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Developing a Sustainable Union: *Identifying the correlation between renewable sources of electricity and European integration*

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Introduction

"Winston Churchill once said: 'Politics is the ability to foretell what is going to happen tomorrow, next week, next month and next year. And to have the ability afterwards to explain why it didn't happen.'

Churchill was right, we can't predict the future. Unexpected events will always occur.

But as politicians, it's our job to lead and to chart a course. It's our job to set goals and make choices that help achieve those goals. And looking at Europe and the world today, it's clear: the European Union needs to make choices. Choices about its course and its role in the years to come."[1]

This was the opening statement of Dutch Prime-Minister Mark Rutte on June 13th, 2018 to the European Parliament (EP). Central to the entire speech was the concept of 'choices'. Instead of the desire to influence governance in every topic, the European Union (EU) should make choices about what it would embrace as its own, creating a system where the EU can use its unique position in the world to excel in specific areas. In other words: "Less is more."[2] To illustrate, Rutte presented several topics where the EU would be a benefit instead of a burden, with a specific emphasis on climate- and environment. Climate policies are, according to Rutte, "by definition a cross-border issue."[3] Changes in climate, weather or environment do not adhere to the borders of individual states and can therefore not be addressed without international cooperation.

Climate policies and the future of European integration were both central pillars of Rutte his speech, and he made that decision for a reason. Both are topics which cannot be postponed indefinitely, and which need decisive and transparent leadership. European integration is, especially after Brexit, a topic in need of solutions. Climate policies share this sense of urgency. An increase in environmental awareness has created a movement dedicated to changing existing structures through the construction of a world built on sustainability and long-term wellbeing of both mankind and nature. There is also the fact that contemporary structures built on the availability of fossil-fuels cannot continue to operate indefinitely because known and easily accessible deposits are rapidly approaching depletion. Both European integration and climate policies are therefore topics which are relevant for societies and governments alike, potentially altering the very structures our contemporary lives are built upon.

So far, climate policies and European integration have been illustrated as separate topics, but they can also be invoked in conjunction. As stated by Rutte, climate policies are at their very essence cross-border issues which require international cooperation to achieve results.

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[1] Rijksoverheid, 'Toespraak minister-president Rutte over de toekomst van de Europese Unie - Europees Parlement, Straatsburg', (13 June 2018), https://www.rijksoverheid.nl/regering/bewindspersonen/mark-rutte/documenten?pagina=2 (03 July 2018).
[2] *Idem.*
[3] *Idem.*

The way this happens (or not) is a direct example of interaction between climate policies and European integration. This interaction can be measured through identifying the situation, priorities and goals of individual member-states and to compare them with why they voted in favour or against certain policies. Through a comparison between past outcomes and contemporary decisions, an analysis can be created which identifies why certain policies changed or stayed the same.

To successfully perform a comparison between past- and present policymaking, theoretical concepts must be narrowed down to useable standards; which means that the ambiguous concept of 'climate policies' does not suffice. Within climate policies, the importance of *energy* is paramount, with a specific emphasis on the way energy is generated. Within the EU, energy is often generated through fossil-fuels, which have several negative characteristics such as limited supplies and the emission of greenhouse gasses. In an effort to reduce dependency on fossil-fuels, a phenomenon is taking place within the EU which from now on will be identified as *the transition to renewable energy*. Through this transition, fossil-fuels will be replaced with renewable sources. The EU is currently in the middle of this transition, with member-states trying to adjust their energy-mixes accordingly. Energy is already better suited for identifying differences between past and present but is unfortunately still too broad to effectively use. It is an overarching term which has several subservient fields with distinctive characteristics, sources and implications. As an example, energy generated for use in transportation is different than energy used to generate heating. Therefore, the decision has been made to narrow the topic down even more and focus on one subsidiary of energy, which is electricity.

A primary reason for this decision is the strong international aspect of electricity on several levels. The first level is cooperation through the direct trade of necessary sources, such as the trade of oil or coal for electricity production. The second level is the trade of electricity itself, through an international grid and regional electricity markets. The third level is the direct role of the EU in its efforts to create an internal EU market for all member states, complete with the infrastructure necessary to achieve this goal. Electricity is therefore often an international affair, which makes it very applicable for a comparative analysis with European integration in the past, present and future.

Therefore, this article has been built on the premise that a correlation between electricity generation and European integration exists. This correlation is changing through the transition to renewable energy, which is currently taking place in all 28 EU member-states. As old structures are making place for new ones, the central question of this article will therefore be how the transition to renewable sources for the generation of electricity influences European integration.

This question is relevant because a gap exists in the literature about the correlation between international relations and renewable sources of electricity, or energy, in general. There are many sources describing the technical aspects of renewable energy, but a direct connection to international politics is a field which is often overlooked, especially within the unique setting of the EU. The increasing shares of renewable energy in electricity generation are fundamentally changing the structures upon which European energy integration is built, and it is in favour of not only academics and policymakers, but society as well, that we understand how these changes are taking place and what the results can be.

To be able to successfully answer the question, it is necessary to identify a theoretical framework to which the question can be attached. A primary reason why energy policies are not merely national affairs, but instead have an international dimension as well, is the concept of *energy security*. This concept, which will be further explained and analysed in the first chapter, will form the theoretical basis which can explain the correlation between electricity generation and European integration. The concept of energy security will then be combined with a historical analysis of three events which have defined European energy policies so far. This will be done to illustrate how the concept has influenced European policies in the past. The first event is the founding of the European Coal and Steel Community (ECSC) and its stance towards fossil-fuels, specifically coal. The second event is the 1973 Oil Crisis, and the consequences it had for energy throughout Europe. The third event is an analysis of the efforts of recent years. After past energy policies have been identified, contemporary alternatives to fossil-fuels which can already be deployed will be described and discussed, with specific attention to their inherent characteristics which define their applicability in Europe.

This combination of concepts, history and renewable alternatives will form the base of a thorough analysis of contemporary efforts of three EU member-states. These are the Netherlands, Sweden and Bulgaria. The decision to not analyse the efforts of the entire EU simultaneously is based on the motto of the EU itself, which is "United in diversity."[4] The fact that each member-state is in a unique situation cannot be underestimated, and what policies might be applicable for one member-state might therefore be disastrous or irrelevant for others. These states have been chosen because they all deal with the transition to renewable energy in their own way. Sweden is one of the forerunners in the world when it comes to renewable energy, whilst the Netherlands has ambitious plans but is underperforming in actual deployment. Bulgaria, at the periphery of the EU, also wants to reach EU-goals, but has other problems of its own to handle first.

The primary goal of this article is to create a foundation for further research about the connection between the transition to renewable energy and European integration. It will therefore be a combination of a description and an analysis, identifying past and contemporary energy policies and combining them. Upon this basis, future in-depth research can be done, focussing on other fields of energy such as transportation and heating or different case-studies within the EU.

[4] Europa.eu, 'The EU motto', https://europa.eu/european-union/about-eu/symbols/motto_en (03 July 2018).

Chapter 1: Historical Context of Energy Integration in Europe

The concept of Energy Security

To answer the question what the relationship between renewable energy and European integration entails, a clearly defined theoretical framework is necessary. In answering this particular question, the theoretical framework will be linked to the concept of energy security, which plays a vital role in policymaking within the EU. Before this can be illustrated however, it is necessary to first describe energy security itself and its potential uses. Even though the term is widespread in official documents and academic papers, it does not always hold the same meaning and context; the concept of energy security has, throughout the years, been used by different actors in different situations to describe different phenomenon.

A solid place to start is the definition used by the International Energy Agency (IEA). It states that energy security is “the uninterrupted availability of energy sources at an affordable price.”[5] That being said, the IEA believes that energy security has differing dimensions depending on factors such as time. Long-term energy security can deal with “timely investments to supply energy in line with economic developments and sustainable needs”, whilst “short-term energy security focuses on the ability of the energy system to react promptly to sudden changes within the supply-demand balance.”[6] What energy security means, according to the IEA, changes depending on the timeframe and relevant circumstances.

Other actors also believe that energy security is more than a singular definition which can be applied at all times. Christian Winzer has analysed past usage of the concept in his article *Conceptualizing Energy Security*.[7] In his article, he identifies a link between energy security and the position of the actor who invokes the concept. Energy security can, when individuals are the relevant actors, mean that society is protected from mismanagement by companies and states. In this case, relevant facets of the concept are price-management and availability for individual consumers.[8]

When states invoke the concept, other factors become relevant. For states, energy security is about subjects such as the reliable provision of energy and the protection of the economy. In this case, enhancing energy security is about making sure that sources of supply are as stable as possible and that proper contingency plans are in place when supply fails.[9]

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[5] International Energy Agency, ‘What is Energy Security?’, https://www.iea.org/topics/energysecurity/whatisenergysecurity/ (27 June 2018).
[6] *Idem.*
[7] Christian Winzer, ‘Conceptualizing energy security’, in: *Energy Policy, July 2012, Vol.46*, 36-48.
[8] Winzer, ‘Conceptualizing energy security’, 36.
[9] *Idem.*

Having identified the role of actors, Winzer defines energy security as an ambiguous concept governed by three principles: scope, source and severity.[10] The actor who invokes the concept determines the scope. This can range from individuals to supranational bodies such as the EU. Source is about the risks which can potentially harm energy security, such as technical, human or natural risks. Severity details the magnitude and importance of topics relating to energy security.[11] In short, Winzer does not pursue the goal to create a definition for the concept which fits in every situation. Instead, he focusses on identifying critical elements which define the concept of energy security depending on the context.

Another academic, Benjamin Sovacool, uses comparable criteria to define what energy security can mean in certain situations in his article *An International Assessment of Energy Security Performance*.[12] These are topical focus, scope and coverage, transparency and continuity. Topical focus is about the actors involved, whereas scope, coverage, transparency and continuity once again detail the circumstances under which a specific form of energy security can be considered relevant.[13] Sovacool therefore also concludes that Energy security is relative to the situation at hand and open for multiple interpretations.

What is also important to understand is that energy security, as a specific form of security, is inherently connected to the field of security studies. David Baldwin concluded that security is multidimensional, and that several types of security, such as economic security and social security, are not fundamentally different concepts from each other.[14] The central idea of security, according to Baldwin, is that security is "a low probability of damage to acquired values".[15] This basis can then be specified through the application of three questions, *security for whom, for what values* and *from what threats?*[16] When comparing the factors used by Sovacool, Winzer and the IEA with the questions formulated by Baldwin, it becomes clear that there are many similarities. Actors (who), scope (what values) and source/severity (what threat) essentially boil down to the same core elements. Energy security cannot exist in a vacuum. It will always be invoked by a specific actor to protect something from a specific risk, which makes energy security inherently ambiguous.

