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Unlocking Fossil Fuel Dependency in the European Union

Studying the Failures of Removing Fossil Fuel Subsidies in the European Union and Possible Pathways Forward.

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Abstract

Despite the well-known threat that the use of fossil fuels poses to the climate many countries continue to provide large subsidies to the fossil fuel industry. The EU has declared that its member states should phase-out fossil fuel subsidies, but progress has been lacking and subsidies for fossil fuels in the EU remain large. This paper aims to understand which factors explain the persistence of subsidies as well as the factors which can reduce these. In order to understand this puzzle a co-variational research design is applied. The main independent variable political will is compared together with three control variables across six member states. The member state's national energy and climate plans are analysed using a qualitative content analysis to help determine the degree of political will reflected in working to remove fossil fuel subsidies. The main findings from this paper indicate that having at least a moderate political will is a necessary factor if a country is to reduce its fossil fuel subsidies. A large renewable energy sector works as an enabling factor making this reduction larger. Therefore, a combination of these two factors is necessary if countries are to reach the goal of phasing out fossil fuel subsidies.

Key words: Fossil Fuel Subsidies, Political Will, Carbon Lock-ins, Path Dependency, Climate Change.
Words: 19 999

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List of Abbreviations

CO_2	Carbon Dioxide
COV	Co-Variational
EHS	Environmentally Harmful Subsidies
EU	European Union
FFS	Fossil Fuel Subsidies
G20	Group of 20
GDP	Gross Domestic Product
GHG	Green House Gases
GII	Global Innovation Index
IEA	International Energy Agency
IMF	International Monetary Fund
IO	International Organization
IPCC	International Panel on Climate Change
NECP	National Energy and Climate Plan
OECD	The Organization for Economic Co-operation and Development
PISA	The Programme for International Student Assessment
QCA	Qualitative Content Analysis
RE	Renewable Energy
SEI	Swedish Environmental Institute
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
WTO	World Trade Organization

1 Introduction

1.1 Background

Climate change is one of the greatest challenges facing humanity in modern times. We know that if we do not change our current way of life and manage to reduce emissions drastically the planet will face severe consequences in the shape of rising sea levels, drought, biodiversity loss and other long-lasting effects. The usage of fossil fuels poses a great challenge if we wish to reach the goal of not increasing global temperatures to more than 2°C or preferably 1.5°C, which was agreed upon in the Paris Agreement (UN 2015). The IEA estimated that even a partial phase out of environmentally harmful subsidies (EHS) could reduce GHG emissions by 12%, the amount needed to keep the world on track for the 2°C goal (ODI 2013 p.1). Despite the current knowledge of fossil fuels negative impact on the climate and effects of removing them the usage of fossil fuel continues and many countries still subsidize fossil fuels. Recent studies have found that fossil fuel subsidies (further referred to as FFS) make up 6.3% of global GDP which equals 4.7 trillion USD (IMF 2019 p.4). In the EU FFS are estimated to range between €39 to over €200 billion annually (Hayer 2017 p.4). Indicating that there is a lack of coherence between the member states in their transparency when it comes to the subsidies as well as the complexity in removing them.

The EU has positioned itself as a strong leader in global environmental governance and has introduced many ambitious goals for mitigating climate change. For example, the union aims to have no net emissions of GHG by 2050 as well as wanting to decouple economic growth from resource use (European Commission 2020a). These are ambitious goals which requires a transition from fossil fuels to more sustainable alternative energy sources. The EU has made several pledges to phase out harmful subsidies including FFS. One of these pledges was made during the Pittsburg G20 in 2009. The EU is represented in the G20 group by the President of the Commission and the president of the EU council (G20 Research Group 2009). Despite this member states continue to provide FFS and no country has yet achieved the goal of a complete phase out (Trinomics 2019 p.268). This failure poses the question why subsidies for fossil fuels continue to persist despite the knowledge that they are harmful to the environment and in direct opposition to EU climate targets. Removing FFS in the EU would not only be beneficial in environmental terms but would also mean the money that would usually be spent on the EHS could be redistributed to help achieve the EU's goal of transferring to

a more sustainable union (Directorate-General for Environment 2013). So why is not more action being taken regarding this urgent issue of removing FFS?

1.2 Aim and Research Question

The aim of this paper is to study and try to better understand and explain what factors are hindering member states in the EU from removing FFS. Despite the known negative impact the subsidies have on the environment as well as also being directly counterproductive to the EU's climate goals. The paper also aims to better understand which factors can help facilitate a reduction of FFS. By doing so this paper aims to help answer why the EU's goal of removing FFS has not yet been achieved. The hope is that this paper by further studying the factors which cause persistence of FFS in the EU can help contribute to the knowledge how future policies can be shaped in order to reach the goal of removing them and help explain why so many environmental goals are not met despite being agreed upon. This paper will also contribute with ideas for future research in the field of FFS, which will be important in order to reach climate goals in the future and transition to a pathway free from fossil fuels.

Based on the aim and background section the research question guiding this paper will be the following:

- *What factors explain the persistence of FFS in the EU and which factors could facilitate a reduction of these?*

1.3 Epistemological and Ontological Approach

In order to provide the reader with clarity and to fully understand and grasp the content of this paper and why certain methodological choices have been made it is of value to understand from which epistemological and ontological approaches the research is being conducted from. Firstly, the ontological approach of this paper lies within the foundationalist understanding the world. This understanding and view of the world states that there is a real world which exists independent of our knowledge of it, therefore not dependent on our direct observation of it (Marsh et al. 2017 p.182).

Secondly, within the epistemological approach this paper belongs to the realist perspective or more specifically a critical realist perspective of understanding the world and how knowledge is acquired. The critical realist perspective shares the understanding with the positivist approach in that the concern lies in establishing causal relationships to understand the world. The difference however lies in that the critical realist does not privilege the direct observations. Instead, this approach

believes that there are structural behaviours which have an impact on different social phenomena. These structural relationships cannot be directly observed but are important for understanding the world (Ibid p.184). Though they cannot be directly observed, the knowledge of their existence can help explain social action which can be observed directly (Ibid p.194). The critical realist perspective will become more evident when reading this paper and is reflected in the methodological choices made. For example, in how the variables used have been chosen based on their ability to reflect theory with the underlying idea that the variables have a causal impact on the persistence on FFS. *Political will,* for example is considered to play a key causal role in explaining the persistence of FFS as well as being important for removing them but is not something that is simple to measure or can be directly observed. This will be further discussed later in the paper.

2 Literature Review

This section will present results and discussions from previous studies conducted which are of interest to the aim of this paper. The literature presented here will help define important factors which are considered important to study for understanding the persistence of FFS. The definition of what constitutes FFS will be brought up, different estimations of the potential effects of removing FFS will be examined and finally the possible ways forward for phasing out FFS in the future will be presented. These different studies will be utilized later in the analysis and be discussed in relation to the results of the study.

2.1 Defining Fossil Fuel Subsidies

One of the difficult aspects when it comes to removing FFS is that the definitions of what constitutes as such varies depending on which definition a country or organization has adapted to. Subsidies for fossil fuels are considered a hindrance for reaching international climate targets, despite this there is not one agreed upon definition of what constitutes such subsidies, which is quite puzzling. Policies which lower the price of fossil fuels for consumers below the market price is unanimously considered a subsidy, however other cases are more disputed. Two distinctions when discussing subsidies which are important to highlight is firstly the one between definitions which define them in terms of benefits conferred on a specific group and secondly the definition which define it in terms of a price gap between the factual price and a benchmark price (Skovgaard 2017 p.343). The OECD and IMF are two examples of international organizations which have differing definitions of what constitutes a subsidy. The IMF's definition considers environmental externalities in its calculation which is a radical difference from the OECD definition which is seen as being more conventional. The different uses of what constitutes a subsidy can result in vastly different estimations of FFS (Ibid p.342). This dilemma is not unique to these two IOs, when studying the EU, one comes across an indicator of a similar problem where there is no standard definition of energy subsidies within the EU. This provides the member states with a considerable freedom when reporting on their FFS and creates a problem with transparency and complicating any cross-country comparison (European Commission 2020b p.1). The literature highlighting the gap between countries and IOs perception of what constitutes FFS is important knowledge in understanding the difficulty of also removing them. Even though as discussed previously the goals which have been agreed in removing these subsidies are often international, the

action in removing them lacks international agreement on their definition which complicates political action unless a definition is agreed upon.

2.2 Estimated Effects of a Removal of Subsidies

2.2.1 Environmental Impact

One of the most common arguments used when advocating for a removal of FFS and a major subsidy reform is that this is a crucial step in mitigating climate change and keeping global warming below a 2°C increase. Several studies have studied this claim and tried to measure the impact of reforming and removal EHS on the climate. As previously mentioned in the introduction one study conducted found that FFS accounted for 6.5% of global GDP both in 2013 and 2015. The same study suggests that the CO_2 reduction gained from removing post tax subsidies using 2013 figures amounts to a 21% decrease (Coady et al. 2017). Which is a significant finding and could prove crucial in reaching climate targets.

Another study conducted by the Potsdam Institute for Climate Impact Research also studied the effect of phasing out fossil fuels but conducted a comparison focusing on both the short- and long-term effects on the environment. The results confirm the short term positive environmental effects of removing EHS as found in by Coady et al. However, these benefits are smaller in the long term, therefore highlighting the importance of combining a removal of FFS with other policies. Otherwise, there is a risk of slowing down the global transition towards a renewable energy system (Schwanitz et al. 2014). This highlights the importance of having a holistic focus when setting environmental policies, just removing subsidies for fossil fuels is not sufficient to transfer to a cleaner energy system and fulfilling the Paris agreement. The studies also highlight the importance of removing the subsidies and transitioning to a more sustainable global energy system if countries wish to lower emissions and mitigate climate change.

2.2.2 Socioeconomic Impact

Having access to cheap energy alternatives is essential for a large portion of the global population and is also seen as an important pathway for reducing poverty globally. Currently one billion people are living without access to electricity, posing the dilemma of how to provide access to energy for these people while simultaneously reducing harmful carbon emissions. There tends to be a positive feedback mechanism between energy resources, infrastructure and industrial development which suggests a locking-in of economies into specific consumption patterns (Fouquet 2016 p.1). In the poorest countries a World Bank study found that households spend as much as 10% of their income on energy, mostly related to

necessities such as boiling water and for cooking. A removal of subsidies which lower consumption prices would therefore hit these households disproportionately harder (Birdsall & Diofasi 2015). Highlighting the importance of removing subsidies with a holistic approach so that already vulnerable groups are not the most affected by any negative consequences. However, studies have also shown that FFS disproportionately benefit the top quintile in society. With this group on average receiving more than six times the subsidies compared to the bottom quintile. The same study also found that although low-income households receive a higher share of the subsidies associated with kerosene there is a substantial leakage of these to the higher earning income groups. Sustaining these subsidies are also non effective through an economic viewpoint where for example transferring one USD to the poorest 40% used for the study this cost is actually 14 USD. Due to 93% of this cost leaking to the higher quintiles. It is important to highlight that even though the higher income groups receive a greater proportion of the subsidy benefits low-income groups could be due to subsidy reform loose a sizable part of their incomes. Once again highlighting the importance of well targeted measures when conducting a subsidy phase out reform (Coady et al. 2015 p.12-14).

2.3 Potential Pathways for Phasing Out Fossil Fuel Subsidies

2.3.1 EU State Aid Mechanism

One important mechanism which could possibly be used to phase out the subsidies is the EU's State aid control mechanism. Which does not require member states agreement and political will in order to enforce it (Nowag, Mundaca & Åhman, 2020 p.5). State aid according to the EU courts are described as economic advantages which would not have been available under normal market conditions. This could be what we refer to as subsidies, but it could also mean an economic burden in some cases (Ibid. p.12). By establishing a separate category for FFS, the EU could use State aid laws to control the subsidies (Ibid. p.25). Using the state aid law would require member states to report them to the Commission to be accepted, before implementing them in practice. The Commission would therefore make a determination of the legality of the aid. These rules also require transparency and all the aids granted are to be published each year for the different areas and for which state they have been granted for. As of now fossil fuels are not a separate category but likely found under the Energy and Environmental Aid category. Establishing a separate category for fossil fuel aids and using the transparency mechanisms could help with addressing state aid such as FFS which contrast with the EU's commitment to address climate change. Lastly, the state aid tools are important since the Commission has the power to determine which aid should be

considered legal and under what conditions it should be accepted. Therefore, the Commission holds the power to under some conditions stop harmful subsidies from being granted (Ibid p.22-24). It has been estimated that using the EU State aid law could address between €58.22-€69.59 billion of the current FFS within the EU. While this is not the full extent of the subsidies it is a substantial amount which could be addressed using this law (Ibid p.25).

