May 2023

A Path to Achieve European Energy Security

Nicholas Wolf
nicholaswolf411@gmail.com

A Path to Achieve European Energy Security

By Nick Wolf

Abstract

The apparatus of Europe's energy security has collapsed. The Russian Federation's invasion of Ukraine, hydrocarbon market turmoil, and the ever-growing threat of climate change has thrust the continent into crisis. As the risks of severe recession, acute energy shortages, and climatic disasters have begun to materialize, the member states of the European Union (EU) have been left scrambling to secure novel energy supplies. In the short-term, these developments pose severe risks to the EU and its member states. Yet, opportunity often presents itself in the midst of hardship, and the European Energy Crisis of 2022 is no different. This essay discusses the EU's path to achieve energy security. Chapter 1 begins with an overview of the EU's energy market, with regards to its current policy and energy mix. The second features a historical overview of hydrocarbons and renewable energy sources in the EU, commencing with the formation of the European Coal and Steel Community in 1952. Chapter 3 details the inherent risks of continued hydrocarbon dependance, and specifically discusses troubling market forces, the war in Ukraine, and climate change. Chapter 4 delves into an economic overview of the EU's unique ability to unilaterally alter global markets through aggressive regulatory action, with a particular emphasis on energy and environmental policy. The final chapter advocates for the EU to achieve energy security through two policies. Firstly, the EU must rid its dependency on hydrocarbons, and establish a reliance on renewable energy. Secondly, to truly limit the deleterious effects of climate change, the EU must use its power in influencing global markets to spur global action to decarbonize.

Keywords*:* Europe, Climate, Russia, Energy, Hydrocarbons, Renewables

Table of Contents

Introduction: The European Energy Crisis of 2022

Chapter 1: An Analysis of EU Energy

Chapter 2: A History of Hydrocarbons and the Rise of Renewables

Chapter 3: The Risks of Markets, War, and Climate Change

Chapter 4: The EU as a Source of Global Regulation

Chapter 5: Policy Recommendations

Introduction

The onset of the first industrial revolution indelibly punctuated monumental global upheaval. The rapid proliferation of hydrocarbon-oriented technologies has since enabled unprecedented economic development throughout the past two centuries. Indeed, the birthplace of this technological and economic revolution has wielded the power of hydrocarbons to achieve considerable affluence and power. Fossils fuels are deeply woven into the history and politics of the nations of Europe. Throughout the past two centuries, these sources of energy have been central to the affairs of European states. Colonial endeavors, unprecedented global conflict, and, more recently, economic integration through the creation of the European Union (EU) have all prominently featured fossil fuels. The EU's hydrocarbon dependence has generated profound wealth for the continent, allowing it to become the largest single market in the world. However, this apparatus of energy security has recently come crashing down.

This essay addresses the EU as an institution, separate from the governments of its member states. While the interests and prerogatives of these bodies often intertwine, the policy recommendations detailed in this essay are designed to comply with the governmental functions of the EU. This is not to say that these national energy policies are insignificant in the construction of an energy secure model. The analysis this essay will provide relies on an understanding of individual member states' energy policies. This is important, as the energy policies and dependencies of the bloc's member states differ widely. As such, this essay's recommendations do not serve as a panacea for each member state's energy needs. The aim of this essay is rather to maximize the EU's role in harmonizing these energy policies to achieve broad energy security for the bloc.

For clarity and experience, this essay often uses shorthand terminology to describe broad concepts. For example, hydrocarbons are the combustible natural compounds found in fossil fuels that allow for their utility in generating energy. As such, this essay uses the term hydrocarbon to generally refer to fossil fuels, namely coal, oil, and natural has. Moreover, this essay often uses the term "renewable energies and related technologies" to delineate a future energy system primarily powered by renewable energy. This term denotes more than simply relying on renewable sources for electricity generation. Indeed, green hydrogen, heat pumps, and other technologies will collectively serve to displace fossil-fuel oriented technologies. As such, this phrase refers to this wide array of technologies that will be necessary to replace hydrocarbons.