The way the concept of energy security will be used in answering the question about European integration and renewable sources of electricity production will be based on the findings of these academics and the IEA. The concept will be connected to a specific actor, the values they want to protect and the risk which has the potential to harm security. With this understanding of energy security, it is time to apply it to three events which have defined European energy policies so far.

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[10] *Ibidem,* 43.
[11] *Ibidem,* 38.
[12] Benjamin K. Sovacool, 'An international assessment of energy security performance', in: *Ecological Economics, 2013 Apr, Vol.88*, 148-158.
[13] Sovacool, 'An international assessment of energy security performance', 149.
[14] David A. Baldwin, 'The concept of security', in: *Review of International Studies, 1997, Vol.23(1),* 23.
[15] Baldwin, 'The concept of security', 13.
[16] *Ibidem*, 13-16.

The European Coal and Steel Community

The first historical case to be analysed is the European Coal and Steel Community. Central to the creation of this institution is Robert Schuman, who, as the French minister of foreign affairs, played a critical role in determining the scope and role of the ECSC through what would later be known as the Schuman Declaration.[17] Central to the ECSC was the production and use of coal in post-war Europe. Not only was it one of the primary means of energy production at the time, West-Germany its energy mix would still rely for 85% on coal in 1957,[18] but it was also critical in maintaining and operating heavy industry which could potentially be used to support war-efforts.

Schuman, in his declaration, focussed on these two issues. Not only would the creation of a common High Authority over the production of coal and steel make "any war between France and Germany not merely unthinkable, but materially impossible",[19] but it would also be essential in bringing back economic prosperity after the devastation brought upon the European continent by the Second World War. Therefore, it can be argued that energy security is closely related to the founding of the ECSC in two ways. First, Schuman and the other founding-members of the ECSC believed that a European body controlling the production and distribution of coal would diminish the chances of another war breaking out within Europe. Energy security in this instance is strongly related to state-security as a whole. The second role of energy security is creating economic prosperity through cooperation in the extraction and distribution of coal.

Even though the ECSC focussed specifically on coal, it still illustrates how energy policies and energy security have been central concepts of European integration since the beginning. This would continue to be the case when the ECSC would be incorporated into the European Communities (EC) in 1967 and coal was gradually replaced by oil in importance. Contrary to coal however, policies regarding oil remained divided.[20]

The 1973 Oil Crisis

In 1973 several Arab oil-producing states decided to artificially increase oil prices and gradually turn down production to put pressure on the mostly European states which had supported Israel during the Jom-Kippoer War. This resulted in oil shortages in Europe. Even though coal was broadly managed through the ECSC, other sources of energy did not have similar regulations. This made it difficult to deal with the crisis as a unified bloc, which resulted in states individually searching for temporary- and long-term solutions.

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[17] European Union, 'The Schuman Declaration – 9 May 1950', https://europa.eu/european-union/about-eu/symbols/europe-day/schuman-declaration_en (10 June 2018).
[18] John S. Duffield, *Fuels Paradise: seeking energy security in Europe, Japan, and the United States* (Baltimore 2015), 153.
[19] European Union, 'The Schuman Declaration – 9 May 1950', https://europa.eu/european-union/about-eu/symbols/europe-day/schuman-declaration_en (10 June 2018).
[20] Peter Stingelin, 'Europe and the Oil Crisis', in: *Current History, Mar 1, 1975, Vol.68(403)*, 97.

John Vogler concludes that the reason why a common policy could not be decided upon was because each state had a distinct energy-mix and would thus be impacted in a unique way.[21] Any European-wide effort to regulate oil could therefore be seen as an infringement on the sovereign capacity of an individual state to determine its own energy policy. In the end, the ability to retain sovereignty was deemed more important than the creation of a common European policy.[22]

It remained difficult to convince states to support pan-European policies after the oil crisis as well. Calls for an internal European market were halted in 1996 and 1998.[23] This can be explained through the efforts made by European states after the oil crisis to strengthen national energy policies in order to protect their own security of supply. The United Kingdom (UK) started searching for new oilfields to diversify their sources and found them in the North Sea.[24] In Germany, oil had taken over the central position of coal in the years before the oil crisis.[25] The crisis showed the German government that reliance on oil as a primary source of energy brought large risks for security of supply, and the government therefore looked at alternatives without necessarily going back to coal. One of the potential alternatives was the use of nuclear energy, but it was decided that nuclear energy should only be developed to the extend absolutely necessary to secure energy supply.[26] This decision ultimately made the Germans move towards investments in renewable energy instead.

The oil crisis illustrated how important it is for states to safeguard their security of supply, and that this goal does not always go hand in hand with common European policies. When energy security can be maintained through national solutions, states will prefer sovereignty over common European solutions.

Towards Renewables and European Policies

Even though states remained wary of the concept of a unified energy market, the EC, and later the EU, never completely let go of the idea. The resistance of individual states gradually diminished during the first decade of the 21st century, primarily due to two factors. The first was the appearance of *global warming* on the world stage, whilst the second factor was the realisation that fossil-fuel resources are depleting at an alarming rate.[27] To illustrate, the sources of fossil-fuels which the UK found after the 1973 oil crisis are already nearing depletion. The negative effects of these developments are profound, since the UK changed from a net exporter of energy to a net importer in 2005.[28]

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[21] John Vogler, ‘Changing conceptions of climate and energy security in Europe’, in: *Environmental Politics, 01 July 2013, Vol.22(4)*, 629.
[22] Vogler, ‘Changing conceptions of climate and energy security in Europe’, 629.
[23] *Ibidem*, 613.
[24] Duffield, *Fuels Paradise*, 68.
[25] *Ibidem*, 153.
[26] *Ibidem,* 158.
[27] Ibidem, 67.
[28] Tomas Maltby, ‘European Union energy policy integration: A case of European Commission policy entrepreneurship and increasing supranationalism’, in: *Energy policy, April 2013, Vol.55(100),* 440.

For individual states, having access to secure sources of energy is of tremendous importance. Tomas Maltby has identified this phenomenon and concludes that European energy policies have mostly been shaped by the ability to securely import energy sources. Fossil-fuels can only be extracted from specific locations, resulting in a situation where many EU member-states have to import fossil-fuels from outside the EU. Russia, as an example, supplies substantial amounts of gas and oil to many EU member-states, predominantly in the Southeast of Europe.[29] This poses a risk for energy security because many states are dependent on a single source for their energy imports.

Maltby comes to the same conclusion as Vogler that, in the past, individual states valued freedom over a common policy regarding energy security. But he believes that, since the oil crisis and two gas-import disruptions in 2006 and 2009, states have been more willing to discuss a common policy to not only help strengthen Europe its position regarding Russia in negotiations, but to also create an international safeguard for when states have to deal with supply issues.[30] This wish for a safeguard resulted in a European wide 'Energy Security Strategy', which was created and published in May 2014.[31] Central to this strategy are short- and long-term solutions regarding energy security. The short-term solutions are mostly about crisis management, whereas the long-term solutions are about creating internal unity in negotiations to strengthen positions when dealing with external actors, working on- and completing an internal energy market and creating necessary infrastructure to be able to diversify sources.[32]

The goal of diversification has a double meaning. It is not merely about identifying locations from which sources can be imported, but it is also about actively using several types of sources, such as renewable- and nuclear energy. Stimulating these developments is also a goal of the EU, and has been formulated in the 2020[33] and 2030 energy strategies, which stipulate energy-related goals for the coming 12 years.[34] Targets of the 2030 energy strategy are a 40% reduction in greenhouse gas emissions compared to 1990 levels, a share in consumption of at least 27% renewable energy, an improvement in energy efficiency of at least 27% and the completion of the internal energy market.[35] Through these goals, the EU wishes to direct states towards the transition to renewable energy.

Renewable energy therefore takes a central position in contemporary EU energy policies. A side-note in this matter is that the noble goals of protecting the environment should not be overstated. As long as security of supply is safe, Europe will push for goals which protect the environment, but when energy security is at risk these goals will be the first to be

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[29] Maltby, 'European Union energy policy integration: A case of European Commission policy entrepreneurship and increasing supranationalism', 435.
[30] *Ibidem*, 438.
[31] European Commission, 'Energy Security Strategy', https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/energy-security-strategy (27 June 2018).
[32] *Idem*.
[33] European Commission, '2020 Energy Strategy', https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2020-energy-strategy (27 June 2018).
[34] European Commission, '2030 Energy Strategy', https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy (27 June 2018).
[35] *Idem.*

abandoned.[36] The reason for this is simple: even though renewable energy is very valuable in its own right, it also has its limits and weaknesses. The goals of using renewables is very important but cannot be more important than risking the availability of affordable and accessible energy. This once again illustrates why the concept of energy security is relevant for answering the question regarding the impact of renewable energy on energy policy in Europe.

Where in the past a common energy policy seemed far away, it can be said that in recent years the EU has made significant steps towards realising common grounds. In the past, several initiatives failed because states favoured the ability to choose their own energy policies over collective security, but it seems that recent developments such as climate change, an increase in dependency and a reduction in fossil-fuels reserves have watered down this argument enough for actual measures to be taken. Now that the EU has formed a clear Energy Strategy for the coming decades, it is time to analyse what kinds of energy can be used to achieve these goals.

Chapter 2: Opportunities and Restrictions of Energy in the European Union

With the strict directives made by the EU to reduce dependence on fossil-fuels, alternative sources of energy have to be found in the form of nuclear and renewable energy. Within these overarching terms, distinct types of energy can be found, each with its own opportunities and limitations. The goal of this chapter is to identify these characteristics, and to analyse the usefulness of these distinct types of energy in reaching the goals stipulated in EU Energy Strategies. Experimental types of energy such as tidal energy will not be analysed in this chapter because the choice has been made to focus on proven types of energy which can already be deployed across the EU. This is done to reduce uncertainty and speculation, and to keep this article rooted in contemporary observations. The forms of energy which will therefore be analysed are nuclear, bio, solar, wind and hydro energy.

Nuclear Energy

As stated in the introduction, nuclear energy is actually an overarching term instead of a specific type of energy. There are several types of reactors, several different forms of fuel and distinct approaches when it comes to energy generation, most notably through fission and fusion. All commercial reactors currently operate through fission, whilst fusion is an experimental form of nuclear generation which cannot be commercially used as of now.[37]An example of a fusion-reactor is the ITER project, which has the goal to create the largest

[36] Malcolm C. Grimstom, *The Paralysis in Energy Decision Making: European Energy Policy in Crisis*, (Dunbeath 2016) 10.
[37] Thomas Hamacher, Matthias Huber, Johannes Dorfner, Katrin Schaber and Alex M. Bradshaw, ‘Nuclear fusion and renewable energy forms: Are they compatible?’, in: *Fusion Engineering and Design, October 2013, Vol.88(6-8),* 657.

fusion-powered reactor in the world. However, it will probably take years before the results of this project can be translated into commercially viable reactors.[38]

The reason why nuclear energy is relevant for the transition to renewable energy is because energy security plays a vital role in contemporary and near-future European- and national politics. Many forms of renewable energy have fluctuating power levels because of environmental impact, which has the potential to make them unreliable to use without a stable energy source operating next to them. Nuclear energy has the capability to be this 'stable anchor', especially in states which have heavily invested in nuclear power plants (NPP's) in the past.

