assumption that it has not yet arrived within the discourse, due to the overwhelming amount of uncertainties and

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dangers connected to the technology, is hardened (p.2). To Corry Plan B “encourages a segregation of assessment, ensuring that climate engineering methods are typically assessed against ‘business as usual’ with each other” (p.4). Similar to the CDA of Sikka and her paper on activism and neoliberalism, he sees a disparity between economic interests on one side and environmental and societal interests on the other. To him the pure technologization of GE bears risk to “side-line political issues and risk, [...], often assuming a singular global actor, particular to the international problem disappear further out of view” (p.4). GE and what he called “interstate security” bear immense risks towards turning “the global climate system to a theatre of war” (Clive Hamilton cited in Corry, 2017). Even when not in an escalating conflict, he perceives the problem of the “free-driver” as an international issue of salience, “because of the relatively low costs of delivering [SRM], preventing unilateral ‘rouge’ climate engineering is a worry” (p.6). To him the framing of Plan B is in a shift towards “more governmental approach”, which would result in SRM “being started not as an emergency measure but rather a precaution” (p.11).

In his conclusion of the security hazard and GE, “few observers are optimistic enough to envisage a comprehensive system of global governance of SRM with high legitimacy” (p.12). The lack of international agreement and legitimacy through treaties that are being ratified, “despite initially much lower economic costs, the security hazard described in this article makes the politics of climate engineering look more costly and decidedly unlike an ‘easy’ option politically” (p.13). However, “awareness of such risk might help guard against them”, since “assessment of whether a technology can reduce climate risks should weigh risks of inaction, on the one hand, against the environmental but also the political risks of GE, on the other” (p.13).

4.2 Main framings of the discourse around Geoengineering

The discourses around GE and its implications are traversed across all of social sciences and beyond. Although the aims diverge, the intentions of a responsible implementation seem to be the same across all fields. However, the framings of the discourses do differ within the data that has been analysed. Nonetheless, similarities within the different framings do occur, which will be shown in this chapter and furthered within the conclusion. One of the main framings on GE is the famous ‘Plan B’ argument, used by: Nerlich & Jaspal (2012); Macnaghten & Szerszynski (2013); Powys Whyte (2018); Sikka (2012,2018); Frumhoff & Stephens (2018); Anshelm & Hansson, (2014); Corry (2017). This finding falls in line with Nerlich and Jaspal’s argument from the master argument and their interlocking main metaphors of “THE PLANET IS A MACHINE” and “THE PLANET IS A BODY”. The argument that being able to chemotherapy without using it makes a strong case for at least researching about it, in the hopes never being forced to use it. Further, “THE PLANET IS A MACHINE” in conjunction with the master argument is another form of Sikka’s concept of exceptionalism (2012), whereas the exceptional circumstance of economic unwillingness to reduce emissions is coupled with political incapability to legitimately govern the unwillingness accordingly (Corry, 2017).

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The framings of “double fear” and “pure technology as a bridge towards a sustainable future” are additional framings that were either implicit or explicit to the discourses that were analysed. They are used to describe GE under the master argument of ‘Plan B’ (Anshelm & Hansson, 2014). In the framings GE finds itself as the most efficient solution to the complex problems revolving around economic and political interests. What is being dismissed, or downplayed are the uncertainties and dangers inherent to the technology. Their apex framing of dismissive behaviour towards the objection of GE’s is the “mimicking nature”, wherein GE is being described as just a human usage of nature’s ability to change the global weather and climate systems. As Sikka has shown in her paper of 2018, the clash of interests between economic giant players and the social public is spurred with uncertainties on not only technological feasibility (Macnaghten & Szerszynski, 2013), but also on socially negative impacts for the less advantaged (Powys Whyte, 2018). The framings are used to convey certain assumptions and transpose the desire for glorification or to vilify the technologies and their implementation (Nerlich & Jaspal, 2012). Within the literature analysed no scholar made the attempt to “sell” GE as the ‘Silver Bullet’ for anthropogenic influence on the climate system through emission. It appears that the framings that are being used by scientists are aimed at an objective and sober representation of dangers and uncertainties.