The term energy security is used broadly for the sake of clarity and comprehensive analysis, as the effects of energy policy are omnipresent throughout the EU's economy and society. However, the criterion of an energy secure model is narrow. To achieve this, an energy model must rely on sources that pose minimal risks to its populous in three interconnected categories. These will be discussed in further detail in chapter 3, and include the economic, geopolitical, and environmental dangers commonly associated with energy insecurity. Typically, the term energy security is referenced in discussions concerning the economic costs of procuring and maintaining energy supplies. However, including the various effects of climate change in such considerations is a natural extension. This is due to the reality that anthropogenic climate change is inextricably linked with energy consumption habits, as the generation of energy through burning hydrocarbons is the primary contributor to global warming. As such, the continuation of fossil fuel energy dependencies perpetuates and augments the various deleterious effects of this phenomenon. Indeed, the ramifications of global warming pose acute economic and humanitarian costs akin to, and often surpassing, those frequently associated with an insecure energy model, thus meriting its inclusion in discussions of energy security.

The EU's existing energy model is untenable, as it fails to deliver security in any of these three facets. Specifically, the bloc's continued reliance on fossil fuels inherently fails in the security test of all these categories. Climate change, the Russian invasion of Ukraine, and limitations of hydrocarbon supply all threaten the EU's energy security, and together have pushed the bloc towards political and economic disarray. These will each be discussed in detail in chapter 3. However, suffice it to say that these crises will serve as a watershed moment for the continent. Indeed, the foremost concern spawned from these has been the necessary upheaval of the EU's energy model.

The geopolitical, environmental, and economic vulnerabilities of the EU's dependance on hydrocarbons have been painfully exposed. The more severe effects of climate change have only just begun to materialize in the EU, and already have caused immense humanitarian and economic pain. Limitations of fossil fuel supply from oil multinationals and the Organization of Petroleum Exporting Countries (OPEC) have driven up prices considerably, even prior to the Russia's military conflict. Moreover, Russia's unilateral invasion of Ukraine has greatly exacerbated these burgeoning prices and dangerously limited energy supplies. In fact, from the very onset of the war, divestment from Russian energy has become a preeminent political priority of the bloc. This perspective is widely shared across the political spectrum of the EU. Yet, movement away from this Russian dependence on its own is insufficient. Rather, it is imperative the EU address all three of these crises to achieve energy security.

As such, this essay will discuss why a reliance on renewable energy sources is an obvious solution to the EU's quandary. However, while this may alleviate the insecurities exacerbated by the Russian invasion and unrestrained hydrocarbon markets, it is only a piece of the solution to the complex process of limiting climate change. Decarbonization for the purpose of mitigating climate change is a global endeavor, one which will require an international upheaval of energy markets. The EU's unilateral divestment from hydrocarbons cannot prevent the worst ramifications of climate change from materializing for this reason. However, an often-overlooked aspect of the EU's global power— its regulatory influence—can be an effective tool in reshaping the world's response to the climate crisis.

The regulatory influence of the EU cannot be understated in formulating any solution to the European Energy Crisis. The EU has a unique ability to unilaterally set global regulatory standards. This is commonly referred to as the "Brussels Effect," and it is discussed in further detail in chapter 4. The EU must leverage this power to achieve energy security within the bloc, sending a ripple effect of change throughout international energy markets. Specifically, the EU must issue regulations with the aim of spurring decarbonization across the global energy sector. Obviously, such a policy requires a comprehensive understanding of the limits of this power and precise timing to maximize its efficacy. However, these difficulties cannot undermine the importance of wielding regulatory power in this capacity. This is the only direct avenue through which the EU can spur global decarbonization unilaterally and thus limit the most deleterious effects of climate change.

This essay will provide further details as to the specific policies the EU must undertake to achieve these aims in chapter 5. Moreover, a more comprehensive examination justifying these determinations for the EU's energy security will be provided in chapters 2 through 4. Through this, this essay will prove any further reliance of hydrocarbons for long-term energy security in the EU is mistaken. Recognizing this trend is incumbent of the EU, and it must wield the entirety of its political and economic powers to rid itself of this dependency and encourage other nations to follow its example.

Chapter 1: An Analysis of EU Energy

A. The Makeup of the EU's Energy

Attempting to determine the constitution of the EU's energy supply as a whole presents an array of challenges. The sources that compose the EU's energy supply are currently in a state of flux. The crises mentioned previously have forced the reconstruction of the EU's energy model. The Russian invasion of Ukraine is indeed the chief engine of this change, as the bloc was heavily reliant on Russian hydrocarbon imports to meet its energy demands. While separate market forces have contributed to burgeoning energy prices, these developments have not directly impacted energy supply in the short term. Yet, the invasion has exacerbated the problem, thereby resulting in immediate shortages of hydrocarbons, primarily in the form of natural gas.