One of the perhaps most cited characteristics of the EU is the access to the internal market with a guarantee of full competition. There is a wide legislation dealing with competition issues with the goal of ensuring the market is not distorted by state practices which could potentially harm consumers. There is however a growing number of cases where the European Commission has allowed state aid for government projects which support fossil fuel energy projects including aid for inefficient coal mines. Capacity mechanisms is a form of State aid which is granted in order to support the availability of electricity and ensure that this demand is always met. Though they can exist in various form they usually offer payments to electricity providers. They have been more debated in recent years where a discussion of their necessity has risen. If they are as essential as they have been perceived and if they are in fact are contributing to a rise in FFS. Especially since it has been found that low-carbon options were more often discarded in favour for fossil fuel options when it came to security of supply in the EU (Trilling et al. 2017 p.8).

This research shows important potential paths towards removing the harmful subsidies using already existing tools as well as raising the question why the EU has not used this measure already since it would help achieve several of the environmental goals set. Though the capacity mechanisms provide a challenge it also highlights a fault in the system where the Commission in many cases contradicts its own goals in terms of removing fossil fuels subsidies.

2.3.2 Creating Change in Technological Systems

In order to be able to fulfil the different climate goals set such as the goal of removing harmful subsidies in the EU and the 1.5 °C target specified in the Paris Agreement knowledge of how to escape and break free from society's dependence on fossil fuels dependency is crucial. The question of how to create pathways to greener and cleaner alternatives is complex since modern society today is heavily dependent on access to cheap energy sources, but there has been research conducted which aims to answer the questions regarding on how to transition to a greener low carbon society. In industrial countries energy and transportation systems are large emitters of GHG. These complex systems have a long history and over time become integrated in society as a result of preferences, expectations and routines. They have also been integrated in institutions due to policy reasons such as universal services, monopoly and other reasons which override market forces and create a pathway which is hard to undo (Unruh 2002 p.317). Though one may argue that such important systems create stability and reliability in society they can also create an unwillingness to change which over time can prove to be problematic, which is the

case today when many of our integrated systems have proven to be harmful to the environment. Change is despite this possible which has been proven in certain cases. The major challenge for policy makers is to create a change in systems which mitigates the negative environmental consequences but also minimizes social disruption which may occur.

Unruh presents three different ideas for creating change in complex technological systems. Firstly, making no changes to the system but treating emissions. The second strategy is to modify certain aspects of the system but maintain the main part of it. These two approaches try to treat any unwanted aspects of the system with add-on technologies, for example end-of-pipe technologies. Both approaches can be referred to as continuity approaches which seek to maintain the system as intact as possible. The third and most extreme sometimes referred alternative is to replace the whole system, referred to as a discontinuity approach (Ibid p. 218). Policy options between the discontinuity and continuity approaches should not be constrained by available technologies instead available technologies can facilitate changes in both approaches. Using renewables technologies can act as a component switch for fossil fuel technologies but it can also be used in a discontinuous strategy for abandoning fossil fuel-based systems. An important aspect to consider when moving away from traditional energy-based systems is that policy makers should be expected to be resistant and favour continuity approaches over a radical change (Ibid p.319).

Institutional theory highlights that institutions favour stability and in order to achieve change a major event or external shock is necessary to reach a different path and thereafter a new stability point. Few researchers have studied or found cases where technological pathways have been broken but there are a few examples. (Ibid p. 320-21). One study which studied the case of combustion automobiles found that there were six types of events which could help with a change of pathways. These were a crisis in the technology involved, regulations, technological breakthroughs, changes in preferences, niche markets and finally scientific results (Ibid p.321). In the case of fossil fuels, the science has already proven the known harms of burning these and one could also argue that there are many alternative energy sources which could be utilized instead. Given the case of this paper of why the EU has not removed the subsidies the major factors left to consider is mainly why there have not been tougher regulations and changes in preferences (especially given the available science). It is also worth discussing how easy it would be to change preferences in terms of systems which play a major part of our infrastructure since we all are reliant and dependent on these. Two potential sources of change regarding these large-scale systems are addressed by Unruh and these are technological and institutional. These are of course also interdependent and a change in one of these often result in changes in the other. In terms of climate change technology is a very major aspect and new technology is needed to replace existing fossil fuel-based systems and a lot of alternatives do exist. A problem is however that a transition to new technologies requires increasing returns on both the demand and supply side, and for that to happen the market share of these technologies would have to increase. Dominant design producers are rarely able to shift to a new technology and try to sustain the current system (Ibid p. 321).

Institutions play a major role in the extension of technological systems however as previously mentioned institutional change does not come easily or rapidly. One possibility in reaching institutional change is that such a change will occur when enough influential members of society recognize the societal importance or such a change, due to the effects of a fossil fuel-based system being intolerable. Rising ocean levels, rising temperatures, deforestation, melting polar caps and other effects of climate change could trigger this. Research however shows that a lot of these examples are already happening around the world. Recognition of the effects seem to be insufficient in reaching a change so far in removing these major fossil fuel-based systems, begging the question if a focusing event is needed in order to initiate a pathway to change (Ibid p.322-23). Looking at these important aspects of reaching a change in terms of our large technological and infrastructural systems it seems like both technological and institutional changes must occur. However, many new technologies are today known which could serve as future substitutes and are in many cases applied to a certain extent for providing energy. It therefore seems like an institutional change and support for these is essential in reaching a new pathway which does not rely on fossil fuel-based systems.

2.3.3 Technological Regimes and Transitional Change

Technology and the environment have a strong but complicated relationship. Where a lot of the debates concerning climate change views technology as a contributing factor for a lot of the current issues concerning it, but also as a possible pathway out of carbon dependency and as a solution for reducing emissions and minimizing environmental impact. But the question remains how industrialized countries which are heavily dependent on carbon could move away and be decarbonized. Previously the debate and research concerning the relationship between technology and environment has mainly been focused on discrete technologies in already functioning systems. By focusing on discrete technological changes, price setting has been central within this perspective. Where price has been seen as an efficient incentive for influencing technological and organizational innovation. Unfortunately, this perspective can also be seen to having contained the discussion to focus on discrete technologies, instead of other perspectives.

The first problem with this limited focus is that by solely focusing on micro-changes within a system one could miss dynamics across the wider technological system. Secondly, the distinguishment between ‘clean’ and ‘dirty’ technology becomes more difficult. Where a single component of environmental performance is highlighted, instead of providing a holistic picture of the entire system. This is not to say that incremental micro changes are not of importance, but a discussion which is one dimensional in its focus can be harmful. There has been a more shift towards ‘system studies’ which aim, to understand how technological systems and how these can be understood in terms of their resource and environmental profiles. This has led to more normative discussions about the future society and technological systems, and more importantly how to bring about change. For there to be a transitional change in technological systems there firstly needs to be a

consensus that this is a necessary step. This must be agreed upon amongst a broad range of actors and institutions. To understand regime change one often highlights stability and continuity to why change rarely happens. Others stress the 'switching costs' which is associated in transitioning between technologies. As well as the importance of commitment to a particular technological regime which is embedded in institutional, political and economic practices. However, the conditions for a change to occur is often very vague. Some conditions which are seen to be a possible pathway for creating change is firstly to consider the many incremental changes within systems and how they could lead to a growing efficiency and integration of environmental ideals. Secondly, regime changes can be viewed as a reorientation of prevailing systems, imaginably leading these onto a more sustainable path. Thirdly, a system change could come to happen incrementally over time to finally replace the prevailing one. An example of this is the transition from wood to coal in recent history. Finally, there may be a normative desire to speed up the regime change in technological systems. Even if a newer system has not yet reached the acceptance of a broad range of actors' history has showed that the emergence of substitutions can emerge in a co-evolutionary process, which can then be utilized by the people which support it.

There are ways to break free from prevailing carbon intense technologies, but it is also important to remember what is referred to as the 'paradox of entrenchment'. Which is that innovation and adoption of new technological regime cannot be achieved without commitment from governments and commercial organizations. There is a need to make heavy commitments to a new technology in order to create a new technological regime but knowing if this technology is optimal or not cannot be decided till after the commitment (Berkhout 2002. p.1-4). How does this relate to the question of why FFS are persisting despite the EU's goal of removing them? Firstly, it highlights the importance of understanding the costs associated with a transition of technological systems. Institutions and political actors may be aware of the environmental benefits of transitioning away from a certain technological system but at the same time the unknowingness of the long-term effects of a new system may prevent political action. The EU and its member state have agreed to the goal of removing subsidies signalling a consensus that this is needed however there seems to be a lacking in knowing how to put this into action. Perhaps due to costs associated with a transition. Secondly, it shows that a transition is possible and removing FFS is not an impossible task, but it requires work and knowledge on which pathway to choose.

3 Theoretical Framework

In this section the different theories and theoretical concepts used to conduct the analysis will be presented. These will later be used to analyse the material and ultimately to help answer the research question of how the persistence of FFS in the EU can be understood and explained.

3.1 Path Dependency and Carbon Lock-ins

Carbon lock-ins is a concept originating from path dependency. Path dependency indicates that past events and decisions tend to self-reinforce which means that the prospect for newer alternatives to be enforced are diminishing and less likely to occur (Erickson et al. 2015 p.1). Path dependency is closely intertwined with transition theory and social memory. One can view a pathway as a process where a certain memory is passed on from one actor or generation to another. This memory consists of experience and knowledge. Pathways are directional and bounded by a 'corridor of the possible', where beyond this corridor human decisions are considered unthinkable, and the decisions made are all within this narrow corridor. The pathways are usually non static and fluctuate depending on factors of change. Pathways are commonly associated with 'nodes' or small bumps indicating a small change in direction of the pathway, these nodes of decision making when added together make up a certain direction of pathway trajectory which defines the path dependency (Wilson 2014 p.8).

Carbon lock-ins is the concept used to explain why technological, political, economic and social efforts are often constrained in industrial countries despite their efforts to reduce carbon emissions, instead countries have been locked into using fossil fuel-based systems and locking out cleaner greener alternatives (Unruh 2000 p.817). In industrial countries a great share of the CO_2 emitted originate from the complex systems which are needed to supply electricity and make up the transportation sector. These systems have become integrated in society as preferences as time has progressed. Eventually also integrating with governmental institutions due to policy reasons such as security, antitrust, universal service or monopoly reasons to name a few. Resulting in carbon lock-ins which despite their now known unwanted consequences are difficult to unlock and remove due to their deep integration in society (Unruh 2002 p.317). Carbon lock-ins pose a great threat to climate change since there is a need for conducting large societal changes within a certain timeline in order to be able to reach the goals of for example the Paris Agreement and other important climate targets which are seen as necessary to mitigate climate change. It is possible to divide carbon lock-ins into different groups

where the most frequently discussed are technological and infrastructural lock-ins, institutional lock-ins and finally behavioural lock-ins, these will be further discussed in the sections below (Seto et al. 2016 p.426).

3.1.1 Technological and Infrastructural Lock-ins

Technological and infrastructural lock-ins refer to when carbon emissions are being locked in due to the long resilience of physical infrastructure and current technology in society. This occurs when initial financial investments which are associated with large technological and infrastructural systems since these are considered quite costly and have long lead times. Therefore, an investment made today is not expected to pay off until much later in the future. For example, street layouts, buildings and other land use patterns are examples often associated with infrastructural lock-ins. There are two main ways in which one could reduce the CO_2 emissions associated with large scale technological and infrastructural lock-ins. The first is to decrease the carbon intensity used per unit of energy and the second is to decrease the energy intensity of the economy, the energy associated per unit of economic output (Seto et al. 2016 p.427). There are also less direct infrastructures which support fossil fuel consumption, for example one could look at gasoline stations, refineries and pipelines as supporting the continued lock-in of carbon intense infrastructure. Since these directly benefit from the continuance of fossil fuel consumption and also the carbon lock-ins (Ibid p. 428). Carbon-emission supporting structure is therefore a serious problem which should be included when discussing a transition away from carbon dependency. Most of the different technologies which are emitting CO_2 are dependent on the existence of supporting networks such as previously mentioned for example pipelines, refineries and refuelling stations (Ibid p.431). The most long-lived form of energy demanding infrastructure is not in contrast to what one might believe power plants but instead buildings, transportation infrastructure and other spatial urban settlements infrastructure. Once these are in place it is not easy to reverse or remove these thereby creating perhaps one of the most difficult lock-in to unlock in terms of energy intensity.