In France, nuclear energy currently provides 75% of the total amount of electrical energy, due to its long-standing policy on enhancing energy security through nuclear development.[39] However, nuclear energy is not risk-free regarding security of supply. Raw materials such as uranium have to be imported. To counter this risk, France has diversified its importers, buying fuel from several states, including Canada, Niger, Australia, Kazakhstan and Russia.[40]

Nuclear energy can therefore play a significant role in the EU its bid to reduce greenhouse gas emissions whilst keeping energy security intact, because there are no greenhouse gasses emitted when generating nuclear electricity. Only mining and shipping of necessary fuels produces greenhouse gasses, but nuclear energy is still much cleaner than fossil-fuels.[41]

That being said, it is still a highly controversial form of energy generation. Especially when related to another form of energy security, the safety involving energy generation, nuclear energy is often the focus of criticism. Chances are very low that something will go wrong, but when it does, the effects can be disastrous through nuclear explosions, meltdowns or radioactive fallout. There is also the issue that nuclear power generation creates waste which is difficult to handle and store, and which will remain radioactive for thousands of years. This has led to countless protests over the years, resulting in policymakers diminishing their support for nuclear energy. Even a state like France, which is the largest net-exporter of electricity in the world because of its reliance on nuclear energy, has introduced plans to reduce reliance from 75% to 50% in 2025.[42] Therefore, even though nuclear energy definitely has the potential to help diversify sources, strengthen energy security and decrease emissions, it is unlikely that states which did not already invest in nuclear power will suddenly choose to do so in the future.

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[38] ITER, 'What is ITER?', https://www.iter.org/proj/inafewlines (28 June 2018).
[39] World Nuclear Association, 'Nuclear Power in France, http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/france.aspx (08 June 2018).
[40] *Idem.*
[41] The Conversation, 'Is nuclear power zero-emission? No, but it isn't high-emission either', (20 May 2015), http://theconversation.com/is-nuclear-power-zero-emission-no-but-it-isnt-high-emission-either-41615 (08 June 2018).
[42] World Nuclear Association, 'Nuclear Power in France, (June 2018), http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/france.aspx (08 June 2018).

Bioenergy

Bioenergy is the overarching term for biomass, biogas and biofuel, sources of renewable energy which rely on (processed) organic matter such as wood, plants or organic by-products. Bioenergy is the most widely used form of renewable energy globally, providing roughly 10% of the global energy supply in 2016,[43] whilst biomass alone accounted for roughly two-thirds of the total renewable energy consumption within the EU in 2012.[44] The various forms of bioenergy make it a versatile resource. Its use is not merely limited to the generation of electricity but can also effectively assist in the sectors of transportation and heating as an alternative to *electrification*. Electrification is the increasing share of electricity in sectors in which its usage was limited in the past, such as electric cars in the transportation sector. Resource-generation itself is also versatile, ranging from small-scale gathering of by-products and organic waste to large scale bio-crop farms.[45] This prominent level of applicability and versatility is the most significant beneficial characteristic of bioenergy, and the primary reason why it is already utilised on a large scale within the EU and the rest of the world.

Another positive characteristic is the potential for storage. With contemporary technology regarding batteries it is impossible to store electricity on an industrial scale for longer durations of time, resulting in the fact that excess energy has to be curtailed.[46] Bioenergy is a potential form of dispatchable energy, meaning that its supply can be adjusted based on demands.[47] It can therefore act as a stabiliser next to the more fluctuating output of other forms of renewable energy.

This does not mean that bioenergy is always suitable for storage. An issue with bioenergy is energy density, which is the amount of energy stored per unit volume. The energy density of bioenergy is dependent on the specific type, but generally tends to be much lower than any traditional form of fossil-fuel.[48] This not only has implications for the ability to store bioenergy, but also for international trade and transportation. Therefore, bioenergy tends to be more effective the closer its resources are extracted to the place where it is generated, because transporting the same amount of bioenergy compared to fossil-fuels takes up more space.[49]

The energy density of bioenergy also has implications for land usage, with large bio-crop farms or agroforestry potentially taking up space which could otherwise be used for other

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[43] World Energy Council, 'World Energy Resources – Bioenergy – 2016', https://www.worldenergy.org/wp-content/uploads/2017/03/WEResources_Bioenergy_2016.pdf (28 June 2018), 2.
[44] European Commission, 'Biomass', https://ec.europa.eu/energy/en/topics/renewable-energy/biomass (08 June 2018).
[45] World Energy Council, 'World Energy Resources – Bioenergy – 2016', https://www.worldenergy.org/wp-content/uploads/2017/03/WEResources_Bioenergy_2016.pdf (28 June 2018), 2.
[46] Anjali Pandit, Alfred Holzwarth and Huub de Groot, *Harnessing Solar Energy for the Production of Clean Fuel* (Strasbourg, 2008), 2.
[47] World Energy Council, 'World Energy Resources – Bioenergy – 2016', https://www.worldenergy.org/wp-content/uploads/2017/03/WEResources_Bioenergy_2016.pdf (28 June 2018), 21.
[48] Ontario Ministry of Agriculture, Food and Rural Affairs, 'Biomass Densification for Energy Production', http://www.omafra.gov.on.ca/english/engineer/facts/11-035.htm#3 (28 June 2018).
[49] *Idem.*

purposes, such as food production or nature reserves. Whether this is actually the case is again dependent on the type of bioenergy, because many forms of bioenergy are by-products of other industrial activities such as wood-production or agriculture, and thus do not necessarily claim land for themselves.[50] Policymakers still need to be wary though that the negative effects of bioenergy on the environment remain as low as possible.

Another issue is the fact that bioenergy is not greenhouse gas emission free. Resource-production, shipping and energy/electricity generation all emit greenhouse gasses. These emissions are often considerably lower than fossil-fuels, but they are higher than other forms of renewable energy, which often do not emit greenhouse gas emissions at all once they start operating.

Bioenergy is definitely an interesting option for the EU to pursue, most of all because of its versatility, potential in storage and room for technological advances. However, the fact that it is not emission-free and often lacking in energy-density are problems which need to be solved before it can truly be relied upon as a central pillar of energy production. Bioenergy is absolutely necessary for the coming decades, but the question remains whether it is truly preferable in the long run.

Solar and Wind

Wind and solar energy share the same analysis because their situation within European power generation is largely similar. Both sources have proven and experimental forms which can be used in energy generation. The most common types utilised in Europe are on shore wind energy and photovoltaic solar energy, with off shore wind energy and concentrated solar power as examples of more experimental or limited forms used in electricity generation. Both on shore wind energy and photovoltaic solar energy contributed 26% and 11% to the total electricity production within the EU in 2015 respectively.[51] Difficulties with off shore wind energy are mostly because of geographical limitations, because it needs to be in open water, and because construction and operation is difficult. Concentrated solar power is currently only economically feasible in Southern Europe because it can only properly function in a location with access to a large amount of intense sun hours.[52]

A strong benefit of both forms of energy, regardless of the way they are generated, is that they can be considered self-sustaining when the production process is finished. Solar panels and windmills do not require any resource which needs to be extracted and transported but instead rely on resources which can be accessed on the spot where they are constructed.

This does not mean that both wind and solar energy are free of geographical limitations or international implications. Not all locations are equally suitable, with efficiency depending on several factors such as the amount of sun hours and the amount of obstructions which

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[50] World Energy Council, 'World Energy Resources – Bioenergy – 2016', https://www.worldenergy.org/wp-content/uploads/2017/03/WEResources_Bioenergy_2016.pdf (28 June 2018), 6.
[51] European Environment Agency, 'Renewable energy in Europe – 2017 Update: Recent growth and knock-on effects', https://www.eea.europa.eu//publications/renewable-energy-in-europe (28 June 2018), 18.
[52] *Ibidem*, 24.

diminish wind power. This also means that wind and solar energy are dependent on weather conditions as well, which results in a fluctuating power output. These fluctuations can result in energy shortages or excess energy, which are both problematic in their own way. The negative effects of energy shortages are obvious, but excess energy generated through these means cannot properly be stored, resulting in loss of energy and a reduction in efficiency.

This fluctuating output, together with a phenomenon known as the *decentralisation* of electricity, poses challenges for the existing energy grids in Europe. In past decades, electricity would almost exclusively be generated in major power plants, with a clear distinction between supplier and consumer, resulting in rigid electricity grids with a distinguished origin and destination. Wind and solar energy can be constructed virtually anywhere on the grid, blurring this distinction. Fluctuating power levels amplify this effect, increasing the chance that consumers suddenly become suppliers. Older infrastructure cannot properly handle rerouting energy in that case, resulting in the need for a *smart grid*, which is capable of efficiently tracking and transferring energy, sending it to the places that need it the most.[53] To make sure that interconnections between European member-states are able to cope with rerouting energy as well, the smart grid is not only a national concern, but will also have to transcend borders, connecting states in an efficient and cost-effective way.

Wind- and solar energy are both crucial forms of renewable energy for reaching the 2030 directives. They are already capable of deployment on an EU-wide scale, have few geographical limitations apart from efficiency related issues and are emission free. However, fluctuating power levels and decentralisation require significant investments in modern technology such as smart grids, whilst requiring other forms of energy to operate as a buffer to account for possible lower yields. It can be said with certainty that with contemporary technology, both types of renewable energy cannot operate without another form used to stabilise output.

Hydropower

Another form of renewable energy which can be considered 'mature' in the EU and which has been used for power generation since the late 19th century is hydropower.[54] Hydropower has accounted for approximately 14% of the *total primary energy supply*[55] (TPES) of renewable energy within the EU-28, with room for further expansion.[56] Hydropower has a strong beneficial characteristic which most other forms of renewable energy lack, which is its proven capability to store electricity. In 2016 approximately 99% of

[53] Smartgrid.gov, 'What is the Smart Grid?', https://www.smartgrid.gov/the_smart_grid/smart_grid.html (28 June 2018).
[54] Claude E. Rupert, *Hydropower: Types, development strategies and environmental impacts* (New York 2014), 2.
[55] Energy Production + Imports – Exports = Total Primary Energy Supply
[56] Eurostat, 'Hydropower', http://ec.europa.eu/eurostat/web/environmental-data-centre-on-natural-resources/natural-resources/energy-resources/hydropower (08 June 2018).

the worlds stored electricity was in the form of hydropower.[57] Reservoirs created by hydropower can act as an indirect electricity storage, through keeping water in reserve in times of abundance, and using reserves in times of need, making an electricity grid more capable of dealing with fluctuations.