Moreover, the EU's current energy supply varies between member states. These differences can be attributed to a wide range of factors. Climatic and geographical differences in conjunction with divergent economic models and political priorities have played a role in these discrepancies. While the EU and its member states have all committed to decarbonization initiatives, the broad scope has not been nuanced enough to harmonize the bloc's energy makeup. Yet, the majority of member states share commonality in that hydrocarbons still firmly dominate total energy generation.

Acknowledging the current fluidity of the EU's energy supply and its preexisting discrepancies is vital in rendering an accurate image of the EU's consumption habits. As such, this section will provide figures of the bloc's energy makeup prior to the energy crisis, and then provide examples of national differences in energy makeup.

This section will provide figures for the EU's energy consumption from the year 2019. The effects of the Covid-19 pandemic on economic activity and the crises previously detailed have generated consistent turbulence on European energy markets and its economic activity more broadly. Due to this, relying on metrics from subsequent years will provide an inaccurate picture of peak energy activity of the EU. The effects of the Covid Pandemic, a return of war to Europe, and other sources of economic turbulence will be discussed in later sections. However, suffice to say, these developments have had an indelible impact on the EU's energy makeup, and cannot be adequately accounted for as of now. As such, a reliance on pre-pandemic figures will provide an accurate picture of EU energy consumption during prior times of relative normalcy.

The EU's share of energy production was firmly dominated by fossil fuels in 2019. Hydrocarbons accounted for 70% of total energy production. Specifically, crude oil, natural gas, and coal accounted for 33%, 24%, and 13% of total energy generation respectively.[1] Importantly, the EU has scant reserves of the former two energy sources available domestically, which has forced the bloc to become reliant on hydrocarbon imports to meet its energy demands. In turn, the energy dependency rate of the EU is high, equating to 60% in 2019.[2] This statistic measures "the proportion of energy that an economy must import" as determined by the division of net energy imports by gross available energy in an economy.[3]

The remaining 30% of energy generation originates from non-greenhouse gas (GHG) emitting sources. Renewable energies, as defined by the European Commission, include wind, solar, and hydropower and collectively accounted for 17% of the EU's total energy generation in

[1] Eurostat
[2] Eurostat
[3] Eurostat

2019.[4] Nuclear power constituted the remaining 13% of the EU's mix.[5] A reliance on these sources of energy is not contingent upon a model of importation to the same degree as hydrocarbons. However, the minerals, rare earth metals, and radioactive materials necessary to construct and maintain these sources of energy are also rare in the EU. Yet, importantly, their continued generation of energy (primarily in the form of electricity) does not, which is markedly different from hydrocarbons. This rate of dependency varies considerably between member-states, as do their energy mixes more generally.

For example, Germany's hydrocarbon-oriented energy model relied heavily on importation. The EU's largest economy was largely fueled by natural gas and lignite coal for much of the past two decades, with the former representing 25% of the Germany's primary energy consumption and the latter accounting for 18% in 2019.[6] Yet, while natural gas represented Germany's primary source of energy, its limited domestic availability forced the nation to search abroad. For much of the 21st century, Germany's energy dependency rate deepened, culminating in 2019 when the nation saw a staggering 71% of its energy imported.[7]

The energy mix of the EU's second largest economy represents a starkly dissimilar national energy model to that of Germany. France is unique in that it opted to rely on nuclear power for its primary source of energy generation. In 2019, the nation saw nearly 37% of its total energy generated from its fleet of 56 nuclear reactors.[8] This energy model has allowed the nation to become a primary exporter of electricity in Europe. Indeed, in 2019, France supplied nearly 73

[4] Eurostat
[5] Eurostat
[6] U.S Energy Information Administration
[7] U.S Energy Information Administration
[8] IEA

TWh of electricity to neighboring countries, while only importing roughly 15 TWh.[9] However, France's energy upheaval did not serve as a panacea for the nation's energy dependency. Both hydrocarbons, which still accounted for 47% of France's total energy generation in 2019, and enriched uranium and thorium—the necessary fuels for nuclear power—are rare in France.[10] As such, like the German model, the French also rely on importation to meets its energy needs. Still however, France's 2019 energy dependency rate of only 44% represented one of the lowest in the EU.