3.1.2 Institutional Lock-ins

Institutional lock-ins are referring to the lock-in effects which can be seen as a result from institutional rules and regulations. These reinforce for example the infrastructural and technical lock-ins. The institutional lock-ins in comparison to infrastructural and technical ones are not seen as unintended consequences by certain decisions but instead they are considered intended features of the institutional design. Which are caused by intended efforts driven by powerful economic and political actors which can be seen to want to reinforce their own goals. By engaging in international coordinated efforts to structure these norms and rules which promote their goals in ways which would not arise otherwise. These

institutional lock-ins are not beneficial for society in a welfare perspective, but they are beneficial to the 'winners' in this institutional battle. Since the institutional lock-ins are resulting from political processes rather than market forces they are more occurring than the infrastructural and technological ones, also often occurring with higher intensity. However, both these are similar in how they can result in an equilibrium with resistance change and proves costly in switching to another alternative (Seto et al. 2016 p.433). How institutional lock-ins are generated can be seen to reflect a power struggle between actors which favour current economic, cultural or social arrangements and those who would benefit from competing arrangements. Institutions can help both achieve their set goals. Institutions enhance the different interests of powerful actors which in turn increases the resources available to these, for example actors in oil and energy companies. The actors who benefit from the institutional rules will strive for more rules which help further their interests and provide them with resources. Shaping the institutions to their liking and benefit. The networks of relationships which exist block initiatives for adopting policies which would help move towards a low carbon transition. Institutional lock-ins tend to emerge through coevolution involving several systems or spheres. Meaning that interactive dynamics favour reproductive actions in contrast to disruptive changes within the systems and spheres. When disruptive changes do occur, they tend to be blocked by the system or sphere in which it emerged or through other spheres and systems. During time making the whole system more resistant to change (Ibid p.434).

Institutional lock-ins are deep rooted and escaping them is a difficult task but according to research not an impossible one. Institutional lock-ins as time progresses become both more likely and resilient, therefore difficult to unlock. A low-carbon transition will need to be rooted at each level of governance in every sphere. Such a transition will be rejected and refused by those benefiting from the current system. This can be overcome through international efforts or beneficial circumstances which create favourable conditions of institutional plasticity. Helping shift political and economic advantage to those benefiting from a low-carbon transition. Removing subsidies, tax provisions and other policies which help favour carbon intensive industries could play an important role in boosting institutional plasticity and helping lay a path towards a low-carbon society (Ibid p.435).

3.1.3 Behavioural Lock-ins

Behavioural lock-ins refer to patterns in human behaviour which is unsustainable from an environmental point of view and therefore a problem for mitigating climate change. Behavioural lock-ins can refer to for example travel patterns, household energy consumption and other consumption patterns which have a large effect on the global climate. These social norms are usually considered as quite slow-moving since human behaviour tends to evolve over centuries. However, there is reason to believe that human behaviour can change quicker when provided with more information. Smoking is one good example of a quick

behavioural change in norms. A lack of understanding for how energy consumption affects the climate has led to an increase in energy use, even though energy use is more efficient today. As an example, it has been estimated that a shift in travel behaviour could reduce emissions by as much as 50% by the end of the century (Seto et al. 2016 p.438). Psychological barriers are important factors which hinder change in behaviour at an individual level. For example, individual habits, sense of urgency regarding the climate crisis and other ingrained behaviours which are resistant to change have a large effect on behavioural lock-ins and individual actions. Research suggests that in order to break free and change behavioural lock-ins these psychological barriers need to be addressed (Ibid. p.439).

Though individual behavioural is an important factor when understanding behavioural lock-ins it is also necessary to look at this from a structural perspective. Existing infrastructures, technologies, norms, culture and our societal routines all influence societal behaviours which constrains individual behaviour (Ibid p.440). Therefore, in order to understand the individual choices made by individuals it is important to put these choices in a larger context studying the societal structures and if these are in fact influencing choices being made. Socially shared practices are coevolving together with technologies, infrastructures, policies and cultural norms. These are also responsive to changes in these environments but also path dependent. Behaviours are deeply rooted in a complex system of cognitive processes, technology, infrastructure, values and institutions. Changing behaviours cannot be achieved without considering this complexity and interconnectedness of these systems. Policies must respond to the system as a whole instead of only focusing on one part of the system for example behaviour (Ibid p. 440). Theoretically there are three major causes of system changes. The first is cause for systematic changes is that systems change due to the elements needed to accomplish them changes. Secondly, when populations using these changes can help accomplish system changes. Lastly, change can also come about when related and interdependent practices to systems change (Ibid p.441).

3.1.4 Interdependence and Reinforcement between lock-ins

When studying the different categories which are commonly discussed within the wider concept of carbon lock-ins it is evident that between these there exists a deep-rooted interdependent relationship. Where one certain type of carbon lock-in reinforce by another. For example, changes in institutions affect social practices which then in term affects individual behaviour which affects infrastructure and technological lock-ins and so on. Increasing the returns to scale which drive lock-ins. The relationships are also multidirectional which suggests that levels can both be affected and affect one another (Ibid. p.442-443). Understanding this interdependence and complexity of the lock-ins also raises the question of how a change can come about in order to move away from the carbon dependency and if one level is more important than another for initiating change. Should change come about at every level or can it be initiated at one level to spread to others through its connectivity? This is an important aspect to have in mind when discussing issues

related to carbon lock-ins and in this case the question of how to remove FFS. This question will be revisited later in this paper.

4 Methodology

In this section the different methodological choices decided upon in order to be able to conduct this research will be discussed. The method of choice for analysis, case selection strategy, data collection strategy and the limitations of these choices will all be discussed here in order to provide clarity and transparency.

4.1 Co-variational Analysis

As a primary method for this paper co-variational (COV) analysis will be utilized. COV analysis is a method used to conduct small N-studies and is aimed at presenting evidence of a co-variation between a main independent variable and a dependent variable to infer causality. Since this research aims to determine which factors have caused the persistence of FFS in the EU as well as which factors can facilitate a reduction, applying the COV approach the research question is suitable and will be useful for understanding the puzzle regarding the remanence of FFS (Blatter & Haverland 2012 p.33).

The COV approach compares cases systematically by looking at the variations between their different features. Since the method is aimed at finding a correlation between the independent variables' effect on the dependent variable. Other factors will have to be controlled for which could have a causal effect on the dependent variable. Therefore, choosing control variables is extremely important and should be considered with caution. Because of this assumption a key aspect of the COV approach is that one must assume that the factor of interest is both necessary and sufficient in order to produce the outcome. A necessary factor specifies that with its absence the outcome cannot occur while a sufficient factor the outcome must occur (Ibid p.39). The control variables are therefore chosen based on their assumed effect on the dependent variable. This assumption is based on theory and previous research in the field. The COV approach is based on the assumption of causality between the independent and dependent variables, in contrast to larger observational N-studies.

It is not possible to generalize the results from a COV study to a larger population (Ibid p.69). Which could be viewed as a limitation of the method. This paper would argue that a wider generation is not the goal of this research, instead the goal is to understand the lack of action within the EU. The COV-approach does allow for generalization for cases with the same scores on the control variables and independent variable which can help shed light on the puzzle of why FFS remain in the EU.

4.1.1 Case Selection Method

Case selection is a crucial step within the COV approach and is especially important in relation to making a good case for the causal inference of the independent variable. A faulty case selection could hurt the validity of this claim and should therefore be considered carefully. Cases should never be chosen randomly, instead cases which are chosen should vary as much as possible in the independent variable of interest and should be as similar as possible regarding the control variables. This method is referred to as both 'comparable cases' and 'the comparative method' (Blatter & Haverland 2012 p.42). By using this comparative method for case selection, the different EU member states will be compared by the chosen main independent and control variables in order to select fitting candidates. They will not be compared or chosen regarding the dependent variable which is important in order to ensure the validity of the research design. When comparing the different cases, one usually speaks of spatial or temporal variation regarding the independent variables. Spatial variation in the main independent variable refers to cases which display this variation at the same moment in time and is called a cross-sectional design. Compared to the intertemporal design where the temporal variation of the main independent variable is of interest and compares before and after a change of score in that variable (Ibid. p.44). In this paper the cross-sectional design will be utilized since the EU member states will be compared during the time period from when the goal of removing subsidies was decided on up until present time and not be chosen in relation to a change in the main independent variable.

Choosing the main independent variable and the control variables is a crucial step for the analysis to be considered valid. For these choices to be conducted in a methodologically correct manner they should be considered with great caution and in relation to the dependent variable. More specifically what is the effect, outcome, consequences of phenomena the research is interested in when analysing the cases against each other (Ibid p.52). When choosing a variable and hypothesizing why the variable influences another variable it is important to clarify and present information of why this assumption is being made. For example, if the assumed effects are expected to be positive or negative (Ibid p.53).

As stated, before control variables are important factors when conducting the case selection and should be kept constant for the different cases compared. It is also important when choosing control variables to include these on the basis that they might also influence the dependent variable. Therefore, an inclusion of these will control for these effects. The similarities of the control variables between cases should be demonstrated and not simply assumed. Although it is impossible to include all possible variables which might influence the dependent variable it is important that the most relevant ones are included in the study otherwise it could lead to omitted variable bias. Omitted variable bias refers to the case where the research results may demonstrate a spurious rather than causal relationship due to a plausible explanation being left out. The causal factors should be based on theoretical approaches which aim to explain the dependent variable (Ibid p.54). In order to assure that this research does not suffer from omitted variable bias the selection of independent control variables will be conducted with caution and the

final selection will be clarified and presented in this paper. The selection will also be based on theoretical assumptions used to explain the dependent variable which is the persistence of FFS within the EU.

4.2 Qualitative Content Analysis

Qualitative content analysis (QCA) will be the method applied when analysing the data selected for determining the main independent variable which has been named *political will*. QCA is a technique which can be used to systematically analyse different texts, in this case it will be applied on the NECPs provided by the member states to the EU commission. By applying this method it is then possible to understand the different underlying themes and core ideas which characterize the texts (Drisko & Maschi 2015, p.82). This study will utilize what is referred to as the direct content analysis method. This approach uses a structured method of using previous theory or research in order to use key concepts or variables as initial coding categories (Hsieh & Shannon 2005 p.1281). This study will therefore create pre-existing categories which will be used for studying the different NECPs in the analysis. There will also be room for when analysing the material to create new categories and codes if the pre-existing ones do not apply to certain content. By using both pre-existing categories as well as categories created in the later stage one can both utilize previous research and theory while also further refine it or even contradict it (Ibid p.1282). Providing this paper with a more holistic approach in explaining why FFS in the EU continue to persist and how countries view them as an issue which will be important if the goal of a full removal can be possible.

4.2.1 Coding Scheme for NECPs

The coding scheme used to conduct the QCA will be presented further in this section. This coding scheme has been created in order to capture the member states' different political will regarding the goal of phasing out FFS. The coding categories will be primarily based on the conceptual definition of political will which will be discussed in section 5.1, but not solely on it since some of the components are not possible to apply in relation to the NECPs. The different categories will in this section be further explained and motivated to provide the analysis with transparency and clarity to why they have been chosen.

Ambition

In this code text which relates to certain ambitions in relation to FFS will be filed under. Ambitions will be parts of the plans which discuss different goals but not the more concrete steps for reaching these. These ambitions can for example be to phase out FFS by 2030 or similar. Ambition is an important reflection of how the

problem is viewed in the country and if there is a commonly found policy solution regarding FFS.

Commitment

Under this category specific measures which reflect a commitment and intent to phase out subsidies will be categorized under. As previously discussed, determining the intent or commitment of decision makers is a complex task but studying the different measures which are discussed in the different plans is a good indicator if there is a real political will of phasing out subsidies or not. This can both include measures which have already been put into action in the different member states, but it could also apply to future measures which are planned but not yet implemented in relation to phasing out subsidies. This category does relate to the ambition code but this one entails more detailed and concrete measures not solely having the goal of phasing out but showing progress in having steps for doing so.