There are currently three traditional forms of hydropower. The first is the direct application of the currents of a river to create hydropower. The second is to create an artificial reservoir from which water can slowly be released. Both forms of hydropower have a net-gain of electricity. The third form of hydropower is called pumped-storage and involves pumping water from a lower reservoir back into a higher reservoir so that it can flow past the turbines again.[58] This type of hydropower does not directly generate electricity but instead strengthens the capacity of hydropower to act as storage. Through utilising leftover electricity to pump water back into reservoirs again, it can still be 'stored' for later consumption, improving energy efficiency and reducing waste.

Even though the benefits of hydropower are numerous, there are several negative characteristics which reduce its applicability in Europe. The first is its reliance on geography. Large-scale generation of hydropower is strongly dependent on the existence of suitable rivers and locations where reservoirs can be constructed without destroying social- and ecological structures.

Besides these geographical limitations, hydropower also often has international implications. Water tends to be a cross-border resource, with 260 rivers crossing at least one national boundary.[59] This international factor of hydropower has caused problems in other parts of the world, such as the Mekong river in Southeast-Asia, where Chinese projects in the upper river have negative implications for communities and ecosystems in other states downstream.[60] Within the EU, most easily accessible hydropower projects have already been utilised, which leaves little room for expansion without damaging systems or creating international implications.

Therefore, most of the potential in Europe does not lie with the larger, traditional form of hydropower generation, but instead in smaller generators which do not have significant implications for societies, ecosystems and international relations. Another opportunity lies in retrofitting older stations to increase energy production and efficiency.[61]

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[57] World Energy Council, 'World Energy Resources – Hydropower – 2016', https://www.worldenergy.org/wp-content/uploads/2017/03/WEResources_Hydropower_2016.pdf (28 June 2018), 14.
[58] Eurostat, 'Hydropower', http://ec.europa.eu/eurostat/web/environmental-data-centre-on-natural-resources/natural-resources/energy-resources/hydropower (08 June 2018).
[59] World Energy Council, 'World Energy Resources – Hydropower – 2016', https://www.worldenergy.org/wp-content/uploads/2017/03/WEResources_Hydropower_2016.pdf (28 June 2018), 25.
[60] Sebastian Biba, 'China's Continuous Dam-building on the Mekong River', in: *Journal of Contemporary Asia, 20 August 2012*, 609.
[61] Hydroworld, 'Hydropower in Europe: Current Status, Future Opportunities, (20 May 2009), https://www.hydroworld.com/articles/2009/05/hydropower-in-europe.html (28 June 2018).

Hydropower will play a crucial role in reaching 2030 Energy Strategy goals, especially because of its characteristic to store electricity. However, its limited applicability reduces its potential in most states.

Conclusion

It seems that no contemporary form of renewable energy is infallible on its own. Emission free solutions such as wind, solar and hydro energy are dependent on geography and weather, which can result in limited room for deployment or fluctuating power levels. Nuclear energy, another form without greenhouse gas emissions,

is expensive and does not enjoy widespread support because of potential risks involving generation. Bioenergy has a lot of versatility but is not emission-free and requires vast amounts of physical resources to function, all with varying levels of energy density. Diversification and cooperation are therefore necessary, and it seems a plausible hypothesis that the transition to renewable energy will bring European member-states closer together. Whether that is truly the case can be seen through the three case-studies of the Netherlands, Sweden and Bulgaria.

Chapter 3 – Case One: the Netherlands

The Kingdom of the Netherlands is a small Western-European state with approximately 17 million citizens, bordering Germany to the East, Belgium to the South and the North Sea to the North-West. It also has one of the highest levels of population density in the world, with approximately 505 inhabitants per square kilometre.[62] The Dutch have a strong and competitive economy[63] and are well known for innovation in many areas dedicated to the environment, such as greenhouse agriculture.[64]

Even though the position of the Netherlands seems strong to facilitate the transition to renewable energy, it is an underperformer when it comes to the deployment of renewable sources. In 2017 the Netherlands found themselves behind almost all other EU member-states when it came to the total share of renewable energy in its energy-mix.[65] The TPES of the Netherlands is dominated by fossil-fuels, with crude oil (57%), natural gas (26.7%) and coal (10.1%) having the largest share in 2015. The source of renewable energy with the most significant share, bioenergy, only follows with a share of 3.3%.[66] When only the sources used for generating electricity are analysed, gas (42.3%) takes the lead, followed by coal

[62] UNdata, 'General Information', http://data.un.org/en/iso/nl.html (29 June 2018).
[63] World Economic Forum, 'Global Competitiveness Index', http://reports.weforum.org/global-competitiveness-index-2017-2018/competitiveness-rankings/ (29 June 2018).
[64] National Geographic, 'This Tiny Country Feeds the World', https://www.nationalgeographic.com/magazine/2017/09/holland-agriculture-sustainable-farming/ (29 June 2018).
[65] NN investment partners, 'Focus Point: Energy Transition in the Netherlands: a template for Europe?', https://www.nnip.com/Default-display-on-11/Energy-Transition-in-the-Netherlands-a-template-for-Europe.htm (29 June 2018).
[66] International Energy Agency, 'Netherlands: Balances for 2015', https://www.iea.org/statistics/statisticssearch/report/?year=2015&country=NETHLAND&product=Balances (29 June 2018).

(38.7%) and wind energy (6.9%). This top-three is followed by bioenergy, (6%), oil (1.3%) and solar PV (1%).[67]

A primary reason for this energy-mix is the geographical situation of the Netherlands. The primary defining geographical feature for the generation of energy is the availability of a domestic supply of natural gas. Not only within the province of Groningen, but also in smaller pockets in the North Sea.[68] The availability of domestic natural gas has created a society and economy which is built on the premise that it can be extracted and used for generating electricity and heat in a relatively cheap manner. Until January 1, 2018, it was mandatory for new housing to be attached to the gas-network, resulting in almost all buildings having access to natural gas in some way or form.[69]

Another reason why fossil-fuels have a significant share in Dutch TPES and electricity production is because nuclear energy never truly managed to win public support. Two NPP's for commercial purposes have been constructed in total, at Dodewaard in 1965 and at Borssele, in 1973.[70] The reactor at Dodewaard closed in 1997, whilst the Borssele reactor is still operating today. Dutch governments have shifted their position on the future of the Borssele reactor multiple times, switching between additional construction and total phase-out. Given the fact that the Netherlands needs to catch up to reach EU Energy Strategy goals, the decision has been made not to phase-out the Borssele reactor in the near future. Instead, plans have been made for a new reactor to help assist in the reduction of greenhouse gas emissions, but this has not resulted in any construction so far.[71]

Due to geographical limitations, hydropower is barely applicable in the Netherlands. The state is exceptionally flat, and a significant part of the Netherlands is located below water levels, making it impossible to construct large scale reservoirs. Larger rivers are also important shipping lanes, reducing their usefulness for large scale hydropower applications.[72] Therefore, hydropower in the Netherlands is mostly limited to small- and medium-scale applications, resulting in a very small share in total electricity production of 0.08%.[73]

[67] International Energy Agency, 'Netherlands: Electricity and Heat for 2015', https://www.iea.org/statistics/statisticssearch/report/?year=2015&country=NETHLAND&product=ElectricityandHeat (29 June 2018).
[68] Rijksoverheid, 'Gaswinning uit kleine velden in afbouwfase', (20 May 2018), https://www.rijksoverheid.nl/onderwerpen/duurzame-energie/nieuws/2018/05/30/gaswinning-uit-kleine-velden-in-afbouwfase (29 June 2018).
[69] Rijksoverheid, 'Verplichte gasaansluiting voor nieuwbouwwoning vervalt', (27 June 2017), https://www.rijksoverheid.nl/actueel/nieuws/2017/06/27/verplichte-gasaansluiting-voor-nieuwbouwwoning-vervalt (04 June 2018).
[70] World Nuclear Association, 'Nuclear Power in the Netherlands', http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/netherlands.aspx (04 July 2018).
[71] *Idem*.
[72] Milieu Centraal, 'Waterkracht', https://www.milieucentraal.nl/klimaat-en-aarde/energiebronnen/waterkracht/ (04 July 2018).
[73] International Energy Agency, 'Netherlands: Electricity and Heat for 2015', https://www.iea.org/statistics/statisticssearch/report/?year=2015&country=NETHLAND&product=ElectricityandHeat (29 June 2018).

Because of these factors, fossil-fuels continue to be of tremendous importance today. This dependency however, is coming to an end. Easily accessible deposits of fossil-fuels are rapidly depleting and vaults of natural gas in the Netherlands are no exception. Besides, the extraction of natural gas has resulted in air-pockets underground, which are responsible for earthquakes and subsidence, resulting in considerable damage in the northern province of Groningen. These factors, together with an increasing awareness of the negative environmental aspects of fossil-fuels and goals stipulated in the EU Energy Strategy directives, mean that the Dutch energy-mix has to undergo drastic changes in the near future.

This no easy task, especially because the goals stipulated by the Dutch government itself can be called ambitious. In a speech to the European Parliament in June 2018, Dutch Prime Minister Mark Rutte stated that he wanted to push beyond the 40% reduction of greenhouse gasses and would instead aim for a 55% reduction.[74] Given the current situation, it is clear that a lot has to change before the Netherlands can even come close to these numbers, which leaves the question whether it can be done at all. It is still too early to definitely answer this question, but an indication can be made based on the available plans presented by the Dutch government.

A central document in which these plans have been made public is the *Energieagenda* of 2016,[75] which identifies a general approach regarding energy until 2050. In this document, three spearpoints are stipulated for innovation within the sector of electricity generation. The goals are to reduce CO2 emissions, work on cooperation in the (mostly) Northwest-European energy market and make the current system of energy production more flexible.[76]

There are several concrete measures which have been taken since then to further these goals. Not only is a connection to the gas-network no longer mandatory, but the goal is to stop connecting any new buildings and housing to the network after 2021. Gas production in Groningen will also be scaled-down the coming years and ultimately stopped, with similar plans for the off shore vaults.[77] A downside is that these measures will almost certainly result in the Netherlands turning into a net importer of natural gas in a couple of years, because the reduction of production is quicker than the construction of alternatives.[78]

At the same time, the Dutch government has also decided to close all five coal-powered plants before 2030. Domestic extraction of coal has been phased-out decades ago, but coal-powered plants still operate on a supply of imported coal, often co-fired with biomass.