These divergent models are by no means fully representative of EU member state's diverse energy portfolios. For example, Sweden is widely considered a paragon of renewable energy installation, as 39% of its energy generated in 2019 came from renewable energy sources.[11] Conversely, Poland's heavy reliance on coal, at 45% of total energy generation, has earned the nation a reputation as a laggard in terms of climate policy.[12] Indeed, this variation is a result of current EU energy policy, which largely allows member states to determine their own energy supply. However, this is not to say that the EU will play a peripheral role in reorienting the bloc's economy from hydrocarbon dependence. In fact, recent political developments have vested the EU with competences for this very purpose.

B. EU Energy Policy

Discussing current EU energy policy is important to this essay. Such an analysis provides salient context to the policy proposals discussed in chapter 5. Moreover, many of these proposals

[9] GlobalData
[10] Climate Transparency
[11] IRENA
[12] IEA

rely on mechanisms provided by existing EU policy. The specifics of this will be detailed in chapter 5.

The differing energy models discussed in the previous section stem from divergent policies between member states. Indeed, provisions of the Treaty on the Functioning of the European Union (TFEU) enable a substantive degree of autonomy for member states in this regard. Specifically, the Treaty stipulates that member states have the right to "determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply."[13] Consequently, the authority to procure and maintain energy supplies and related infrastructure is delegated to the governments of member states.

For example, Germany's dependence on imported hydrocarbons discussed in the previous section was the result of the policies of the successive administrations of Gerhard Schröder and Angela Merkel. Both Chancellor's sought to bolster hydrocarbon importations to fuel and grow the nation's energy intensive industrial economy. Specifically, both administrations saw imported natural gas as cheap transitory fuel to sustain the German economy before it could feasibly rely on renewable energy sources. Moreover, Merkel and Schröder both sought deeper ties with Moscow to procure the bulk of this gas. Further details and the full implications of this specific energy dependence will be discussed in chapter 3.

France's dependence on nuclear energy germinated from political priorities that were in stark contrast to that of its Eastward neighbor. The rationale for this energy model was to strengthen French energy security by curtailing the necessity for energy importation. Indeed, nuclear power was seen by Prime Minister Pierre Messmer and much of the French government as a more

[13] TFEU Art. 194

viable alternative to hydrocarbon dependence.[14] As mentioned in the previous section, the desired effects of the "Messmer Plan" have largely materialized in France, as the nation has consistently led European economies in terms of electricity trade surplus.

The divergence in approach to energy procurement between France, Germany, and other EU member states were enabled by the TFEU. Yet, the EU still plays a vital role in crafting energy policy. In fact, the EU has taken an active role in harmonizing the climate policies of the bloc. While each member state exerts a degree of autonomy in climate related policy, the EU plays an overarching and indispensable role in this area. In fact, given the scope of climate change, member-states have recently largely deferred to the EU on passing significant climate policy. The institutional basis for this arrangement stems from the 2009 Lisbon Treaty. This Treaty delegated political competences to the EU to address climate change. Specifically, Article 194 amended the TFEU to allow for the EU to interject in energy policy on four grounds. Most relevant to this analysis, this includes allowing the EU to introduce policy to "promote energy efficiency and energy saving and the development of new and renewable forms of energy."[15]

Existing EU climate policy is extensive, covering an expansive set of economic sectors and policy areas. For the sake of expediency, this section will summarize the most relevant and impactful of these policies to establish a framework of the EU's current energy policy. While the specifics of these policies have been considerably altered following the Russian invasion of Ukraine, they nonetheless provide the most meaningful outline of EU climate policy.

The EU Emissions Trading System (ETS) is a cornerstone of the bloc's climate policy. The ETS is a carbon emissions "cap-and-trade" program first implemented in 2005. Its core function

---

[14] IAEA
[15] Lisbon Treaty Art. 194

is to set a carbon emissions cap, and to auction a set number of carbon permits to covered private entities. Such firms are then free to trade these permits at competitive market rates. This system is designed to exploit market forces to encourage emissions reductions over time. This is achieved by lowering the cap in accordance with the bloc's GHG emissions reductions targets. Ultimately, the desired outcome is to auction off fewer carbon permits over time, thus lowering the overall cap, and raising the price of emitting carbon.