Support for Fossil Fuels

This category will help collect all the different parts of the NECPs which show support and plans for future use of fossil fuels. Therefore, not reflecting the political will of wanting to phase out subsidies but the lack of political will. Which is an important aspect when determining the final political will variable. For example, in this category different aspects of the plans which discuss new subsidies, expansion of the fossil fuel industry and more general support for fossil fuel industries will be included. Member states showing support for fossil fuels will likely reflect a different understanding of the problem surrounding FFS compared to the overall discourse used in the Commission when discussing it. Therefore, showing a disconnect between the top-level at the EU and the national level governance in the member state responsible for the NECP.

4.3 Data

In order to conduct this research, there is a need for multiple data sources which can guide this research in reaching a satisfying conclusion and for further understanding the puzzle which is the remanence of FFS within the EU. The study will take use of secondary data in order to conduct the analysis. The main source of data will be in the form of EU member states NECP documents which will be used to assess the level of political will countries have manifested in terms of removing FFS. The NECP of a country was introduced as a tool to follow countries commitment to reach the different energy and climate targets which have been agreed upon within the EU. These plans are supposed to cover how member states intend to address questions regarding energy efficiency, renewables, GHG emissions reductions, interconnections, innovation and more importantly for this paper the plan to phase out FFS. Drafts of these plans were to be submitted in 2018 and thereafter be reviewed by the commission. The final NCEPs were to be

submitted by the end of 2019 and consider the recommendations received on the previous draft. (European Commission 2019).

For the main independent variable of if a country has reduced FFS subsidies or not the data will be collected from a report from the EU Commission regarding energy costs. This report has a fact sheet included which reports on the member states different spending on fossil fuels during 2008 to 2018 (European Commission 2020c). There is not much data availability regarding fossil fuel subsidy spending per country. One other source which was considered for the main independent variable was the *Fossil Fuel Subsidy Tracker* which is a collaboration between OECD and IISD. Which presents an estimate of FFS in 42 countries. This data was considered and studied but was not included in the final analysis, due to the lack of data concerning certain subsidies in the selected countries (Fossil Fuel Subsidy Tracker 2020). Where the report from the European Commission was more detailed and therefore will be utilized for the independent variable in the analysis.

Other complementary data used in this paper is mainly in the form of official governmental documents and quantitative data on relevant indicators. This will be discussed further in the section discussing the different selected variables.

5 Variables for Analysis

Under this section the main independent variable and the control variables used to conduct the COV analysis will be discussed. The different data sources used for each variable will also be presented as well as the reasoning behind the choices of variables in relation to the theory. This is to provide the reader with transparency and understand the link between the chosen variables and theory.

5.1 Political Will

The main independent variable chosen for this research design is what will be referred to as 'political will'. Political will refers to the will of removing the FFS as agreed upon within the EU. It was chosen to reflect the theory of institutional lock-ins. Where political will is seen to reflect the goals of political and economic actors, therefore being important for reducing FFS. Political will is a complex and multifaceted concept which therefore makes it very difficult to measure. There is no unanimous definition of what exactly constitutes political will despite the term being frequently used for discussing different policies and especially used when explaining different policy outcomes (Post et al. 2010 p.653). There are several different definitions which could be utilized for defining political will and previous literature has focused on the aspects concerning engagement, capacity and government willingness (Ibid p.657). By analysing these previous definitions and texts Post et al. have created a broad definition of political will which this paper will build on when trying to determine if a member state has demonstrated political will or not regarding removing FFS. This conceptual definition is broken down into four components which together constitute political will. The first component is a sufficient set of decision makers. Having a combination of decision makers which intend to support the policy is a good indicator of success for the policy implementation. These are actors who are capable of approving, implementing and enforcing public policies (Ibid p.660). The second component is having a common understanding of a particular problem on the formal agenda. There must be an agreement that a problem exists and that it requires action, in this case the problem is the remanence of the FFS. The issue should also obtain a spot on the formal agenda. In order to operationalize this component one can study the discussions of the problem to see if there is a similar terminology used (Ibid p. 662-663). The third component is the commitment to support, which can be explained by a sufficient set of decision makers being committed to supporting a certain policy. Judging the intent and commitment of decision makers is a quite complicated task but one important indicator to look for is the undertaking actions or credible or binding

statements which support a policy by decision makers. This can be said to reflect their commitment or intent. This is an important factor which can determine the intent of decision makers in terms of being committed to phasing out and removing FFS. Since when making a statement in support for a certain policy and then switching opinion later this is in game theory associated with reputational cost. In situations where the reputational cost is high the statements and actions made in relation to a certain policy is therefore more credible due to this cost at stake (Ibid p. 663-664). The final and fourth component is that support is given and aimed to a commonly perceived policy solution. In many cases agreeing on a solution is not an easy step however in this case as previous research has pointed out removing FFS is an important step for reducing GHG emissions and reaching climate goals and the EU has already agreed upon this as a solution but not committed to the actions for reaching it, however it will be interesting to see if this is reflected in the different member states.

Political will in this paper will be treated as primarily a continuous variable due to the complexity of determining if a member state has shown political will or not. By using the conceptual definition discussed previously as an underlying framework for analysing political will as well as the theory of carbon-lock ins and how the different lock-ins are reinforcing each other, but more specifically political will is based on the theory of institutional lock-ins. Though the various lock-ins all have an effect on each other this paper would argue that political or institutional lock-ins have a greater effect on the two other lock-ins since these can be seen as the results of political and institutional behaviour. Since both energy dependence and societal behaviour as described previously are to a large extent results from different institutional processes. Therefore, in order to change these there is a need for an institutional change regarding removing the FFS. In order to determine if a country has shown a political will in wanting to remove their FFS the main source of data used will be national energy and climate plans (NECP) reports.

The NECPs were introduced to monitor the EU member states and ensure that set climate targets could be achieved as well as provide transparency. Draft of these plans were to be sent into the Commission by 2018 and the final versions were to be sent in by the end of 2019. These plans are to include a plan to phase out fossil fuels and how to achieve the set climate targets for 2030 (European Commission 2019). Though these plans are aimed at presenting an action plan for 2030 since drafts have been submitted before 2020 this paper argues that these can give a good indication of the member states ambition of phasing out fossil fuels. As well as indicating their ambition during the previous years, it is reasonable to assume that a country's attitude towards these FFS has not likely undergone a rapid change.

5.2 Control Variables

The control variables chosen for this research have been chosen based on them having a causal effect on the dependent variable and are therefore included in the research to account and eliminate them as being the driving force between any found change in the dependent variable when comparing the cases in the analysis.

5.2.1 Educational Level

Educational level is included as one of the control variables and has been based on the theory of behavioural lock-ins. The main reason for this is that educational level has been shown to be linked to how strongly climate change is perceived to be a threat to society. Higher levels of education and knowledge can significantly predict the level of risks perceived regarding biodiversity threats and public costs. People with lower levels of education on the other hand are more likely to find uncertainties regarding climate change an obstacle for engaging in pro-environmentalism behaviour (Yu et al. 2020). Therefore, the theory behind including this as a variable is that the more education a country has the more likely that country is to act on threats to the climate and in this case that would be FFS. Therefore, also impacting the individual behaviour of a country's population. For example, this could have an impact on the travel patterns, energy consumption and consumption patterns. A greater knowledge of the negative impacts on climate change would reasonably impact the politics in that country. In short, these countries should be more inclined to remove the subsidies. There are many different measurements one could use for measuring the education of a country. Since I wish the variable to be as correct as possible and reflect different aspects of education in a country, I will use a comparison of different educational factors when comparing countries. By including several measurements in this variable, the reliability will be strengthened as well as the educational variable capturing more of the whole sphere of education. Firstly, the educational index from the HDI index will be used for comparison. This index combines expected years of schooling and the mean years of schooling and the mean years of education to create an index. PISA results from each country will also be compared. PISA is an OECD program which is used to compare and assess students' education. Many educational comparisons are based on years of schooling which does not provide insight to what students actually know. PISA measures students' knowledge while also considering data regarding teachers, schools and different educational systems in order to provide an understanding of a country's educational level. The PISA report assesses students' knowledge in reading, mathematics and science but also what the student can do with this knowledge (Schleicher 2019 p.3).

5.2.2 Innovation Level

The second control variable included for comparing the cases is the innovation level of the different member states. In order to measure this aspect, the global innovation index (GII) will be utilized which was selected since it is a comprehensive index which is often used to compare countries in their innovation aspect. The reasoning behind comparing rankings of how innovative different countries is the hypothesis that more innovative countries will not be as dependent on carbon-based systems and should be more likely to utilize and change systems using new technology which is more sustainable. This variable was chosen based on the infrastructural and technological lock-in theory as well as the previous literature which discusses change in technological systems. Where technological advancements are seen to create changes in preferences regarding technological systems. Therefore, the countries which are more focused on innovation should also be more likely to have stopped or be more progressive in ending subsidies for fossil fuels since they have access to newer technologies or have progressed longer in the research of substitutes to fossil fuel as energy sources. The GII will be applied to compare this variable. The GII uses 80 different indicators concerning education, political environment, infrastructure and business sophistication to construct the index regarding 131 countries' different performance regarding innovation (WIPO 2020).

5.2.3 Energy Mix

The reasoning behind using energy mix as a control variable is that it relates to the theory of infrastructural and technological lock-ins. By studying the energy mix a country has in order to supply its energy related needs this variable should be a suitable indicator to determine if there are any strong systematic built-in lock-ins related to the country’s energy consumption. For example, if a majority of the energy in a country is dependent on coal production it is reasonable to assume that this country has a stronger incentive to keep the subsidies which are supportive of sustaining coal production and lowering consumer prices. If a country has a higher fossil fuel consumption it is also reasonable to believe that this country is more dependent on FFS and therefore less inclined to remove or reduce these. In order to compare cases in this aspect data from the IEA will be utilized. The different sources of data used for this variable will be in studying the energy sources in relation to how large part comes from fossil fuel energy systems and how large part is renewable energy sources. Studying this energy mix from each country will help paint a good picture of how the countries different dependency and views on FFS can be explained as well as indicating if there are reasons to believe there are any major infrastructural and technological lock-ins in the countries. The goal here is to find countries which can be argued have a similar energy mix in relation to renewables and fossil fuels, no country will be identical, but they should show similar enough patterns to be considered to be in the same grouping. Fossil fuel energy sources are for example coal, oil and natural gas (NRDC 2018a). Renewable

energy sources are for example hydro, sun and wind energy, which is naturally occurring, and their supply is non diminishing (NRDC 2018b).

6 Results & Analysis

Firstly, this section will analyse the different political wills reflected in the countries NECPs. This will be conducted using the coding scheme presented previously. The countries selected through the case selection strategy (see appendix for the detailed case selection process) are divided into two groups. The first group consists of Denmark, France and Finland. The second group consists of Ireland, Germany and the Netherlands. The countries will be compared within the group at first. Thereafter they will be compared as one group. After the degree of political will for the countries has been decided the results of regarding if FFS have increased or decreased will be compared. This will be followed by a discussion of the results.

6.1 QCA of NECPs

This section will analyse the political will by comparing the NECPs of France, Finland and Denmark against each other and finally comparing the plans of Ireland, Germany and the Netherlands against each other. This will help determine the main independent variable political will, which will help determine which countries have shown a will in removing FFS and which have not. The coding scheme specified previously will be utilized but other categories will be added if necessary, to complement these. It is important to highlight that the NECPs are written to reflect the different member states plans for fulfilling the EU climate related targets and FFS is only a small part of this. Therefore, information regarding these might be limited in certain cases. Other climate related information in these can however reflect the political will and ambition regarding this as well at it also being important to highlight what is not said or displayed in these plans.

6.1.1 NECPs of France, Finland and Denmark

In this section the content the NECPs of France, Finland and Denmark will be analysed using the coding scheme.

6.3.1.1 France

The French NECP contains several aspects relating to the ambition of removing fossil fuels and stopping the funding of these. France has set targets for GHG reductions for the years 2030 and 2050 (Ministry of Ecological Transition, 2019 p.4 & p9). Where for example fossil fuel consumption is to be reduced by 40% in

reference to 2012 and coal fired plants should be closed by 2022. The plan specificizes that it would be possible to shut down coal fired plants in 2020 but additional measures are to be taken before to ensure electricity production is secured therefore pushing the deadline forward to 2022 (Ibid p.11). The NECP also discusses visions for a carbon-free society with different milestones in 2030 and 2040, with a gradual elimination of fossil fuels for a new energy system (Ibid p.38). Further the NECP discussed the elimination of tax loopholes but highlights that for sectors which face international competition carbon pricing is more appropriate (Ibid p.112). Another ambition discussed is limiting imports of fossil fuels, transferring to a more circular economy and having fossil fuels removed from the energy mix by 2050. In relation to the energy mix it is specified that since natural gas releases the least GHG emissions there is a temporary transfer from coal and oil to natural gas for a limited time (Ibid p.224).