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[74] Rijksoverheid, 'Toespraak minister-president Rutte over de toekomst van de Europese Unie - Europees Parlement, Straatsburg', (13 June 2018), https://www.rijksoverheid.nl/regering/bewindspersonen/mark-rutte/documenten?pagina=2 (03 July 2018).

[75] Rijksoverheid, 'Energieagenda: naar een CO_2-arme energievoorziening', https://www.rijksoverheid.nl/documenten/rapporten/2016/12/07/ea (04 July 2018), 1-116.

[76] *Ibidem*, 9.

[77] Rijksoverheid, 'Gaswinning uit kleine velden in afbouwfase', (20 May 2018), https://www.rijksoverheid.nl/onderwerpen/duurzame-energie/nieuws/2018/05/30/gaswinning-uit-kleine-velden-in-afbouwfase (29 June 2018).

[78] NRC, 'Nederland moet mogelijk al over vier jaar aardgas importeren', (30 August 2017), https://www.nrc.nl/nieuws/2017/08/30/nederland-moet-mogelijk-al-over-vier-jaar-aardgas-gaan-importeren-12736365-a1571576 (29 June 2018).

Whether or not these plants will continue after 2030 as full-biomass-plants is still under debate, but it is certain that coal-powered production will be phased-out.[79]

Dutch decisions to close coal-powered plants and stop the extraction of domestic natural gas are ambitious but also difficult to achieve whilst maintaining energy security. Renewable sources not only have to take over the electricity production provided by fossil-fuels, but also the increasing energy demands generated through electrification in other sectors. It would be very difficult to achieve these goals whilst keeping electricity available and affordable. This has been recognised by the Dutch government, and as stated in the *Energieagenda*, the Netherlands therefore seeks active cooperation with its (mostly) Northwest-European neighbours in several fields.

This emphasis on cooperation is not necessarily new, because a lot of cross-border connections are older than the recent directives made by the EU. As of today, the Netherlands has direct electric energy links with Norway, Belgium, the United Kingdom and Germany.[80] The connection with Norway is called NordNed, a power cable between Norway and the Netherlands, which operates since 2008. This cable is a smart grid with the capacity to operate in both ways, depending on several factors such as demand and prices. In practice, the cable is mostly used during the day to transfer excess hydropower to the Netherlands. During night-time energy is often sent from the Netherlands to Norway. Norse hydropower plants tend to operate at lower capacities during night-time, and Dutch leftover energy can be used for pumped-storage.[81]

A similar cable exists between the United Kingdom and the Netherlands since 2011 and is called BritNed. Just like NordNed, the cable can be used for both import and export of energy based on similar factors.[82] The successes of these cables have paved the way for more interconnection, with concrete plans to create a similar cable with Denmark to link the Danish and Dutch wind-energy markets together.[83] This cable will be called COBRAcable and will most likely be completed in 2019.[84] A direct connection with Germany also exists. When gas prices are higher than the prices of coal, cheaper coal-powered energy is often imported from Germany for the time being. On sunny days, solar power also tends to be a cheaper alternative than gas resulting in solar energy being imported.[85]

As illustrated, cooperation with neighbours through connecting electricity grids is not a new practice and is something the Netherlands has done for quite some time. Cooperation with

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[79] Rijksoverheid, 'Kabinet verbiedt elektriciteitsproductie met kolen', (18 May 2018), https://www.rijksoverheid.nl/actueel/nieuws/2018/05/18/kabinet-verbiedt-elektriciteitsproductie-met-kolen (04 July 2018).

[80] Centraal Bureau voor de Statistiek, 'Electriciteit in Nederland – Februari 2015', https://www.cbs.nl/nl-nl/publicatie/2015/07/elektriciteit-in-nederland (29 June 2018), 17.

[81] Tennet, 'NorNed', https://www.tennet.eu/our-grid/international-connections/norned/ (29 June 2018).

[82] Tennet, 'BritNed', https://www.tennet.eu/our-grid/international-connections/britned/ (29 June 2018).

[83] Centraal Bureau voor de Statistiek, 'Electriciteit in Nederland – Februari 2015', https://www.cbs.nl/nl-nl/publicatie/2015/07/elektriciteit-in-nederland (29 June 2018), 17.

[84] Tennet, 'COBRAcable', https://www.tennet.eu/nl/ons-hoogspanningsnet/internationale-verbindingen/cobracable/ (29 June 2018).

[85] Centraal Bureau voor de Statistiek, 'Electriciteit in Nederland – Februari 2015', https://www.cbs.nl/nl-nl/publicatie/2015/07/elektriciteit-in-nederland (29 June 2018), 18.

neighbours does not merely relate to the physical electricity grid, but also extends into other areas. An example is the *Political Declaration on Energy Cooperation between the North Seas Countries*, which has been signed by Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway and Sweden.[86] This declaration deals with a myriad of issues, but is mostly concerned with all facets of research, production and deployment of off shore wind energy. On shore wind energy is less than ideal in large parts of the Netherlands because resistance tends to be relatively high due to its high population density. Therefore, the Netherlands has invested heavily in the technology and construction of off shore wind platforms, such as the wind park in Borssele, which has a capacity of around 700MW.[87] An issue which can potentially implicate these efforts is the fact that off shore wind energy can be deployed in international waters as well, and that therefore close cooperation with direct neighbours might be necessary. The North Seas countries recognised this issue, and therefore decided to actively cooperate in the planning and development of off shore wind and grid projects[88] through new organisations such as the Offshore Wind Forum (IGF) and the North Seas Countries Offshore Grid Initiative (NSCOGI).

Bioenergy is also a renewable source which benefits from international cooperation. Its versatility can be illustrated in the Dutch case, with bioenergy being used for electricity generation, heating, co-firing, transportation and more. Its significant role in renewable energy generation in the Netherlands is likely to expand in the near future, which creates opportunities and challenges alike. Problems with energy density and land-usage are amplified in the Netherlands because of the limited space which is available. There is currently still room for expansion,[89] but the combination of a phase-out of fossil-fuels and an increase in energy/electricity demands will most likely make it a necessity to import bioenergy as well. To reduce the greenhouse gas emissions generated from shipping and to be able to have a say in quality and environmental protection, it would be beneficial to keep bioenergy trade largely within European borders. International cooperation in bioenergy therefore has two dimensions. The EU can create and enforce regulations regarding environmental impact and quality, and individual states can foster trade through bilateral and regional agreements.

Concluding, the Netherlands can be characterised as an ambitious state in a difficult position. Reaching and surpassing EU Energy Strategy goals will require significant alterations in the functioning of Dutch society. The availability of fossil-fuels, especially gas, has kept electricity-prices constant, accessible and cheap, and the removal of gas as an

[86] European Commission, 'Political Declaration on energy cooperation between the North Seas Countries', https://ec.europa.eu/energy/sites/ener/files/documents/Political%20Declaration%20on%20Energy%20Cooperation%20between%20the%20North%20Seas%20Countries%20FINAL.pdf (29 June 2018) 1-7.
[87] Rijksoverheid, 'Windpark Borssele goedkoopste ter wereld', (05 July 2016), https://www.rijksoverheid.nl/onderwerpen/duurzame-energie/nieuws/2016/07/05/windpark-borssele-goedkoopste-ter-wereld (04 July 2018).
[88] European Commission, 'Political Declaration on energy cooperation between the North Seas Countries', https://ec.europa.eu/energy/sites/ener/files/documents/Political%20Declaration%20on%20Energy%20Cooperation%20between%20the%20North%20Seas%20Countries%20FINAL.pdf (29 June 2018) 4.
[89] Rijksoverheid, 'Biomassa 2030', https://www.rijksoverheid.nl/documenten/rapporten/2015/12/01/biomassa-2030 (04 July 2018), 22.

energy source will have significant effects on these pillars, especially because coal-powered electricity is also being phased-out. A potential solution to mitigate some of the issues which might arise from the phase-out of natural gas is importing gas from other parts of Europe, but the applicability of this solution is limited by differences in composition. Dutch natural gas has a relatively prominent level of nitrogen, which means that nitrogen needs to be added to foreign gas to make it compatible with the Dutch market. The facilities where this transition is possible are in that case the bottlenecks limiting the availability of natural gas, creating new infrastructure dilemmas for the Dutch to solve.

To make matters even more difficult, nuclear energy is still quite controversial in the Netherlands and even though the chance exists that a new reactor will someday be constructed, it is clear that the Netherlands will, for the foreseeable future, not increase its dependency on electricity generated through nuclear means. This limits options for future large-scale energy generation to mostly bio, wind and solar energy. Whilst wind- and solar are very reliant on weather conditions, biomass emits CO2 and takes up valuable space for production.

Therefore, cooperation is not just an option for the Dutch, it is the only way to even have a chance at reaching their goals of reducing their reliance on fossil-fuels. Hydropower is not an option in the Netherlands, but through importing it from Norway, the fluctuating power levels of solar- and wind-energy can be stabilised. Through Belgium, nuclear energy can be accessed for the same reasons as long as the reactors there are not decommissioned. Bioenergy can also only reach its potential in the Netherlands through cooperation. Through importing bioenergy from other European states, issues of supply can be overcome and generators can be kept running. The Dutch are also actively working together with neighbours when it comes to wind energy. Instead of focussing all their energy on constructing less-efficient windmills on land, the Netherlands is actively cooperating with neighbours to create more efficient technology, locate perfect locations for windfarms and create an interconnected system to support each other when security of supply is at risk.

For the Dutch, accomplishing the transition towards renewable energy with contemporary technology is not akin to doing it alone, it is done through achieving goals together.

Chapter 3 – Case Two: Sweden

The Kingdom of Sweden is a Northern-European state with roughly 10 million citizens. It has direct borders with Finland, Norway and Denmark, whilst being separated from Estonia, Lithuania, Latvia, Poland and Germany by the Baltic Sea. The historical context of electricity-generation in Sweden has been characterised by a strong commitment to renewable sources combined with a significant reliance on nuclear power. Sweden is also a world-leader in the field of bioenergy, especially in research regarding biofuels.[90] fossil-fuels in Sweden barely contribute to electricity generation but still continue to play a key role in transportation and heating. This results in a significant difference between TPES and electricity generation. The three most important sources defining Sweden its TPES in 2016

[90] Sweden.se, ‘Energy use in Sweden’, https://sweden.se/society/energy-use-in-sweden/ (02 July 2018).

are nuclear (34%), biofuel (24%) and oil (24%), whilst electricity generation is almost entirely dominated by hydro (40%), nuclear (40%) and wind (10%) energy.[91]

These numbers can be used to draw several preliminary conclusions. The first conclusion is, even though Sweden has large shares of renewable sources in electricity production, nuclear energy still continues to be of tremendous importance. It also seems that, even though electricity production is almost fully free of emissions, other sectors still actively use fossil-fuels such as oil. In 2014, only 12% of the registered total vehicle fleet in Sweden could be called fossil-fuel free.[92] To completely remove fossil-fuels from the TPES, Sweden still has a lot of work to do.