What this section sought to show, was the widely common framings, despite different naming, used by the scientific community. Whether GE is being referred to as “Plan B”, exceptional, or “just mimicking nature”, all these tend to frame GE as the lesser evil compared to the excruciating pain that would follow if governments and economies would follow their paths of the past. Political failures and a perception of relatively low salience of GE by the public is giving it the biggest challenge towards a responsible governance. Mass media and governmental education programmes are acting as main promoters of such framings and, eventually, amplification stations for public perceptions. The clash between economic and social interests are visible within the mass media landscape (Sikka, 2018). Media campaigning and post-truth tendencies can be used not only to influence, but also shape public perceptions, as well as governmental approaches.

Of course, some scientists like David Keith (1992), are more in favour of the technology, because they sense the urgency for the “Plan B” as more dominant, than the fear for “moral hazards” (Corry, 2017). Him being financed by for instance Bill Gates with a 20 million Dollar project could presumably foster this perception of salience (Sikka, 2018). As pointed out in the theory section, discourses are framed by hegemonial power structures, and marginally shaped by contesting ones. Since the framings of scientists are often being transposed through media landscapes as amplification stations, the careful framing of scientists is not only a prerequisite for the claim of being scientific, but also a necessity in proliferating truthful and honest information to the public, to which it can form its perception and further transpose it to political salience through activism and voting behaviour. The salience of GE has certainly increased over time (Corry, 2017, Frumhoff & Stephens, 2018). However, the building of a legitimate internationally binding legal framework of governance has yet to come, alas.

5. Conclusion and discussion

The thesis tried to show the nature of the discourses revolving around GE and the technological feasibility towards a sustainable energy transition. The research showed that the discourse, despite being not very old by academic standards, has already a rich body of literature. That body of literature was compressed and analysed through the lens of discourse analyses being analysed. Throughout the years GE has been a topic of controversy. Known in academia and largely dismissed as conspiracy theories by the public. To this day, public knowledge about GE is relatively rare in terms of what GE entails and what its perpetual aims are. On the one hand media is dissecting information on the evolving technologies through framings provided by scientists, but on the other hand the danger of fear and fact mongering emerge out of that. The main framings provided are the “Plan B” argument, coupled with exceptionalism and “THE PLANET IS A MACHINE”. Its governance is to this day demarcated with uncertainties and political insufficient legitimacy. This is by mere chance the fault of the technology, but the disparities embodied within the neoliberal system of economic proliferation (Sikka, 2012, 2018). Coupled with theories of colonialism and other explanatory theories aimed at explaining economic, social, and political disadvantageous, not to say exploitative systems, these issues are prominent throughout all discourses that have been analysed.

Although, the scientific fields all agree that it is worth researching the feasibility of such technologies and simultaneously making sure that these are not being used for further exploitation. Specifically, the aim of science is to guarantee the least “risk boldness” that is possible, whilst taking calculated risks for the interventions. As it was argued within the theory section, the calculability of such risks is expectedly high, since McGrail (2013) has shown that even proponents of model-based calculations are admitting the pitfalls of relying on models that are empirical without guarantee to be predictive. This is a problem that manifests itself in the many “Uncertainties”, which were counted with 203 (29, 85%) of 680 paragraphs being coded. What was striking to me was that these uncertainties did neither diminish nor increase. One possible explanation for that could be the high number of “Policy implications” with 163 (23,97%) and “Dangers” with 178 (26,18%). Since there is no legally binding global framework for GE, despite some provisions (Geneva Environmental Weather Modification Convention, IPCC, etc.), the academic perceives not only legitimate, but also a binding framework for a proper and relatively safe implementation of GE as an urgent necessity. In terms of “Benefits” the discourse analyses were coded overall with 112 (16,42%), which bring a legitimate case of viability for GE to the table. If academia would not see a potential behind GE, it would render further research futile. The technological benefits for all strata of humankind could, at least theoretically, help humanity in their abatement of climate change, whilst protecting economies from any significant losses. However, the uncertainties tied to not only technological issues, but social ones as well, make the case for an implementation towards a sustainable energy transition rather difficult. Being able to boost for instance solar plantations through SRM could not only increase the efficiency of already existing technologies, but could also through creative destruction, foster new technologies of energy productions to emerge.