There were several aspects of the NECP which could be seen to reflect commitment in terms of moving away from fossil fuel usage and trying to take a newer path in terms of energy reliance. Firstly, there is mentioning of The National Low-Carbon Strategy which is a roadmap for France's climate change mitigation which is to transition France to a low-carbon society by 2050 (Ibid p.4). Having this roadmap shows an ambition and unity in some terms where a sufficient number of actors have agreed upon it to be set in place, indicating a political will and a common view of fossil fuels being problematic. Another dimension of commitment is reflected where a new policy adopted in 2017 is discussed in relation to scaling back on gas and oil produced in the country and more research into use of hydrocarbons is to replace these (Ibid p.19). France is also shutting down its coal fired power plants where the deadline is set for 2022. France plans to see a 75% reduction in coal consumption in the industrial sector (though excluding steel) from now until 2028. This is a promising step where France seems to be tackling the infrastructural lock-ins. The same section also discussed the Heat Fund which plans to prioritize substitutions for coal in industry and the importance of increasing renewables instead of coal. The aim being to make the transition within five years, using EU state aid (Ibid p.120). This is a promising outlook for France where more concrete goals and actions are discussed. That the government is prioritizing renewables and focusing on supporting industries in moving away from fossil fuel reliance is a good sign. The French government will no longer authorize new power stations which generate electricity solely from oil, provide grants for installation of renewable heating and abandon oil heating in public buildings by 2028, this reflects action on tackling infrastructural lock-ins (Ibid p.120).

In the French NECP it is stated that there are no FFS in France in the true sense of the term. This was coded under the new category, Denial of Fossil Fuel Subsidies. The statement is a quite vague and does not specify the meaning of the formulation "true sense of the term". What is most probably referred to is that France does not consider their FFS which go to industries which use fossil fuels as FFS as they are indirect and not directly financing fossil fuels. This theory is strengthened since the continuation of this discussed that certain sectors are subject to tax reductions for their energy consumption. For example, road freight transport, agriculture, fisheries and other energy intensive industries. The plan also

specificizes that these are considered to be FFS according to the OECD definition of FFS. This indicated that France does not share the definition of FFS provided by the OECD and thereby it is also reflecting a divergence from the goal of phasing out subsidies (Ibid p.112). In relation to the commitment coding discussion this is problematic in terms of tackling infrastructural lock-ins, since these by this definition are not FFS.

In terms of fossil fuel support coding in France there was one coding in the NECP. This was the current public funding in the energy sphere where it was presented that France spent €18 million on fossil fuels in 2018 (Ibid p.301). This is a confirmation of support provided by the French government to fossil fuel. This can be viewed from both a positive and negative perspective. The negative one being that support is given to this industry, which of course in negative from a climate perspective. The positive perspective would highlight that it is a good thing that this is being recognized especially given the lack of transparency surrounding funding to fossil fuel industries in many countries. It must also be looked at in relation to the rest of the content of the NECP.

6.3.1.2 Finland

Finland demonstrates ambitions in transitioning away from fossil fuel use and towards a more sustainable society. Including achieving a GHG reduction of 80-95% by 2050. Coal is planned to be phased out except for minor exceptions. (Ministry of Economic Affairs and Employment of Finland 2019 p.14). Several other climate targets are mentioned with goal end dates. The plan highlights the Nordic cooperation in this transition where work is being undertaken to increase the use of renewable energy sources in the energy mix (Ibid. p.22). There are also discussions of how to improve energy efficiency in buildings which should be subsidized more according to the plan, which suggests work for combatting infrastructural lock-ins. There is a goal of having phased out fossil fuels oil in heating by 2030 and in government owned buildings by 2024. An action plan for encouraging properties in switching to renewable sources is also being discussed (Ibid p.106). A tax reform regarding taxes and payments in sustainable transport to reduce emissions is proposed, where taxes on fossil fuels will be increased by €250 million over the electoral term, which is in line with the forecast rise in consumer prices (Ibid p. 87). This suggest as well as seeing fossil fuels as a problem an aim of trying to change behaviours regarding consumption of fossil fuels.

Finland has taken steps in their climate plan for phasing out the use of coal energy by 2030. This included that no new power plants for these will be built and no new investments based on coal will be made (Ibid p.100). The NECP also discusses energy taxation and argues that Finnish taxation promotes renewable fuels since the energy is taxed through their CO_2 content, thereby making fossil fuels more expensive (Ibid p.95). Plans regarding a reform of taxes and payments to sustainable transport and increasing the taxation of fossil fuels is also brought up (Ibid p.87). Actions for removing FFS are mentioned in this plan, which was announced during the 2020 budget negotiation, where the government is currently working on making cuts to FFS and redirect these funds to more sustainable uses.

This work was scheduled for 2020. The fact that the plan mentions work for removing FFS is a very positive sign and suggests that there is a common perceived solution and a common understanding of these being a problematic issue. It also suggests that there is a sufficient number of actors which support this policy. It should be highlighted that the plan mentions making cuts to the subsidies and not phasing out completely, this might not have a larger meaning, but it could also suggest that not all of these harmful subsidies are planned to be removed.

The Finnish NECP states that there is no established view in the country of which energy subsidies should be considered to be FFS. Since the subsidies do not account for which energy source it is based on. However, there is a table included which presents subsidies which are considered by Finland to partially or wholly in the category of energy being produced by fossil fuels (Ibid p.102). It seems like there is a slight reluctance in acknowledging that there are FFS being financed in Finland but at the same time there is an admission that some of the subsidies presented could fall in the category of FFS. This indicates that the understanding of the problem regarding FFS is shifting from the EU level to the country level, in this case Finland.

6.3.1.3 Denmark

There were several contents of the Danish NECP which fell under the code ambition. The NECP mentions that Denmark is transitioning to a fossil fuel independent society which aims to reduce GHG by 70% in 2030 compared to 1990 levels. Therefore, the country will not be importing as much fossil fuel energy as previously. A goal which is related to this and mentioned several times is the phase out of coal in electricity production from now by 2030. This is not directly mentioned in relation to FFS. However, since coal production is related to fossil fuels a phase out of these and a transitioning to a fossil fuel independent society is related to removing subsidies this is a positive trend (Danish Ministry of Climate, Energy and Utilities 2019 p.62). The plan also mentions Denmark's commitment of phasing out FFS by highlighting the Danish involvement as a member of the coalition Friends of Fossil Fuel Subsidy Reform. Which works for promoting the phasing out of ineffective FFS and has through the G20 worked for holding countries accountable in this aspect. Denmark argues that it is represented through embassies in the respective countries for the G20 meeting and therefore is a direct influence (Ibid p.99). This is a quite vague argument for working for a phase out of FFS. Since it is not mentioned how Denmark is conducting this work except that the organization co-finances an initiative which analyses the effects of FFS including in emerging and developing countries. It is interesting that though the overall goal of phasing out fossil fuel is mentioned here it is done so in a vague term which leaves out any dates or more concrete plans for such a phase out. It is also interesting that emerging and developing economies are mentioned in relation to FFS, but it fails to acknowledge developed economies such as Denmark. In relation to political will, what can be said here is that the component of having a

common solution to a problem is fulfilled where fossil fuels and subsidies for these are to be phased out. There is however not much action reflected in these parts.

Denmark has until January 2019 subsidized electricity on heat and power plants which are based on natural gas or waste incineration. These were subsidized but a new support scheme is now phasing out these rapidly. This demonstrates a concrete step which Denmark is taking to reassess subsidies which is promising, that natural gas heating plants will not be subsidized is a concrete measure in not supporting fossil fuel sources (Ibid p.61). The plan also provides a table of indirect subsidies which are going to fossil fuels. Some of these are being phased out according to the plan. In relation to this table, it is mentioned that some of the fossil energy have lower tax rates or in certain cases are fully exempted from paying taxes. This is explained by being a result from firms facing fierce international competition (Ibid p.98). The phasing out reflects commitment of ending subsidies but the pointing to international competition comes off as trying to protect these firms which are benefiting from fossil fuel use and not paying taxes or paying lower taxes. This formulation suggests a support of fossil fuels and does not reflect the seriousness of climate change and the importance of phasing out FFS. Here the goal of phasing out fossil fuels and the subsidies is contrasted by the government's actions.

An important aspect of the Danish NECP is the denial of Denmark having FFS, *"In Denmark no direct subsidies to fossil fuels are given*" (Ibid p.98). This is a strong indicator of Denmark removing the blame on itself and trying to indicate that it does not subsidize fossil fuels.

The Danish NECP specifies that oil and gas will play a role in the Danish energy mix in the years to come and the former government of Denmark signed a new North Sea Agreement which is to ensure a future for oil production in the North Sea. Obviously, this is in stark contrast to the goal of making Denmark independent from fossil fuels. The government signing a deal for oil production is not signalling that Denmark is working for phasing out fossil fuels in the near future. The plan also mentions the main gas production facility in the Danish North Sea will be temporarily shut down until 2022 due to reconstruction as well as the Baltic Pipe-project being planned to start in 2022 which will help increase the gas diversification supply in Denmark (Ibid p.62-63). These projects all suggest that Denmark is not moving forward a fossil fuel free society in a rapid pace but instead is continuing to invest in fossil fuels.

6.1.2 Results of Political Will for France, Finland and Denmark

The results from studying the first three NECPs demonstrate that in terms of ambition all countries do present clear goals in which they aim to reduce GHG emissions and a willingness to transition from fossil fuel dependence. The plans all show some sort of commitment as well in terms of presenting policies and measures which are aimed at reducing GHG and transitioning away from fossil fuel dependency. In terms of FFS the plans contain limited discussions of these and any plans to remove them. All the three countries show a lack of accountability in terms of FFS since they all state that there are no existing direct FFS in their country.

Even though there is a recognition that subsidies might be financing the continued use of fossil fuels indirectly, the denial of FFS suggests a lack of understanding of the issue concerning FFS as well as a disconnect from the central European level. All three plans showed a similar degree of understanding and commitment regarding phasing out FFS. No country included a timeline for phasing out FFS and neither did they include a detailed discussion and presentation of their current FFS. Finland did include a table of subsidies which could be considered FFS. The degree of political will show in these plans when it comes to removing harmful environmental and FFS are similar and no plan shows a stronger will than one another. The Danish plan did reflect a lacking political will in terms of the future oil drilling plans in the Danish North Sea, which is contradictory to the EU's and Danish climate targets. However, the concrete steps Denmark was taking in terms of phasing out the natural gas subsidies and the commitment for supporting developing countries in removing FFS does bring the political will slightly up. The result in terms of the reflected political will in these plans is that all the plans demonstrated a similar political will which was not particularly high. The coding for the dependent variable will be *moderate will* for all the three countries. This is based on the discussions regarding the transitioning away from a fossil fuel dependent society which all the countries did highlight as being important. As well as a certain degree of recognition of there being existing subsidies which support the continued use of fossil fuels.

6.1.3 Ireland, Germany and the Netherlands

This section will analyse the NECPs of the remaining three countries which were more reliant on fossil fuels in their energy mix.

6.3.2.1 Ireland

Ireland's NECP recognizes that 75% of environmental subsidies in the country can be considered as potentially environmentally damaging subsidies. The NECP also includes a table of the different subsidies which is accompanied by a small analysis of them (Department of Communications, Climate Action and Environment 2019 p.221). This presents a certain degree of transparency and recognition of FFS in the country.

The Irish plan discusses several different ambitions related to climate targets and states that Ireland must step up fundamentally in terms of its commitment to tackle climate disruption and put Ireland on a pathway of decarbonization to 2030 which is consistent with the overall goal of reaching net zero targets by 2050 (Ibid p.18). Ambitions include removing fossil fuels, specifically the burning of coal by 2025 and replace these sources with renewable technologies (Ibid p.48). The plan highlights the unavoidable need to decarbonize the Irish economy but doing this in such a way which the burdens associated are distributed in a fair manner (Ibid p.125).