Sweden has ambitious goals, but at the same time relies on another form of energy which can also be called controversial. Even though nuclear energy has brought significant benefits to Sweden through cheap and reliable electricity for consumers, questions regarding safety, waste-management and cost-effectiveness dominate a fractured Swedish political climate.[93]

Before 1960, Sweden almost entirely relied on electricity generated through hydropower. The state is home to several larger rivers in the scarcely populated northern areas. These rivers, which had limited economic potential, could be used for the generation of hydropower instead. In turn, a system was created where larger hydropower plants would operate in the north, whilst being connected through electricity cables to the population centres in the south.[94] However, during the late 1950's it became increasingly more difficult to continue the construction of hydropower plants to satisfy energy needs. Most rivers had been utilised and concerns began to rise regarding the negative impact of hydropower on the environment. Sweden needed alternatives, and predictions about vastly increasing energy needs made the Swedish government believe that other options had to be pursued as well. Therefore, during the 1960's, the decision was made to pursue the field of nuclear energy.[95]

This decision had profound consequences, with nuclear power generation gradually increasing its share in the production of electricity until it became one of the main pillars, next to hydropower. Even though construction continued and NPP's started to supply significant amounts of energy to Swedish society, several political parties would still openly question Sweden its reliance on nuclear energy, leading to a referendum in 1980 about its future in Sweden.

After the referendum, the government decided that no further construction would be done on new NPP's, and that all 12 plants would be closed before 2010 if realistic energy sources

[91] International Energy Agency, 'Sweden – Energy System Overview', https://www.iea.org/media/countries/Sweden.pdf (02 July 2018).
[92] Sweden.se, 'Energy use in Sweden', https://sweden.se/society/energy-use-in-sweden/ (02 July 2018).
[93] Tomas Kaberger, 'History of nuclear power in Sweden' in: *Estudos Avançados, 01 April 2007, Vol.21(59)*, 226.
[94] Kaberger, 'History of nuclear power in Sweden', 227.
[95] *Ibidem*, 229.

existed by then to replace them. This marked the beginning of the phase-out period of Swedish nuclear policies.[96]

Since then, several older reactors which were at the end of their life-span have been closed. Total phase-out of nuclear energy however, was constantly delayed until 2010, when the government decided that nuclear energy would remain as a power source next to renewable energy for the foreseeable future. Construction of NPP's on new locations would still be embargoed, but when existing reactors would reach the end of their operational life-span, the government allowed the replacement of these reactors with newer models.[97]

These measures were a confirmation of the existing status quo. At the same time, the Swedish government did once again stress that it aims to increase the importance of renewable energy in power generation, with a specific focus on wind energy.[98] Therefore, even though nuclear energy will remain part of Swedish power generation, its total share will gradually decrease. The decision to revert the phase-out policy of nuclear energy is understandable. Nuclear energy is capable of providing a level of security which cannot currently be reached by renewable energy. With the current energy-mix, Sweden already turns into an energy importer when hydropower yields are low.[99] Therefore, it seems unwise to get rid of nuclear energy until another stable source of energy is ready to take over the role of an 'anchor' for other fluctuating sources.

Besides, completely relying on renewables would lead to a situation where a large amount of excess energy has to be generated. As stated, batteries are currently incapable of storing energy on larger scale, meaning that electricity cannot be stored in times of high production to be used in times when production is lower. A potential solution would be to export this excess energy to other European states but given the fact that these are also investing in renewables, specifically wind- and solar energy, and thus potentially have to face the same problems and overproduction, application of this solution is limited.[100] It can therefore be argued that it would be better, not only for Swedish energy security, but also for the energy security of neighbouring states and the EU as a whole, that Swedish reactors will keep operating for the foreseeable future.

Sweden has been at the forefront of cooperation and interconnection with neighbours for decades. In 1996, a Norwegian-Swedish power exchange was created and the joint trading exchange Nord Pool ASA was established. Finland joined in 1998, with Western Denmark in 1999 and Eastern Denmark in 2000. Since then, Estonia, Lithuania, Latvia, the United Kingdom and Germany have also formally joined.[101]

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[96] World Nuclear Association, 'Nuclear Power in Sweden', http://www.world-nuclear.org/information-library/country-profiles/countries-o-s/sweden.aspx (05 July 2018).
[97] *Idem*.
[98] Sweden.se, 'Energy use in Sweden', https://sweden.se/society/energy-use-in-sweden/ (02 July 2018).
[99] Nord Pool, 'Market Members', https://www.nordpoolgroup.com/the-power-market/The-market-members/ (05 July 2018).
[100] Barry W. Brook, Staffan Qvist and Sanghyun Hong, 'Economic and environmental costs of replacing nuclear fission with solar and wind energy in Sweden', in: *Energy Policy, 2018, Vol.112*, 63.
[101] Johannes Mauritzen, 'Dead battery? Wind power, the spot market, and hydro power interaction in the Nordic electricity market' in: *Energy Journal, 2013, Vol.34(1),* 6.

This power exchange, which will be called Nord Pool from now on, is a market which operates on a day-ahead basis. Each day, suppliers and consumers of energy can place 'bids' on each individual hour the following day. When all bids are placed, an equilibrium is created in all individual bidding areas. The prices are calculated and published afterwards, and energy is sent in the right direction. Bidding areas can be entire states, such as the individual Baltic states, or portions of a single state, such as East- and West Denmark. This system has been created to ensure that the market considers existing local infrastructure and prices.[102]

Nord pool is a regional international energy market which can be used by suppliers and consumers to strengthen security and lower prices. Consumers can search the market for cheap energy, whilst suppliers can sell excess energy to consumers in other states, increasing profits and energy efficiency. This market could not exist if infrastructure was lacking. Sweden has recognised this responsibility, and together with their Nordic neighbours, invested heavily into improvements and connections.

The EU 2030 goals call for electricity interconnection targets. In 2020, each European state needs to be able to send at least 10% of their produced electrical-energy towards neighbouring countries through electricity cables.[103] The Northern-European states, through their investments in setting up Nord pool and other bilateral projects such as NordNed, are well underway to reach or surpass these targets.

Investments in infrastructure continue to expand. In the past, the Baltic states were unable to directly trade electricity with the rest of the EU due to a lack of infrastructure. To solve this issue, the Baltic Energy Market Interconnection Plan Initiative (BEMIP) was agreed upon in June 2009 with the major goal of eliminating the existing electrical isolation of the Baltic states.[104] This initiative resulted in, amongst other things, the Nordbalt and Litpol links. Litpol is an electrical cable of 500MW between Lithuania and Poland, and Nordbalt is a 700MW electrical cable between Sweden and Lithuania.[105] The Nordbalt cable is in operation since 2016 and delivers electricity through the Nord Pool market.

The improvements in electricity infrastructure are beneficial for the Swedes as well. As the Dutch example illustrated, interconnections with neighbours allows states to play to their strengths. The Swedes have a high reliance on nuclear energy and hydropower. Nuclear energy can be considered stable, but hydropower is dependent on seasons and weather. Through linking and strengthening its electrical network with other states, such as Denmark,

[102] Nord Pool, 'Bidding Areas', https://www.nordpoolgroup.com/the-power-market/Bidding-areas/ (05 July 2018).
[103] European Commission, 'Electricity interconnection targets', https://ec.europa.eu/energy/en/topics/infrastructure/projects-common-interest/electricity-interconnection-targets (05 July 2018).
[104] European Commission, 'PA Energy – BEMIP Action Plan (for competitive, secure and sustainable energy', https://ec.europa.eu/energy/sites/ener/files/documents/BEMIP_Action_Plan_2015.pdf (05 July 2018), 1.
[105] European Commission, 'Communication on strengthening Europe's energy networks', (23 November 2017), https://ec.europa.eu/energy/sites/ener/files/documents/communication_on_infrastructure_17.pdf (05 July 2018), 4.

which invests heavily in wind- and thermal energy,[106] Sweden can export excess energy in times of abundance and import energy in times of need. Linking the Baltic states to the European continental grid and strengthening this connection also reduces their dependence on Russia, which strengthens energy security and stability in the region.

Other regional initiatives besides concrete infrastructure proposals and energy markets are also part of international cooperation. The Nordic ministers of energy regularly meet to discuss new proposals and ideas. One such meetings took place in May 2018, in which primary topics were deepening cooperation in the electricity market, research and deployment of renewable energy and energy efficiency.[107] The result of this specific meeting was a joint declaration in which all Nordic countries want to push businesses and organisations to submit concrete proposals to strengthen exports of technology.[108] All three states, Denmark, Norway and Sweden, are forerunners when it comes to technology of renewable energy, with Sweden having strong expertise in wind, ethanol (biofuel) and hydro,[109] Norway with wind and hydro,[110] and Denmark with wind, thermal and solar.[111] Exporting these technologies can help a long way in assisting other Europeans states reaching targets as well.

In conclusion, the Swedes are, together with the other Nordic states of Denmark and Norway, forerunners when it comes to renewable energy, and are all functioning examples of how a reduced dependence on fossil-fuels can function in practice. Besides, the Nordic states are also a real-life illustration of how liberalised day-ahead markets can function in an international setting. Through cooperation, energy-mixes are strengthened, resulting in benefits in energy security for all states involved. The Nord Pool market is currently home to all forms of nuclear and renewable energy described so far, allowing for flexibility and diversification, whilst improving energy efficiency and allowing consumers to identify the best prices.