The ETS has been impactful in limiting the EU's energy insecurity. Importantly, according to the European Commission, "[i]nstallations covered by the ETS reduced emissions by about 35% between 2005 and 2021."[16] This is not an insignificant sum. Yet, critical structural limitations of the ETS will prevent further, and necessary decarbonization.

The ETS is limited in scope, covering roughly 45% of the EU's GHG emissions.[17] Specifically, this policy only covers "electricity generation, energy intensive industry sectors, commercial aviation within the European Economic Area," and a small range of narrower economic sectors.[18] Functionally, this applies to "emissions from around 10,000 installations" throughout the EU.[19] Apart from this limited sectoral reach, the ETS' current means of allocating emissions permits also limits the efficacy of this policy. Since its implementation in 2005, the ETS has operated under trading periods that broadly dictate the annual GHG emission cap. In theory, each phase was designed to introduce increasingly more stringent emissions cap allowances over time in sync with the bloc's stated GHG emissions reductions targets. The ETS is currently operating in its fourth trading phase, which is set to last from 2021 until 2030. The

[16] European Commission
[17] EPA Ireland
[18] EPA Ireland
[19] EPA Ireland

EU has set the target of reducing annual GHG emissions by 55% compared to 2005 levels within this timeframe. Importantly however, the EU has not provided details concerning the eventual implementation of future trading periods beyond 2030. As such, the stringency and scope of future emissions permit allocation periods is indeterminate. This arrangement presents an array of challenges for the EU, which will be formally elaborated upon in chapter 5.

A critical component of this policy is the Carbon Border Adjustment Mechanism (CBAM). In an attempt to prevent an exodus of European industry to nations with lax climate regulations and pricing—commonly referred to as carbon leakage—the EU has sought to expand the scope of the ETS. While this policy is set to take effect in 2023, its initial phase merely requires GHG emissions reporting from covered firms. However, from 2026 onwards, this policy mandates firms providing certain goods into the EU to buy emissions permits. Specifically, the CBAM mandates importers to declare emitted GHGs during the production of covered goods and buy a corresponding number of carbon credits.

The CBAM, as an extension of the ETS, leverages market forces to encourage carbon abatement in covered industries. Indeed, this policy is designed to function "in parallel with the EU ETS," as it covers the same sectors and issues carbon permits in line with the ETS.[20] This includes "iron and steel, cement, fertilizers, aluminum, electricity, and hydrogen" as well as other narrow, yet carbon-intensive, industries. Importantly, firms operating within nations who impose similar carbon trading schemes to the ETS are exempt from CBAM.[21] The CBAM will prove to be a cornerstone of the EU's climate policy. In the words of the European Commission, "[c]limate change is a global problem that needs global solutions."[22] As such, the mechanisms of

[20] European Commission
[21] European Commission
[22] European Commission

this policy are designed to leverage the size of the EU market to externalize its climate policy. The full implications of this policy will be detailed in chapters 4 and 5.

The ETS is the EU's stick policy to decarbonize its economy and is often lauded as the bloc's most efficient and important avenue to achieve such. However, carrots provided by various subsidy packages introduced by the EU also serve as a cornerstone of the bloc's avenue to decarbonization. In total, the EU and its member-states doled out over €2 trillion in energy subsidies from 2015-2021.[23] Renewable energies and other green technologies were specifically earmarked for roughly €511 billion worth of subsides during this timeframe, whereas fossil fuels directly received €362 billion.[24] The remaining funds were provided to nuclear energy and to steady energy prices more broadly (such as promoting energy efficient technologies and lowering electricity prices).[25]

Importantly, the EU as an institution has limited competences to provide direct financial incentives for green energy technology. This is largely because the EU has not been delegated the authority to tax its populous. As such, the EU's primary avenues for raising funds are through direct member state contributions, legal penalties against private entities, and auction programs like the ETS. Due to this, the EU cannot provide tax exemptions to firms as a form of fiscal stimulus, and rather must rely solely on direct transfers to provide subsidies. As such, the €511 billion worth of subsidies earmarked for green technologies were largely provided by national governments. Yet, the EU still plays an active role in this policy area, both through its own subsidy packages and state-aid rules.