The NECP of Ireland demonstrates a commitment for removing fossil fuels and breaking out of the current fossil fuel dependency. The plan discusses several concrete policies and goals related to accomplishing a phase out of fossil fuels. Examples of these include banning oil broilers from 2022 and gas boilers from 2025 in new dwellings as well as phasing out already existing dwellings with several measures (Ibid p.15). The plan discusses several initiatives related to building and infrastructure. Up-skilling is one such initiative to influence industry players, which also speaks to trying to change behaviours within the industry by educating. The plan specifically mentions how use of fossil fuels are firmly embedded in driving culture. The plan therefore has decided on several initiatives to try and decarbonize the transport sector for example a plan for all new cars sold in Ireland being zero carbon emission or zero emission capable by 2030 as well as the public transport (Ibid p.77). This reflects a will of trying to unlock behavioural and infrastructural lock-ins. As well as the recognition of the lock-ins reflect perhaps an unlocking of institutional lock-ins which have promoted fossil fuels in the past. The plan also discusses the decision to close two of the three peat generation facilities in the country by the end of 2020. This as a part of the larger plan of phasing out coal fired electricity by 2025 and peat-fired electricity by 2028. The action of shutting these down have also been accompanied by an action model for securing energy supply (Ibid p.121-122). The plan also highlights the important of a just transition away from fossil fuels. The Irish plan includes actions for making sure that the transition away from fossil fuels is not affecting people negatively, including the workers affected from power plants shutting down. Including addressing the possible negative impact on low-income groups and enhancing the educational system to include a more specific focus on skills needed in a low-carbon transition. In relation to FFS the plan specifically discusses actions which have been taken in terms of agricultural subsidies which of many have been phased out and replaced by direct payments (Ibid p.123). The plan states that there is commitment to model the impacts in terms of the economy and emissions in order to remove FFS (Ibid p.222).

6.3.2.2 Germany

The German NECP contains similar goals as of many of the other NECPs where a phase out of coal-fired power is discussed and the goal is set for 2038. Goals and policies supporting this is also presented. Overall goals of reducing GHG emissions are presented and the overall goal in terms of energy supply is to replace fossil fuel sources with renewable energies (Federal Ministry of Economics 2019 p.12). Since coal is the main contributor of emissions in Germany a lot of focus is put on the importance of replacing it with renewable sources if Germany is to reach set climate targets (Ibid p.61). Plans to develop regional and local energy infrastructure is introduced with the plans of these being developed in accordance with the principles of the energy transition. The plan states that the transition should be driven by market forces in regards of deciding which technologies are most successful and that in the ideal situation decarbonization is driven my market forces and price signals without lock-in effects (Ibid p.111). The plan also brings up the importance of planned policies and measures in terms of not only climate and

environmental gains but importance relating to health and synergetic effects. Where human health, animals and the natural environment is supposed to gain from an energy transition (Ibid p.162).

The German NECP recognizes the goal of phasing out FFS and states that the phasing out subsidies which promote hard coal is the most important measure currently in the German goal of eliminating FFS and there are several measures being taken for eliminating these (Ibid p.83-84). The NECP also provides a list of current FFS both direct and indirect as well as measures which have been taken to end these or planned measures, not all of these have any measures planned but the recognition of these shows a transparency regarding FFS (Ibid p.147).

The plan presents the Energy Efficient Strategy 2050 which has as the key objective to develop energy efficiency policies to reduce energy consumption in Germany, where specific goals in the roadmap have been set for 2030 and 2050. Energy consumption should be reduced, and renewables should be replacing fossil fuel sources as much as possible. In relation to fossil fuels in general the plan discusses several measures related to the building sector where the Energy Efficient Strategy for Building sets out a long-term strategy which will help provide financial supports for the transformation of fossil fuel existing heat networks to transform to newer systems primarily based on renewable energy sources. The roadmap also presents a hydrogen strategy for Germany which is seen as a keystone for decarbonizing Germany (Ibid p.84-85 & 98). The NECP also talks about the phase out of fossil fuels and how taking the lead in this structural change is of major importance for the Federal Government (Ibid p.110). This of course does not have to imply political will simply because it is written out in the NECP, but it is interesting that it is stated. The federal government has also drafted a version of a law which is aimed at supporting coal regions in this transition which will focus on sustainable and future focused structural growth.

6.3.2.3 Netherlands

The Netherlands similar to many of the other NECPs have ambitions related to closing down coal-powered plants and phasing out gas extraction from the Groningen gas field in this case by 2030 at the latest (Ministry of Economic Affairs and Climate Policy 2019 p.11). Plans also include recycling more materials in the industrial sector, increasing offshore wind energy, creating more sustainable housing and having 100% zero emissions for newly sold cars by 2030. The plan discusses the need for a climate neutral energy system but raises the issue of the Netherlands being limited in its access to renewable sources, though wind energy is a possibility for expanding. The goal is for the Netherlands to have a 70% share of renewables of the total electricity generated in the country by 2030 (Ibid p.30).

The Dutch NECP does include policies aimed for replacing fossil fuels with renewable sources for example it will be forbidden by law in 2030 to generate electricity with the use of coal and introducing a minimum price for CO_2 emissions (Ibid p.53). From 2022 gas extraction in Groningen can potentially be zero on an average year but it will remain open for providing gas on cold winters. This is a bit contradictory since there seems to be no real will of stopping the extraction of gas

especially since the plan in a different chapter discusses oil as a replacement of gas (Ibid p.112 & p.6). Which suggests that the reduction of gas extraction is not related to the will of removing fossil fuels from the energy mix but perhaps more related to market forces. The plan also discusses programs which have been formulated to achieve the goals of making housing more sustainable and remove the use of fossil fuels, by 2050 in certain selected environments should be completely free from fossil fuels (Ibid p.76).

The Dutch NECP states that there are not any direct FFS in the Netherlands. This is argued by saying that "in the sense that resources are made available to stimulate the use of fossil fuels" (Ibid p.52). By using this definition of FFS the plan therefore distances itself from providing FFS. The plan however later states that certain tariffs for example in energy taxes could be related to the use of fossil fuels which could be viewed as FFS by some if a broad definition of these are used.

There are several aspects of the Dutch NECP which reflects a support of fossil fuel consumption. For example, there has been openings of three new coal-fired power plants in recent years which has led to an increase in consumption. Important to point out that five coal plants have also been shut down recently (Ibid p.52). Even though some plants have been shut down the opening of three new ones show a direct contradiction of the overall EU goal of transitioning away from fossil fuels. Another interesting aspect is the discussion concerning crude oil which is stated will maintain its dominant position as a fuel and will in the years to come overtake natural gas as the principal energy carrier in the energy mix. The closure of nuclear plants will also end the contribution of nuclear energy which will likely be replaced with fossil fuels. The NECP also states that there is no specific policy aimed at reducing dependence on oil imports and oil will remain a key component of the energy mix for the foreseeable future (Ibid p.39). The fact that there are no policies directed at even trying to reduce oil consumption shows a very lacking political will of limiting the use of fossil fuels and reaching set climate targets.

6.1.4 Results of Political Will for Ireland, Germany and the Netherlands.

The final three NECPs show a similarity to the previously three discussed countries in terms of lack of a more concrete plan for phasing out FFS, but there are also clear differences between these two groups. These countries had a more dependency on fossil fuels demonstrated by their energy mix compared to the previous group. Which formulated a hypothesis that these countries also would be less inclined to phasing out fossil fuels, resulting in a lower political will. This cannot be concluded to be true given the NECPs analysed in this paper. The Irish NECP contradicted this hypothesis and was one of the plans which showed a compliance in terms of working for phasing out fossil fuels and the FFS which reflected a deeper rooted political will compared to other plans. The Irish plan also reflected a deeper understanding of the importance of also including supporting policies when conducting a phase out of fossil fuels. Something which from

previous literature was highlighted as vital in terms of a successful transition. The language used in the Irish NECP reflected a true sense of urgency regarding acting on climate change and transitioning away from fossil fuels. Something which was not reflected in the previous analysis. The German NECP shows a recognition of FFS as different direct and indirect subsidies are presented, which reflects transparency. The goal of phasing out FFS is also mentioned. Policies are also presented aimed at supporting regions heavily affected by a phase out of coal. The plan is lacking in comparison to the Irish plan. Where a more detailed analysis of the subsidies was included. The Dutch plan shows a considerably less positive outlook in phasing out fossil fuels. The Netherlands was also the country which was most heavily reliant on fossil fuels which this might reflect. Firstly, the comment that there are no existing direct FFS in the Netherlands shows a lack of compliance in terms of the EU definition of subsidies but also a negligence in the overall goal of phasing out fossil fuels and reaching climate targets agreed upon. There is also no transparency in presenting FFS which was conducted in the other two NECPs. This combined with the opening of new coal power plants, the continued support for oil and lack of a more concrete plan for phasing out fossil fuels overshadows the commitment and ambition which is in fact reflected in the Dutch NECP in terms of phasing out fossil fuels. Making the case that the political will in the Netherlands seems to be very low. As a conclusion none of the countries studied can be seen to reflect a high degree of political will in wanting to remove FFS. No country presented a timeline for the phasing out of FFS which would have shown a more concrete will and ambition. However, Ireland stands out in its comprehensive NECP which reflects a transparency regarding the width of environmentally harmful subsidies in the country and the policies aimed at reducing these. The plan also reflected a true sense of understanding and urgency for acting to mitigate climate change. The policies presented had a holistic focus where a just transition was key. Therefore, Ireland has been coded as having a semi-high will. Germany has been coded as having shown a moderate degree of political will and the Netherlands shows a very low will in removing FFS.

6.2 Comparison of Countries in Phasing Out Fossil Fuel Subsidies

Finally, this paper has reached the point where the results can be compared in how the countries have performed in relation to the goal of removing FFS. As previously mentioned no singular country has achieved this goal even though it was agreed upon by member states. The countries will now be compared to see if FFS have been reduced or increased during recent years and how this corresponds to the political will which was analysed through their NECPs in the previous section.

The data which is used to see if the countries have increased or decreased their FFS is provided by the European Commission report ‘Study on energy costs, taxes and the impact of government interventions on investments’. The data covers the

FFS by countries from the year 2008 and up until 2018 (European Commission 2020c). Which is a significant time period and should be sufficient to study the trends of if countries are working towards phasing out subsidies or not. It would of course be desirable to have data up until 2020, but due to the lack of data availability in terms of energy subsidies this is the closest known source. It is also unlikely that a larger change would have occurred in the short remaining time period.

As the previous section demonstrated there was not one country which in its NECP could be seen to reflect a strong political will in its aim of removing FFS. Ireland was the country which demonstrated the largest degree of political will. Germany reflected a moderate degree of political will and the Netherlands a low degree of political will. These three countries will firstly be compared with each other since they have been determined similar enough on the control variables. Using the different degrees will also provide an interesting dimension to see if the dependent variable is affected by these nuances.

Secondly, the group consisting of Denmark, France and Finland will be compared which also share the same constants on the control variables. All of these demonstrated an equal political will which was coded as being moderate. None the less it will be interesting to see if the result reflects the same degree of political will. Lastly, all cases will be compared to see if there are any trends in terms of FFS.

Table 1: COV Analysis Result Table (Source: EU Commission 2020c)

	Education	**Energy Mix**	**Innovation Level**	**Political Will**	**FFS 2008-2018**
Denmark	High	High share RE	High	Moderate	Significant Decrease (-53%)
France	High	High share RE	High	Moderate	Significant Increase (+61%)
Finland	High	High share RE	High	Moderate	Moderate Increase (+9%)
Ireland	High	Low share RE	High	Semi-high	Moderate Increase (+12%)
Germany	High	Low share RE	High	Moderate	Moderate Decrease (-12%)
Netherlands	High	Low share RE	High	Low	Moderate Increase (+17%)

As indicated in the result table above the results for France, Finland and Denmark show a surprising result of Denmark being the only country which has significantly decreased its FFS out of the three during the time period from 2008 to 2018. Despite the same degree of political will being reflected for these three countries. For Ireland, and the Netherlands there is an increase of FFS. Germany did decrease its FFS despite having a lower degree of political will than Ireland. It is a surprising result for Ireland given that the Irish NECP reflected the highest political will. The results presented here might however indicate a lesser incline to phase out FFS in countries which are more heavily dependent on fossil fuels compared to countries which have a more diversified energy mix. The results are in line with the overall trend over recent years which have shown an increase in spending on fossil fuels.