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In terms of a sustainable energy transition academia does not seem to conclude the feasibility of GE yet. This is partly scolded to the uncertainties for sure, but also due to the economic power structures behind fossil fuels and their close ties to the political systems, through e.g. lobbying and, sometimes, bribery. Flaws within the legislative frameworks open up possibilities for hegemonial systems to prevail, whilst simultaneously suppress contesting ones in the short run. Only 24 (3,53%) paragraphs that were coded within this thesis referred to a renewable energy transition. None of them specifically aimed at the conversion of GE and the energy production cycle. This is probably the most striking finding within this work. Since the technological possibilities are well known and their implementation the end goal, it was perceived to be an inevitable next step to foster the energy transition through the help of GE. Nevertheless, most scientists aim their approach towards mitigation of the already existing GHG outputs, which is, again, referring to the moral hazard of the “Plan B” master argument. Problems of governance and uncertainties are two of the main barriers for the feasibility of GE and a sustainable energy transition. These will probably not be worked out in the short run, and given the estimates of James Hansen, “means that humanity doesn’t recognize that it’s dangerously near a tipping point” (Hansen cited in McGrail, 2013). Further, in line with Corry (2017) “it is the security hazard described in this article [that] makes the politics of climate engineering look costlier and decidedly unlike an ‘easy option’ politically”.

The scientific fields that were represented within this paper showed a common ground in the uncertainties, the dangers, but also in the potential benefits of GE. In contrast to the original assumption of general discord across fields, they only differed in their focus of details. Whereas Corry focused his works on the security and moral hazard, he perceived the dangers more prominent within the political sphere, than for example Powys Whyte did within the social. Still, GE has yet to come to the scrutiny of the public around the world, which eventually will happen. The question for future research, derived from this thesis, could be aimed at how uncertainties can be tackled without having to implement large-scale testing for empirical evidence. Also, public perceptions are being shaped everyday by mass media landscapes. How can the world of academia and media work in symbiosis to not only inform, but also form publics and their perceptions? The analysis showed, that to this day the public is relatively uninformed, due to the low perception of salience. How can the perceived salience for GE be increased without entering the informational landscape as a fear or fact mongerer? Rising tendencies of populism (Sikka, 2018) and disinformation through the internet will have a high impact of such goals. The more academia understands not only about their respective scientific fields, but also by further meta-cooperation between them, the chances of knowledge being able to be transposed to the public is likely to be increased.

This thesis should have shown that for one, the discourses on GE have evolved over time in multiple directions. Different branches of science have been focused on different issues coming along with the technology. From governance to physics, GE to this day is marked with uncertainties and unpredictable trajectories. Therefore, the scientific community, as well as the political bodies, share the responsibility alongside the media to not only inform and educate the people about climate change and the possible solutions to it. It is mandatory to

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share perceptions, as well as information as much as possible. In terms of a sustainable energy transition it does seem that once the uncertainties are being eliminated from the discussion, the path for implementation could be paved with ease. Problematic to that would be the testing without testing. Since many contracts prohibit the large-scaled implementation, the calculations based on empirical models will have to function as loose “guarantees” before field testing. Every scientist within the literature that has been read advocated for the proper research being conducted before implementing such technologies. None was for an experimental approach before knowing all the risks connected to GE.

Finally, GE is not only a technological issue, but this thesis should have shown, that its impact is interwoven throughout humanity, since the impact of such interventions are 1. Globally scaled 2. Almost impossible to foresee without testing 3. Seem like an easy “Plan B”. When referring to climate change, publics to this day are focused on the average temperature raise. Yet, climate change and GE are way more than just that. The urgency of precipitation patterns, oceanic acidification and general raising of water levels of the oceans put enormous pressure upon not only science, but also political systems around the world. It will need not only science and politics to tackle the issue, but also the conversation with the rest of the Weberian spheres to be able to prevent humanity from destroying itself for economic profitability. Educating the people throughout the globe will be the best chance in preventing this apocalyptic scenario from happening.