Increasing the total area covered by this market will only emphasise this concept of strength in numbers and will assist in strengthening energy security even more. It therefore does not come as a surprise that besides other energy markets based on the template of Nord Pool are also being created throughout Europe. In the end, through interconnection, the idea is that all these markets will be joined together in a single liberalised European market. Nord Pool serves as a functioning example that, to secure supply and prices in energy-mixes

[106] Nord Pool, 'Market Members', https://www.nordpoolgroup.com/the-power-market/The-market-members/ (05 July 2018).
[107] Government Offices of Sweden, 'Ibrahim Baylan leads Nordic Energy Ministerial Meeting', (21 May 2018), https://www.government.se/press-releases/2018/05/ibrahim-baylan-leads-nordic-energy-ministerial-meeting/ (05 July 2018).
[108] Government Offices of Sweden, 'Energy ministers want to strengthen Nordic leadership in global energy transition', (22 May 2018), https://www.government.se/press-releases/2018/05/energy-ministers-want-to-strengthen-nordic-leadership-in-global-energy-transition/ (05 July 2018).
[109] Sweden.se, 'Energy use in Sweden', https://sweden.se/society/energy-use-in-sweden/ (02 July 2018).
[110] Nord Pool, 'Market Members', https://www.nordpoolgroup.com/the-power-market/The-market-members/ (05 July 2018).
[111] *Idem.*

dominated by renewable energy, this goal is possible and beneficial for everyone involved.[112]

Chapter 3 – Case Three: Bulgaria

The Republic of Bulgaria is located in Southeast-Europe with a population of 7 million inhabitants. Situated on the periphery of Europe, Bulgaria shares borders with EU-member states Romania and Greece to the north and south respectively. Serbia, Macedonia and Turkey also border Bulgaria in the north, west and south. Bulgaria is a relatively new addition to the EU, having formally joined on 1 January 2007. It is not a member of the Schengen Area and is also not part of the Eurozone, though the prospect exists that Bulgaria will become a full-fledged member of both groups in the coming years.[113]

The TPES of Bulgaria is dominated by fossil-fuels. In 2015, crude oil (36%) and coal (35%) are the sources with the largest share in TPES, followed by nuclear energy (21%) and natural gas (14%).[114] Even though crude oil and natural gas both have a significant impact on the TPES of Bulgaria, there is almost no domestic production of both. They are instead almost entirely imported from one supplier, which is the Russian Federation.[115] There is a noticeable difference between the TPES of Bulgaria and the sources which are used for the production of electricity. The most important sources of electricity production in Bulgaria are coal (45%), nuclear (31%) and hydro (12%), which are followed by natural gas (3.7%), wind (2.9%) and solar energy (2.8%).[116]

The energy-market in Bulgaria is under control of a relatively small group of influential power-companies. In 2012, the energy-market was controlled for 92% by 8 out of a total of 24 businesses. Besides the lack of choice for consumers, switching between power-companies is almost non-existent because energy-prices in Bulgaria are still heavily regulated.[117]

Not only the energy-market is controlled by a small amount of companies. The same situation can be witnessed on the production-side, with the Bulgarian Energy Holding EAD

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[112] Nord Pool, 'Integrated Europe', https://www.nordpoolgroup.com/the-power-market/Integrated-Europe/ (05 July 2018).
[113] Europa.eu, 'Bulgaria – Overview', https://europa.eu/european-union/about-eu/countries/member-countries/bulgaria_en (26 June 2018).
[114] International Energy Agency, 'Bulgaria: Balances for 2015', https://www.iea.org/statistics/statisticssearch/report/?year=2015&country=BULGARIA&product=Balances (26 June 2018).
[115] Export.gov, 'Bulgaria – Power Generation', (23 August 2017), https://www.export.gov/article?id=Bulgaria-Power-Generation-Oil-and-Gas-Renewable-Sources-of-Energy-and-Energy-Efficiency (26 June 2018).
[116] International Energy Agency, 'Bulgaria: Electricity and Heat for 2015', https://www.iea.org/statistics/statisticssearch/report/?year=2015&country=Bulgaria&product=ElectricityandHeat (26 June 2018).
[117] European Commission, 'Bulgaria', https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_bulgaria.pdf (26 June 2018), 25.

(BEH) and its subsidiary NEK controlling 45% of the total installed capacity of production in Bulgaria.[118]

The Bulgarian government is currently trying to remedy this situation through several reforms. In 2012, one-third of the electricity-market in Bulgaria was opened up, allowing consumers to choose their own suppliers of electricity.[119] Another example is the Independent Bulgarian Energy Exchange (IBEX). IBEX is a day-ahead market which was originally established in January 2014. This market was at first completely under the control of the BEH, which led to suspicions of abuse of power, given their substantial role in both the production process and open market. These suspicions resulted in the sale of IBEX to the Bulgarian Stock Exchange in August 2017, which is directly owned by the government instead.[120]

Another defining aspect of Bulgaria is that it is currently a net-exporter of electricity. The availability of nuclear energy, hydropower and coal have created a situation where the Bulgarians tend to produce more than they need, with net-exports reaching 20.4% in 2012.[121] The state is still very reliant on imported fossil-fuels such as oil and gas, but these are barely used in the production of electricity, with gas having a share of 4.1% in 2012 and oil only reaching 0.3%.[122] The shares of renewable energy are increasing, but because of the fact that no existing coal- or nuclear powered plants are being shut down, the Bulgarians still continue to be an important exporter of electricity in the Southeast-European region.

Just as Sweden, Bulgaria has a long history with nuclear power, with the first reactor beginning operations in 1974. At the Kozluduy plant, the Bulgarian government started construction in what would eventually result in six reactors. When Bulgaria applied for an EU-membership, the discussion was raised whether the older reactors would remain operational. Reactors 1 and 2 already closed in 2002, but numbers 3 and 4 were still active at that time. In the end, the decision was made to close them as well, even though the opportunity also existed to upgrade them. Only reactors 5 and 6 remain operational today.[123]

Since then, there have been several proposals for other projects, both at the Kozluduy plant and on a new location, which has come to be known as the Belene NPP. The site has been the host of several projects, which so far have all been cancelled due to a lack of funds. In the 1980's construction started on two reactors which were partially built until they were aborted in 1991.[124] After that, the site remained vacant until construction was officially

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[118] *Ibidem*, 24.
[119] *Idem*.
[120] Balkan Green Energy News, 'BSE-Sofia take over Bulgarian Energy Exchange', (12 February 2018), https://balkangreenenergynews.com/bse-sofia-takes-bulgarian-energy-exchange/ (26 June 2018).
[121] European Commission, 'Bulgaria', https://ec.europa.eu/energy/sites/ener/files/documents/2014_countryreports_bulgaria.pdf (26 June 2018), 24.
[122] *Ibidem*, 22.
[123] World Nuclear Association, 'Nuclear Power in Bulgaria', (June 2018), http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/bulgaria.aspx (26 June 2018).
[124] *Idem.*

restarted in 2008. Due to a lack of investors, construction was once again frozen in 2010, with the project being officially abandoned in March 2012. The two reactors are still unfinished as of today.

In recent years, with the growing impact of renewable energy on Bulgarian energy- and electricity production, the government is once again identifying the possibility of continuing construction at the Belene site. A primary reason cited for this decision is the fact that the Belene NPP can assist in reaching 2030-EU goals regarding pollution and emissions. So far, this has not resulted in any actual construction being done.[125]

The Bulgarian government is also working on increasing the share of renewable energy. These efforts have had some success, especially in the field of electricity, but there are still challenges which need to be overcome. Electricity production in Bulgaria is currently reliant on the availability of lignite, a form of coal which is especially polluting when used in electricity production.[126] In reaching emission goals of the EU, it would be preferable if these plants could be shut down, but they do possess the positive trait of being very stable in their electricity output. The same cannot be said for most forms of renewable energy. Renewable energy also tends to be more expensive to produce, increasing electricity prices and production costs in a state which is already economically weaker than most other EU member-states. This effectively means that Bulgaria needs the assistance of investors, which is an arduous process for several reasons.[127] One of these reasons is that most investors are foreign, which can result in potential unwanted implications for Bulgarian sovereignty over their energy-production. Another problem is the fact that many investors ultimately back down or turn out to lack necessary funds, making it a challenge to find suitable investors at all.[128]

Another issue is that the Bulgarian economy and society are amongst the most energy-intensive in the EU, which is a situation which has to be addressed because improving energy efficiency is one of the 2020 goals stipulated by the EU. Especially in the fields of heating and cooling, the Bulgarian government has the opportunity to work on more efficient ways of generation and transmission.[129] However, the same issue of costs is also relevant here, limiting the capacity of the Bulgarian government to act on its own.

The last challenge is, even though investors have expressed support for large wind- and solar farms, the Bulgarian power grid is sometimes unable to harness the power generated

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[125] Ministry of Energy, 'Petkova: The report of the Bulgarian Academy of Sciences will serve as the basis for the realization of the assets related to Belene Nuclear Power Plant', (16 November 2017), https://www.me.government.bg/en/news/petkova-the-report-of-the-bulgarian-academy-of-sciences-will-serve-as-the-basis-for-the-realization-2520.html?p=eyJ0eXBlIjoiaG90In0= (26 June 2018).
[126] International Energy Agency, 'Bulgaria: Coal for 2015', https://www.iea.org/statistics/statisticssearch/report/?year=2015&country=Bulgaria&product=Coal (26 June 2018).
[127] Ministry of Economy, Energy and Tourism, 'National Renewable Energy Action Plan', (20 April 2011), http://pvtrin.eu/assets/media/PDF/EU_POLICIES/National%20Renewable%20Energy%20Action%20Plan/203.pdf (26 June 2018), 18.
[128] *Idem*.
[129] *Ibidem*, 25.

from these farms.[130] Solar- and wind energy both contribute to a decentralisation of electricity. To cope with these changes a *smart grid* is necessary which can send electricity in the right direction whilst operating as efficient as possible, but such a grid is costly and difficult to construct, once again requiring the Bulgarian government to search for foreign investors.[131]

The deployment of renewable energy in Bulgaria is therefore hampered by the fact that three issues need to be solved at the same time with limited funds. That being said, these issues can at least partially be solved through investments in infrastructure.

Infrastructure does not only have a national aspect, but an international one as well, and as illustrated in the cases of the Netherlands and Sweden, security of supply can be guaranteed through working together with other states. The Bulgarian government has recognised this opportunity and has invested in several projects so far. The efforts of the Bulgarian government in infrastructure are not merely because EU-2020 goals stipulate that a 10% electricity capacity interconnectivity needs to be achieved,[132] but also because Bulgaria and the rest of the Southeast-European states often only have access to one supplier of gas and oil. The fact that Bulgaria and its neighbours can only access natural gas through Russia leaves the state at a political disadvantage and poses a serious threat to security of supply. Some of the states involved are not (yet) part of the EU, but this common predicament has created a situation in which non-EU member-states and EU member-states cooperate to improve energy security in several ways.

The first form of cooperation is the Energy Community, which is an international organisation founded in 2005 with the goal of creating a pan-European energy market which also includes relevant neighbouring states as contracting parties or observers. The current contracting parties are Albania, Bosnia and Herzegovina, Kosovo, the Former Yugoslav Republic of Macedonia, Georgia, Moldova, Montenegro, Serbia and Ukraine. Armenia, Norway and Turkey are observers.[133] Bulgaria itself is currently an EU-participant but assisted in founding the Energy Community back in 2005 as a contracting party, because the state had not joined the EU back then. Even though contracting parties of the Energy Union obviously are not directly bound by EU-goals and directives, they are still considered essential in making sure surrounding EU member-states are capable of reaching stipulated goals. Especially in the Balkan, where many states have not yet fully joined the EU, it would be a tremendous benefit if energy and electricity could also flow through these states instead of the connection Romania-Bulgaria-Greece.