From these results the conclusion that political will and institutional lock-ins are the biggest hinders in removing and phasing out FFS cannot be drawn. In trying to find an answer for the question of why FFS remain large and in many cases are increasing in the EU this paper has shown that there are definitively institutional barriers hindering change. The NECPs reflect a very clear-cut attitude in the EU member states where FFS is not a top priority for most countries and there is a very apparent lack in transparency in presenting which FFS exist. Which undermines action for phasing them out. The fact that no country presented a comprehensive plan for phasing out FFS with an end date speaks to an overall low political will and that political will is not a necessary or sufficient factor in bringing about change.

6.3 Discussion

6.3.1 Understanding the Results

Perhaps the most interesting and telling findings from comparing the change in FFS during the time period 2008 to 2018 is that only Denmark out of the six selected countries was able to reduce its FFS with a significant amount, seeing a reduction of 53% during the time period studied. This despite not exuding a particularly high political will in its NECP, Denmark was only coded as having a moderate political will. Germany also reduced its FFS while also not exuding a high degree of political will, this reduction was however not as significant as the Danish decrease.

These results raise the question of what drives the reduction of FFS and what importance does political will play in achieving policy goals and achieving climate targets. According to the results acquired from this paper the findings suggest that the lack of a high degree of political will is not a necessary factor when understanding and trying to explaining the persistence of FFS in the EU. Since no country did reflect a high degree of political will and still two countries managed

to reduce their FFS. One might ask if is political will is a necessary factor at all in understanding why subsidies for fossil fuels continue to exist and which factors are important in order to achieve a reduction of these.

In order to better understand this puzzle of what has driven Denmark to phase out its FFS to such a high degree a bit of extra digging is required, to try and explain which factors are important for reducing FFS. One possible explanation which is worth investigating is if the share of renewables plays a part in the explanation for the large Danish reduction of FFS. Perhaps this could be the factor which explains why Denmark has evolved further in terms of reducing the FFS compared to the remaining countries and especially Germany. Since Denmark was included in the group which was not as dependent on fossil fuels in their energy mix this is worth looking further into. In order to examine this idea further, the produced energy per renewable energy source will be compared using all six countries.

Table 2: Renewable Electricity Generated by Source (Source: IEA h,i,j,k,l,m. 2020)

	Wind 2008	**Wind 2018**	**Hydro 2008**	**Hydro 2018**	**Solar 2008**	**Solar 2018**
Denmark	19%	42%	0.07%	0.06%	0.008%	2.4%
France	0.9%	4%	12%	12%	0.007%	1.5%
Finland	0.3%	4%	22%	23%	0.005%	0.03%
Ireland	8%	20%	4%	3%	0%	0.02%
Germany	6%	12%	4%	4%	0.7%	6%
Netherlands	4%	7%	0.01%	0.09%	0.04%	1.4%

The table above has divided the produced electricity by source into the different renewable production methods as the total share of electricity produced. Where the table presents the results of electricity produced both in 2008 and 2018, which are the same years which the results of the FFS were compared to. When studying Denmark in comparison with the remaining countries there has been a substantial growth in the wind sector during these years, which stands out. Where the production of wind electricity has more than doubled compared to 2008 and is now responsible for 42% of the electricity produced. When comparing the other renewable sectors (hydro and solar) we can see a growth in both sources. Solar despite a large relative growth in many countries is still very marginal compared to other sources. Hydro does produce a substantial amount of energy in France and Finland but during the years this amount seems to have been relatively stable during the time period. These results demonstrates that Denmark distinguishes itself regarding the renewable sector especially its wind sector, which signals that this is an important factor in terms of the results of the Danish reduction of FFS.

Ireland and Germany have also undergone a substantial increase in the electricity produced by the wind sector during the years studied. The Irish electricity

generated by wind grew from around 8% to 20%. Germany doubled the capacity from 6% to 12%. The Netherlands almost doubled their wind capacity as well, growing from 4 to 7% during the years studied.

Ireland did display the largest reflection of political will in their NECP, despite this the FFS had grown in the years studied. Comparing Ireland and Denmark's wind sectors during 2018 one sees that the Danish wind sector produces 42% and the Irish 20% of the energy. Which is quite a large difference even though both countries have seen a substantial growth in this sector during a relatively short time period which could partly explain the difference in results. It is a rather puzzling result but one plausible explanation for this could be due to the high degree of fossil fuel dependency in Ireland. Even though the wind sector grew by more than double during these years if one looks at the energy mix studied in the case selection (see appendix) where the total energy supplied was studied Ireland had 88% of its energy dependent on fossil fuel sources.

Another explanation for the results which the result table could be reflecting is that when the renewable energy sector grows (wind sector in this case) the larger it becomes the easier it becomes to reduce and remove FFS. Which helps a country transition away from fossil fuels and decrease the fossil fuel dependency. This could be explained by that when the renewable energy sector grows this helps unlock infrastructural lock-ins which have been in place due to the economically costs associated with a transition away from fossil fuels. These costs would decrease as the technology evolves and the sector grows and becomes more efficient and economically profitable. This is in line with the research previously discussed regarding regime change. In the section where the switching cost was discussed it was mentioned that when transitioning between technologies if the cost is too high it can lead to a continued stability of the prevailing technology. If the cost is low enough and seen as profitable it could lead to a change in systems. In this case there seems to be results indicating that a switching cost has been determined to be more profitable leading to a transitioning to the wind sector, away from fossil fuels in Denmark and Germany. This also explains the results in relation to the paradox of entrenchment previously mentioned. Since even though a large degree of political will was not reflected in the Danish and German NECPs there has been support of governmental actors in this transition, otherwise it would not have been possible. However, the transition away from fossil fuels was not primarily driven by environmental ideals but economic factors.

It could also be interpreted or suspected from the results that Ireland is experiencing the same path that Denmark has undergone during these years, but the Irish path was initiated later, perhaps due to the high degree of fossil fuel dependency in the country. Which would suggest that Ireland in the coming years will experience a similar transition where wind energy will become more standard practice and replace fossil fuel sources if the growth continues. This will be evident in coming years and show if the fossil fuel dependency in Ireland will make this transition more difficult and slow moving. Even though the German wind capacity did double the total share was still small likely explaining the smaller decrease of FFS.

The difference in Germany and Ireland where Germany decreased its FFS while Ireland's FFS increased could perhaps be explained by Ireland's energy mix having a higher share of fossil fuel dependency. Another possible explanation could perhaps be found in the Irish plan where a just transition was highlighted. As previously discussed, lower-income households are often disproportionally affected by a removal of subsidies since these spend a higher share of income on energy. A lack in removing FFS subsidies in Ireland could therefore reflect that supporting measurements are being put into place before a removal. Which would protect low-income households and vulnerable groups and according to the previous literature discussed will also be more beneficial in the long run.

By studying the result table in combination with the electricity produced by source table it becomes evident that in the two countries which did manage to reduce their FFS reflected a moderate will. This was the least amount of will reflected which also showed a decrease in subsidies. These results suggest that at least a moderate will should be reflected in order to reduce FFS, making having at least a moderate will reflected a necessary factor for achieving a reduction. A semi-high degree of political will is not a sufficient factor, which was shown in the Irish case. This also point to political will being one important factor which can help explain the persistence of FFS as well as a factor which can help facilitate a reduction.

The other conclusion which can be drawn from studying the tables is that having a large renewable energy sector is an important factor for being able to dramatically reduce FFS, reflected especially in the Danish case. Both in Denmark and Germany this was in the form of the wind sector, which in Denmark had grown extensively during the time period. Germany did not see the same rapid growth. Pointing to this being a factor partly responsible for the difference in reduction of FFS. This helps draw the conclusion that the renewable energy sector in the countries can act as an enabling factor for reducing FFS. Where a larger sector enables a faster reduction of FFS. The important factors in order to reduce FFS is therefore a combination of these two factors, where one can see both a developed renewable energy sector and at least a moderate will. This combination is necessary for reducing FFS in a country. In relation to this the one other factor differentiating Denmark from Germany was the higher fossil fuel dependency in Germany when studying the energy mix. Which points to a higher degree of fossil fuel dependency in the energy mix being a preventing mechanism for reducing FFS. While in the Danish case a smaller fossil fuel dependency and more renewable sources in the energy mix works as an enabling factor for reducing FFS.

The control variables which have been constant throughout all the cases should be considered as necessary factors. This since these were present in all cases. This suggests that a high educational level and a high degree of innovation within a country are also necessary factors. In terms of the energy mix this variable was divided into two groups based on the countries. One where the countries were more dependent on fossil fuels and one where they were less dependent. All countries had some degree and type of renewable sector present in their energy mix, therefore a combination like these two groups of energy mixes will also be considered as necessary factors.

6.3.2 Political Will and the Interdependence of Carbon Lock-ins

As for the case of political will the results from this paper indicate that political will is not the most important factor when creating pathways for unlocking carbon lock-ins and reducing the use of fossil fuels for countries. At least not by itself. It seems that for a pathway away from fossil fuel to be initiated there must be an economical and efficiency incentive for governments to change large infrastructural systems. This can happen when the renewable sector grows large enough and the wind sector seems to be the renewable sector with has the most potential in this aspect. Highlighting once again the interdependence of carbon lock-ins. Where in order to break free from infrastructural lock-ins there needs to be a decrease in the institutional lock-ins which can happen when the renewable sector becomes more efficient and proves itself to be economically profitable. Therefore, creating an incentive for governments to making changes in the technological and infrastructural system of countries.

As mentioned, one of the main variables needed for countries to transition away from fossil fuels seems to be a large enough renewable energy sector which is efficient enough to be economically profitable, thereby replacing long-lived fossil fuel energy systems. According to the theory of technological and infrastructural lock-ins an unlocking of these is difficult mainly due to the huge costs associated with a transition from one system to another. The efficiency and economic viability of the wind energy sector seems to be able because of its technological advancement push decision makers out of the long-lived 'corridor of constrained choices'. Other renewable sources such as hydro and solar energy have not undergone the same technological advancement, which is needed to unlock carbon lock-ins. Decision making has before not included policies for investing in renewables and has instead benefited fossil fuel sources which have resulted in these been deeply locked into society.

The change of systems which has been demonstrated in the Danish case shows how a new path has emerged which is less dependent on fossil fuel sources. Likely this is a result of the technology of wind power has developed and grown over the years to become more efficient both in terms of costs and technology. Which seems to have influenced the institutional lock-ins and institutional environment. Resulting in institutional actions changing in terms of the FFS. Where supporting the transition towards wind energy is not seen as being contra productive to institutional goals anymore but instead corresponds to these goals and benefits institutions, allowing for a reduction of FFS. The conclusion drawn from this is that in order to unlock institutional lock-ins there needs to be a certain growth and efficiency development in the renewable energy sources. Where these are viewed as equal or better substitutes to fossil fuel systems. Which will help unlock the infrastructural lock-ins and change in technological and infrastructural energy systems. The findings point to the importance of focusing resources on the technology for increasing the efficiency of renewable technologies especially wind power.

One of the most interesting findings when examining the NECPs is the wide denial of FFS by the members states. The dilemma of there being several definitions

of what constitutes FFS was brought up in the literature reviews and is clearly reflected in the NECPs. Since the EU does not provide a standard definition of what constitutes FFS the member states can choose their own interpretation. Which is clearly reflected in the analysis. Out of the countries studied in this paper only Ireland and Germany did not deny providing FFS. This wide denial of FFS indicate that there is a disconnect from the EU level to the national level. Which is a puzzling finding given that the countries often provide a list of subsidies which are considered as indirect FFS. Suggesting that there is both institutional lock-ins which are hindering further action in removing FFS. Because if FFS are not acknowledged then action and policies for removing these will not be put into place. This also raises the issue of the ambitions provided in the different NECPs. Many countries had ambitious targets for removing fossil fuels and reducing GHG emissions. However, when countries continue to deny FFS this contradicts these ambitious goals and weakens their credibility. If member states of the EU are to be able to phase out FFS these findings indicate the need of a clear definition within the union. Without a clear definition the denial of FFS by countries will likely continue and the work of removing them will continue to be haltered by the lack of consistency of different definitions used.

The goal of phasing out subsidies which was made during the G20 summit where the EU is represented could perhaps explain the disconnect from the EU level to the country levels, reflected in the analysis. As previously mentioned, the EU is represented in the G20 by the president of the Commission as well as the EU council president. Meaning that the goal pledged during this summit to phase out FFS does not require any broader agreements from the parliaments of the EU member states. Which could explain why there is a lacking action being taken in removing FFS. If FFS are not perceived as a problem amongst politicians at the national level, then there is not a sufficient number of influential actors needed to support policies to reduce FFS.