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7. Appendix

	A critical... 39	4: Activism a... 32	5: Frail_clim... 35	6: Legitimac... 41	10: 101Ansh... 43	11: Metapho... 45	12: cony 62	Summe
◇ Benefits	15 18,29%	11 18,97%	1 2,63%	6 8,33%	17 23,29%	27 36,49%	22 15,83%	112 16,47%
◇ Dangers	15 18,29%	15 25,86%	9 23,68%	30 41,67%	18 24,66%	18 24,32%	40 28,78%	178 26,18%
◇ Energy tra...	5 6,10%	7 12,07%	2 5,26%	1 1,39%	3 4,11%		1 0,72%	24 3,53%
◇ Policy imp...	24 29,27%	10 17,24%	6 13,79%	18 25,00%	14 18,18%	5 6,76%	37 26,62%	163 23,97%
◇ Uncertainti...	23 28,09%	15 25,86%	20 52,63%	17 23,61%	21 28,77%	24 32,43%	39 28,06%	203 29,85%
Summe	82 100,00%	58 100,00%	38 100,00%	72 100,00%	73 100,00%	74 100,00%	139 100,00%	680 100,00%

	4: Activism a... 32	Summe
◇ Benefits	11 18,97%	11 18,97%
◇ Dangers	15 25,86%	15 25,86%
◇ Energy tra...	7 12,07%	7 12,07%
◇ Policy imp...	10 17,24%	10 17,24%
◇ Uncertainti...	15 25,86%	15 25,86%
Summe	58 100,00%	58 100,00%

	5: Frail_clim... 35	Summe
◇ Benefits	1 2,63%	1 2,63%
◇ Dangers	9 23,68%	9 23,68%
◇ Energy tra...	2 5,26%	2 5,26%
◇ Policy imp...	6 15,79%	6 15,79%
◇ Uncertainti...	20 52,63%	20 52,63%
Summe	38 100,00%	38 100,00%

		📄 12: corry 🗨️ 62	Summe
◇ Benefits	🗨️ 112	22 15,83%	22 15,83%
◇ Dangers	🗨️ 178	40 28,78%	40 28,78%
◇ Energy tra...	🗨️ 24	1 0,72%	1 0,72%
◇ Policy imp...	🗨️ 163	37 26,62%	37 26,62%
◇ Uncertainti...	🗨️ 203	39 28,06%	39 28,06%
Summe		139 100,00%	139 100,00%

		📄 1: Discourse... 🗨️ 40	Summe
◇ Benefits	🗨️ 112	2	2
◇ Dangers	🗨️ 178	12	12
◇ Energy tra...	🗨️ 24		0
◇ Policy imp...	🗨️ 163	22	22
◇ Uncertainti...	🗨️ 203	24	24
Summe		60	60

		📄 11: Metapho... 🗨️ 45	Summe
◇ Benefits	🗨️ 112	27 36,49%	27 36,49%
◇ Dangers	🗨️ 178	18 24,32%	18 24,32%
◇ Policy imp...	🗨️ 163	5 6,76%	5 6,76%
◇ Uncertainti...	🗨️ 203	24 32,43%	24 32,43%
Summe		74 100,00%	74 100,00%

		2: Indigeneit... 46	Summe
◇ Benefits	112	11 13,10%	11 13,10%
◇ Dangers	178	21 25,00%	21 25,00%
◇ Energy tra...	24	5 5,95%	5 5,95%
◇ Policy imp...	163	27 32,14%	27 32,14%
◇ Uncertainti...	203	20 23,81%	20 23,81%
Summe		84 100,00%	84 100,00%

		3: A critical... 39	Summe
◇ Benefits	112	15	15
◇ Dangers	178	15	15
◇ Energy tra...	24	5	5
◇ Policy imp...	163	24	24
◇ Uncertainti...	203	23	23
Summe		82	82