A direct example of cooperation between EU member-states and Energy Community contracting parties is the European Commission Initiative on Central Eastern and South-

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[130] *Ibidem*, 18.
[131] Export.gov, 'Bulgaria – Power Generation', (23 August 2017), https://www.export.gov/article?id=Bulgaria-Power-Generation-Oil-and-Gas-Renewable-Sources-of-Energy-and-Energy-Efficiency (26 June 2018).
[132] European Commission, 'Electricity Interconnection Targets', https://ec.europa.eu/energy/en/topics/infrastructure/projects-common-interest/electricity-interconnection-targets (26 June 2018).
[133] Energy Community, 'Who we are', https://www.energy-community.org/aboutus/whoweare.html (26 June 2018).

Eastern European Gas Connectivity, also known as CESEC. This initiative was launched in 2015 by nine Middle- and Southeast EU member-states, including Bulgaria, and was later joined by eight Energy Community contracting parties. A direct goal of CESEC is to make sure that all states in the region have access to at least three diverse sources of gas, which means that infrastructure in the region needs to be constructed and strengthened.[134]

Because of several successes in the field of natural gas, the original scope of CESEC has been expanded to other areas as well. Since 2016, CESEC also assists its member-states with the construction of infrastructure in electricity and energy efficiency. The primary reason for this expansion in scope is that CESEC believes that the key to security of supply is a comprehensive energy strategy, dealing with the total energy-mixes of all states involved.[135]

These initiatives illustrate how the energy situation of a state is bound by its specific situation and geographical location. Southeast-European states barely produce natural gas themselves but still rely on the resource for heating and electricity. Given the fact that Russia is often the only supplier because of infrastructure limitations creates a risk in their security of supply which has to be amended as soon as possible. In Northwest-Europe, an increase in interconnection is done to keep energy security stable in the future, whilst in Southeast-Europe interconnection is necessary to amend risks to energy security which are relevant right now.

Examples of fossil-fuel infrastructure in the region which directly involve Bulgaria are the IGB project, a gas-interconnector between Greece and Bulgaria,[136] and the Transgaz-BRUA Gas Interconnection Project between Bulgaria, Romania, Hungary and Austria, which is partially funded by the European Investment Bank.[137] It serves as a reminder that, even though the EU vouched to reduce, and eventually remove, its dependency on fossil-fuels, investments still have to be made to secure supplies whilst natural gas is still critical for energy security.

That being said, there are also investments in electrical infrastructure. National smart grids to accommodate an increased reliance on renewable sources are one example, but interconnection with other states is also a priority for the Bulgarian government. An example is the wish of both Bulgaria and Macedonia to look at the opportunities provided by the integration of their respective energy markets under non-discriminatory and fair conditions. This project is only supported by a memorandum so far but provides an interesting pilot on the integration of energy markets between an EU member-state and an

[134] European Commission, 'Energy: Central Eastern and South Eastern European countries join forces to create an integrated gas market', (10 July 2015), http://europa.eu/rapid/press-release_IP-15-5343_en.html (26 June 2018).
[135] European Commission, 'Energy: Strengthening solidarity between Central and South-Eastern European Countries, (28 September 2017), http://europa.eu/rapid/press-release_IP-17-3506_en.htm (26 June 2018).
[136] ICGB AD, 'IGB Project', http://www.icgb.eu/about/igb_project (27 June 2018).
[137] European Commission, 'EIB supports gas supply improvements and diversification in Europe with the EFSI guarantee', (27 October 2017), https://ec.europa.eu/commission/news/eib-supports-gas-supply-improvements-and-diversification-europe-efsi-guarantee-2017-oct-27_en (27 June 2018).

Energy Community contracting party.[138] This is important to note because, even though EU-directives regarding renewable energy deal with internal EU situations, it would be strategically valuable if the energy market could be extended to Energy Community contracting parties and other strategically located states.

To conclude, the state of Bulgaria is in a very interesting situation regarding its energy policies for several reasons. First of all, because of its economic situation and historical context. Its market functions differently than Northwest-European states and still needs to make several significant steps before it is truly liberalised. The Bulgarian government also needs to address several critical issues to reach EU-goals but lacks the funds to achieve these without (foreign) investments. Security of supply is also at stake in Bulgaria, with a critical reliance on Russia for the supply of gas and oil, leaving the state vulnerable to disruptions in times of political turmoil. It is also located at the periphery of the EU, being the only route on land for energy infrastructure towards Greece, whilst at the same time fulfilling a vital role as a gateway to Energy Community contracting parties and observers such as Macedonia, Serbia and Turkey.

Bulgaria illustrates how fossil-fuels remain critical to the energy-systems of the EU as well, and that terms as diversity, scarcity and interconnection are not merely relevant for renewable energy, but applicable to fossil-fuels too. Diversity within suppliers of a specific source of energy is just as critical as diversity in sources for maintaining energy security.

Conclusion

In conclusion, to answer the central question of this article how the transition to renewable sources for the generation of electricity influences European integration, it is apparent that the distinct characteristics of renewable sources of energy have facilitated change. In the past, common European policies and a single energy market were often met with scepticism because less-impeding alternatives existed. Limited success was met with the regulations regarding coal in the ECSC, but other forms of fossil-fuel never managed to reach the same levels of regulation. Even when security of supply was at a severe risk, such as during the oil crisis of 1973, a common policy could not be agreed upon. Instead, states settled for individual options, identifying deposits, changing energy-mixes or securing bilateral agreements with third parties. These solutions were possible because of the fundamental characteristics of fossil-fuel. As long as supplies could be secured through bilateral agreements or direct access, there was no need for further international cooperation. Only whenever bilateral or regional solutions did not suffice, European cooperation was identified as an alternative.

A contemporary example where European cooperation is necessary for the security of supply regarding fossil-fuels is the case of Southeast-Europe and Bulgaria. Gas cannot easily be imported without pipelines and other relevant infrastructure, so diversification in

[138] Ministry of Energy, ‘Bulgaria and Macedonia have taken an important step towards coupling “day-ahead” electricity markets’, (18 May 2018), https://www.me.government.bg/en/news/bulgaria-and-macedonia-have-taken-an-important-step-towards-coupling-day-ahead-electricity-markets-2598.html?p=eyJ0eXBlIjoiaG90In0= (27 June 2018).

suppliers of natural gas can only be achieved through regional- and European cooperation. Bulgaria therefore illustrates that European cooperation to secure fossil-fuels is not unheard of, but that it remains important to understand that there are multiple levels of solving fossil-fuel supply issues, out of which European cooperation is considered a last resort.

This system is gradually coming to an end because of the impact of renewable sources of electricity generation, which fundamentally differ from fossil-fuels. Instead of having to locate and extract deposits which need to be shipped to power plants, sources of renewable energy are dependent on weather, climate and geography. Except for bioenergy, there is also no physical resource which needs to be shipped; the electricity is generated on the site of the resource itself. This effectively means that trade will often not be in physical resources, but in electricity itself instead, resulting in the necessity of an interconnected grid. Besides, even when ideal conditions have been identified, renewable sources are still not entirely stable in electricity output, because weather- and climate-patterns cannot be controlled.

This combination of fluctuating output and natural prerequisites has a negative impact on energy security, because it adds an additional dimension of uncertainty whilst limiting available options. This is where the case-study of the Netherlands is a fitting illustration. The Netherlands has a long history of stable, accessible and affordable electricity through domestic supplies of natural gas. Hydropower and nuclear energy are currently no viable options, resulting in the only currently applicable alternatives being solar, wind and bio energy. This effectively means that there are no ‘stable anchors’ in the Netherlands itself, leaving electricity production in the state largely at the mercy of fluctuating output generated by solar and wind energy. In this case, European cooperation is the only solution to safeguard security of supply when reliance on available forms of renewable energy increases. Through interconnection with neighbours, the Netherlands can reliably access hydropower and nuclear electricity without actually constructing these types of electricity generators on its own territory.

The Netherlands is currently increasing its interconnection with its (North-western) neighbours, and is therefore gradually becoming a part of European energy markets such as Nord Pool, which is an already functioning example of European cooperation determined by renewable electricity. Even states which do not necessarily have to resort to importing energy benefit in a similar system. In an isolated system, excess energy would be curtailed because of a lack of storage capacities. Through international markets such as Nord Pool, consumers in other states can be found instead, increasing profits and energy efficiency. International energy markets also incentivise individual states to play to their strengths. Diversification should therefore no longer merely be seen in a national context, but becomes an international affair as well. Additional connected members amplify benefits, especially when the market outgrows weather-patterns or climate-types and grows to incorporate as many distinct sources of renewable energy as possible.

In short, the fundamental difference between a reliance on fossil-fuels and a reliance on renewable sources is that in the case of fossil-fuels European cooperation is a choice amongst many, but in the case of renewable sources European cooperation is a necessary solution to retain secure supplies. If the EU truly wishes to ultimately remove any kind of reliance on fossil-fuels in electricity generation in the coming decades, it needs to finish the internal energy market and perhaps even add non-European states in the future as well, such as the Energy Community contracting parties. This means that plenty of work to improve interconnectivity remains to be done. Luckily for the EU, it seems that these goals can count on support from individual member-states, as everywhere throughout Europe ambitious projects to strengthen grid connections are being carried out.

It seems that Mark Rutte his decision to identify climate policies as a crucial topic for the EU was the right one to make. If Europe truly wants to be an example for the rest of the world in sustainable development, it cannot be done without international cooperation. A Union built upon renewable sources for electricity production will therefore be the functioning example of its own motto: it will truly be "United in Diversity."[139]

[139] Europa.eu, 'The EU motto', https://europa.eu/european-union/about-eu/symbols/motto_en (03 July 2018).

List of Abbreviations

Bulgarian Energy Holding EAD	BEH
Baltic Energy Market Interconnection Plan Initiative	BEMIP
Central Eastern and South-Eastern European Gas Connectivity	CESEC
European Union	EU
European Coal and Steel Community	ECSC
European Communities	EC
Independent Bulgarian Energy Exchange	IBEX
North Seas Countries Offshore Grid Initiative	NSCOGI
Nuclear Power Plant	NPP
Offshore Wind Forum	IGF
Total Primary Energy Supply	TPES
United Kingdom	UK

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European Commission, '2030 Energy Strategy', https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy (27 June 2018).

European Commission, 'Biomass', https://ec.europa.eu/energy/en/topics/renewable-energy/biomass (08 June 2018).

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European Commission, 'EIB supports gas supply improvements and diversification in Europe with the EFSI guarantee', (27 October 2017), https://ec.europa.eu/commission/news/eib-supports-gas-supply-improvements-and-diversification-europe-efsi-guarantee-2017-oct-27_en (27 June 2018).

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