The question is also raised once again why the EU Commission has not yet enforced the EU state aid mechanism for controlling and phasing out FFS. As previously discussed, this would not require the agreements of the member states and could prove as a more efficient method for reaching the goal of a removal of the FFS as well as achieving targets related to GHG emissions. Since the political will of countries is clearly lacking in terms of phasing out the subsidies it is hard to see that there will be a quick turnaround in this aspect in time for mitigating climate change. There seems to be institutional lock-ins which are deeply embedded within the EU which are persisting and hindering change in the State aid mechanism as well. However, if countries continue to subsidize fossil fuels and are not progressing in the goal of phasing them out this might become inevitable if the EU is to meet its climate targets.

6.4 Limitations

This paper has tried to understand which factors are persisting FFS in the EU as well as which factors can help reduce these. As this paper has shown persistence of FFS is a big threat for mitigating climate change and reducing global warming. Though this paper has shown factors which are important for understanding persistence as well as factors which help facilitate a reduction of FFS the results cannot be generalized to a broader population of countries. The results can however be generalized for other countries which have the same constants on the control variables as in this paper. This meaning that the results found can be applied to countries which have a high education level, high innovation level and a similar energy mix as the countries studied. The results reflect the importance and impact that institutional and infrastructural lock-ins play in maintaining FFS. This paper could however not point to any specific effect on FFS stemming from the behavioural lock-ins. Mainly this is due to the same educational level across cases which was the control variable chosen to represent behavioural lock-ins.

7 Concluding Discussion

7.1 Answering of Research Question

This paper has studied and tried to better understand why FFS continue to exist in the EU today despite goals of removing them, as well as the known harmful effects the continued use of fossil fuels pose to our planet. The paper has also tried to answer which factors can help countries facilitate a reduction of FFS and help initiate a pathway away from fossil fuels.

The question which has guided this research paper is:

- *What factors explain the persistence of FFS in the EU and which factors could facilitate a reduction of these?*

To answer the first part of the question on which factors are persisting FFS in the EU this paper has shown that persistence of FFS is a multi-layered question. Part of the answer lies in the lack of political will in the EU member states which creates institutional lock-ins hindering action in removing the subsidies. Where no country studied could be seen to reflect a high degree of political will in removing the subsidies. Another factor persisting the FFS is the lock-in effects created by the infrastructural and technological systems in the member states.

To answer the second part of the question on which factors can help facilitate a reduction of FFS. A well-developed renewable energy system is crucial for facilitating a reduction of subsidies and acts as an *enabling factor*. Especially the wind energy sector has proven efficient in this aspect. When this sector grows large enough and is proven efficient though an economic perspective it will enable political action in reducing infrastructural lock-ins and helping reduce FFS. Highlighting the interdependence of institutional lock-ins and infrastructural and technological lock-ins, where there must be a certain degree of unlocking of both of these in order to reduce FFS. Having *at least* a moderate will is a *necessary factor* which in combination with a large renewable sector can enable a large reduction in FFS. Which was demonstrated in the Danish case. The control variables of a high educational level, high degree of innovation and a similar energy mix to the cases studied are also *necessary factors*.

7.2 Contribution of Study and Future Research

This paper has contributed to the knowledge of understanding specific factors explaining the persistence of FFS in the EU. This despite the EU's goal of removing these. It has also contributed to understanding which factors can help countries reduce their FFS and transition away from the use of fossil fuels. Given the results of this paper countries and policy makers are recommended to focus resources to help grow the renewable energy sectors, especially the wind sector. In order to make these more efficient and economically viable. Which will help unlock institutional and infrastructural lock-ins which will ultimately reduce FFS and lower emissions. Which is necessary if there is to be any chance for the EU of reaching climate targets and honouring the Paris agreement.

Future studies should continue the work of understanding which factors explain the persistence of FFS and which factors can help reduce these. It will also be of interest for future studies to continue to monitor the political will of countries regarding their political will in reaching climate targets and if this can be seen to grow in coming years when the urgency of climate change will become more evident.

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9 Appendix

9.1 Case Selection Walkthrough

Since it is impractical to use all of the 27 member states to compare the control variables a few countries were selected for the final comparison of NECPs. These were selected based on inductive reasoning to have similar values, by choosing countries with similar educational scores these will be compared on the remaining values and so forth. Until finally member states with similar values remain. Making it possible to isolate the possible causal effect of the main independent variable. Each control variable is discussed in further detail below in relation to the different member states in order to

9.1.1 Education

As previously mentioned, education is an important indicator in understanding if a country and its population views climate change as an urgent issue or not. The reasoning is that since education has a positive correlation in understanding how urgent climate change is viewed it should also thereby in theory have a correlation to how seriously countries have taken the actions needed in phasing out FFS. A country with a better educational system and more educated people would according to this reasoning be more progressive in terms of their climate policies than a country which overall is less educated. Therefore, these countries could also be seen to removing subsidies for fossil fuels to a greater extent and affecting the outcome variable. Firstly, the HDI Educational Index will be reviewed to assess the educational levels of the countries. Secondly the PISA results will be compared and third an overall assessment will be conducted in which states have a similar educational level.

Studying the HDI education index it is evident that the member states all have quite high educational standards in the member states. All the 27 member states score above 0.7 and most of them have a score above 0.8 (UNDP 2020). This is perhaps not too surprising given that the EU is a highly developed region. In terms of this paper, it is however a good indicator that EU member states have a similar educational level and should therefore not be a hinder for understanding the urgency of climate change. For a better reliability concerning the educational levels of the member states the PISA results will also be analysed and discussed. The latest PISA

report was published in 2018 and this is the report which will be utilized for comparison (Schleicher 2019). As previously mentioned in this paper PISA results study students' abilities mainly concerning reading, mathematics and science. PISA has constructed different levels in the different subjects for comparison, the highest the level the higher scoring the country is in the subject. For reading there are nine different levels. Where level one is divided into four different categories. For mathematics there are seven levels ranging from one to six and one level which is for countries scoring below level one. For science there are eight levels ranging to level six and three different categories in level one (Ibid p.6-8). When studying the EU member states and their scores in the PISA report most countries are high scoring in comparison with the total countries included. However, level four is the highest level in all the three subjects which any country is reaching, and no EU member state reaches this level in any subject. Level three is the highest level any EU member state reaches in these rankings. Many of the countries are ranking in level three in terms of all the subjects. Many are ranking a mix of level two and three and some only level two. The countries which rank on level three in all of the subjects are Sweden, Denmark, Finland, Germany, Ireland, Poland, Austria, Belgium, Estonia, Netherlands, France, Portugal, Czech Republic and Slovenia. Since all of the member states previously ranked very high on the HDI education index these Countries will be continued with for the further comparison of control variables based on their high education level and the hypothesis of higher education levels being crucial in acting on climate change.

9.1.2 Innovation Level

The innovation variable as previously discussed will be compared using the GII index. This variable will be used to compare the 14 countries which were selected during the previous comparison of educational level using the HDI index and PISA results. When studying the latest report which was published in 2020 and presents the results regarding countries different performance regarding innovation there is a larger gap between EU member states than when comparing the educational level between member states. The GII has in its report divided the 131 countries analysed into high-, middle- and low-income countries which makes the comparison simple. Within these groups the report also indicated if the results are above under or in line with expectations. Making the comparison between countries simpler. These groupings conducted in the GII will be utilized here to find countries where the value is the same. In the high-income country group seven EU countries outperformed their expected innovation performance. These were Sweden, Netherlands, Denmark, Finland, Germany, France and Ireland (Cornell University 2020 p.25). These will be the seven countries which will be used further when comparing their different energy mix.

9.1.3 Energy Mix

Last out of the control variables to be decided in order to select cases for the main independent variable is energy mix. This variable is not as straightforward as the previous two since there is no index or similar unit to determine if cases are similar enough. Energy mix is a variable which is very fluctuating between countries and there is probably not one country which has the same energy mix as another. Therefore, the data will be discussed here in order to provide transparency in how the decision was made in terms of the similarities between cases. The results will be discussed to hopefully find at least one pair which can be said to show similarities in their energy mix in terms of fossil fuel dependency, which might hinder change in the energy consumption and benefit from subsidies persistence.

6.1.3.1 Sweden

When studying the energy supply distribution in Sweden one sees that the greatest source is by far nuclear energy at 35%, followed by biofuels at around 26% and closely followed by fossil fuels at 24%. Renewables account for approximately 15% of the total energy supply (IEA 2020a).

6.1.3.2 The Netherlands

Fossil fuel sources are by far the largest energy source in the Netherlands accounting for 90% of energy supply. The second largest source is biofuels which makes up 6% and the remaining energy is distributed between renewable sources and nuclear power (IEA 2020b).

6.1.3.3 Denmark

In Denmark fossil fuels is the largest energy source accounting for 59% of the supply. Biofuels is second with 31% and thereafter comes renewables accounting for about 10% (IEA 2020c).

6.1.3.4 Finland

Finland like Denmark has fossil fuel as the largest source of energy accounting for 44% of the energy supply. Bio-fuels account for 32%, nuclear 19% and renewables make up 5% (IEA 2020d).

6.1.3.5 Germany

Germany has a high level of fossil fuel dependency with these sources accounting for 78% of the energy supply. Bio-fuels account for 10%, followed by nuclear at 6% and finally renewables accounting for right under 6% (IEA 2020e).

6.1.3.6 France

In France fossil fuels is the largest source of energy accounting for about 47% but it is closely followed by nuclear energy at 42%. Bio-fuels account for 7% and renewables account for 4% of energy sources (IEA 2020f).

6.1.3.7 Ireland

Ireland has a large dependency on fossil fuels sources which account for about 88% of energy. The remaining sources are divided between renewables which make up almost 7% and bio-fuels account for about 6% (IEA 2020g).

9.1.4 Discussion of Energy Mix

When studying the different energy sources in the different countries it is evident how much it can shift from one country to another. In terms of fossil fuel dependency there were three countries which stood out in comparison to the rest. These were the Netherlands, Germany and Ireland which had fossil fuels accounting for the majority of the energy supply in the countries. Sweden had the lowest fossil fuel dependency and Denmark; Finland and France were relatively close in this aspect. In terms of renewable energy Sweden had the largest share and the remaining countries were all quite far behind Sweden with no other country having a double-digit percentage of renewables accounting for their energy supply. In terms of nuclear energy, it also shifted a lot with some countries having no nuclear power and others such as France, Sweden and Finland having a large nuclear supply of energy. Bio-fuel sources did not shift as much though Sweden and Finland definitively had a larger share than the rest. In terms of determining which cases can be considered to have a similar energy mix as one another the main determinant will be to look at the fossil fuel dependency. The countries which are the most reliant on fossil fuel sources were by far the Netherlands, Germany and Ireland. In the other aspects of their energy mix Ireland is the only country without nuclear power but in terms of biofuel and renewable sources the countries are quite similar. Therefore, these could be considered to have the same energy mix. For the other remaining countries Denmark, France and Finland show similarities in their fossil fuel sourcing. Sweden is the only country which has a relatively low fossil fuel consumption compared to other cases and will therefore not be relevant to compare. When studying Denmark, France and Finland however their energy sourcing shows similarities other for the fact that Denmark lacks nuclear power. Since this paper is mostly interested in fossil fuel consumption this is not an issue though and these three countries can be considered to have a similar energy mix.

9.2 Table 1: COV Analysis Result Table

	Education	Energy Mix	Innovation Level	Political Will	FFS 2008-2018
Denmark	High	High share RE	High	Moderate	Significant Decrease (-53%)
France	High	High share RE	High	Moderate	Significant Increase (+61%)
Finland	High	High share RE	High	Moderate	Moderate Increase (+9%)
Ireland	High	Low share RE	High	Semi-high	Moderate Increase (+12%)
Germany	High	Low share RE	High	Moderate	Moderate Decrease (-12%)
Netherlands	High	Low share RE	High	Low	Moderate Increase (+17%)

9.3 Table 2: Renewable Electricity Generated by Source

	Wind 2008	**Wind 2018**	**Hydro 2008**	**Hydro 2018**	**Solar 2008**	**Solar 2018**
Denmark	19%	42%	0.07%	0.06%	0.008%	2.4%
France	0.9%	4%	12%	12%	0.007%	1.5%
Finland	0.3%	4%	22%	23%	0.005%	0.03%
Ireland	8%	20%	4%	3%	0%	0.02%
Germany	6%	12%	4%	4%	0.7%	6%
Netherlands	4%	7%	0.01%	0.09%	0.04%	1.4%