[23] Enerdata
[24] Enerdata
[25] Enerdata

Regarding the former, despite its limited powers, the EU has launched an array of programs to finance emerging green energy technologies. The most significant of such programs include REPowerEU, NextGenerationEU, and the EU Innovation Fund. Importantly, each of these provides an array of mechanisms to spur decarbonization in the bloc, beyond direct fiscal stimulus. Moreover, these do not represent the entirety of the EU's future planned direct investments for renewable energies. However, these programs are the EU's largest ever fiscal commitment to green energy, and thus represent the most impactful of the bloc's climate policies beyond the ETS.

The REPowerEU program was launched in May of 2022 to fully stem the bloc's reliance on Russian hydrocarbons by 2030.[26] In doing so, it provides €113 billion in funds to renewable energies and other related infrastructure.[27] The EU Innovation fund is a Commission sponsored financing program designed to provide funds to emerging green energy technologies. In total, this program will provide €38 billion (funded by the ETS) towards relevant entities until 2030.[28] NextGenerationEU is the EU's post-pandemic recovery fund that provided over €800 billion to member-states as a form of economic stimulus.[29] The majority of this fund is discretionary once earmarked for any particular member state. Yet, a substantive portion of this investment has been specifically apportioned for green energy through the InvestEU Program. This fund is broadly designed to spur economic growth in the bloc through direct investment until 2027. In doing so, the fund provides around €110 billion to the bloc's climate goals (largely by developing and deploying renewable energy sources).[30]

---

[26] European Commission
[27] European Commission
[28] European Commission
[29] European Union
[30] European Union

In total, funding towards green energy through the EU's leading financial instruments amounts to roughly €260 billion over the next two decades. This figure will likely prove to be an underrepresentation of the EU's subsidies towards green energy, especially when considering individual contributions from member states. As such, the list of instruments designed to finance the green energy transition are numerous and complex. This current system is inefficient and overly bureaucratic due to the sheer amount of subsidy programs within the EU and its member-states. These shortcomings will be discussed in more detail in chapter 5.

The EU's role in regulating state-aid is another critical facet of the bloc's approach to funding green energy. Article 107 of the TFEU provides the EU with the authority to regulate member-state's ability to subsidize private entities. Specifically, the Treaty stipulates that "aid granted by a Member State… which distorts or threatens to distort competition… shall, in so far as it affects trade between Member States, be incompatible with the internal market" and thus may be blocked by the Commission.[31] This policy is designed to prevent wealthier states from leveraging their greater state budgets to attract firms from poorer member nations. Member-states must provide prior notice to the Commission before authorizing any form of state-aid.[32]

Evidently, this arrangement necessarily limits the amount of capital that can be made available to green technology. Germany, France, the Netherlands, and other affluent members of the EU cannot provide a disproportionate amount of state-aid to spur decarbonization. As such, while the EU has provided billions of Euros to achieve this aim, its role in harmonizing the single market inhibits the amount of funds that can be provided to green technologies.

---

[31] Eur-Lex
[32] Eur-Lex

Chapter 2: A History of Hydrocarbons and the Rise of Renewables

Ensuring energy security has been a preeminent political priority of the EU since its foundation. Indeed, throughout its evolution, a chief concern of the EU and its member states has been securing energy resources. The historical development of the bloc's energy policy unveils the core tenets of its energy strategy. Providing such an analysis is important, as identifying these salient political proclivities provides a basis for both criticism and reaffirmation of current EU energy policy. This will be formally elaborated upon in chapter 5. This chapter will analyze the historical development of the EU's energy policy to provide the basis of such, and it will be bifurcated into two sections. The first will provide an analysis of EU energy policy concerning hydrocarbons, delineating how the EU's energy policy concerning fossil fuels has evolved in response to external and internal historical developments. The second section will provide an economic and political history of renewable energy sources in the EU.

A. A History of Fossil Fuels and the EU

The decimation wrought upon Europe by the Second World War left the continent in political and economic disarray. Indeed, "by 1946, Europe was… gripped by a severe energy crisis—a terrible shortage of coal."[33] This was primarily attributable to the collapse of the German economy. The vast coal reserves in Germany's Ruhr Valley were of no use as the country's economy utterly stalled following the war. Such political and economic difficulties allowed for

[33] Yergin 404

little exportation of coal.[34] Moreover, Europe's scant oil and natural gas reserves were a hindrance to the economic recovery of the continent.

However, following the consolidation of the allied occupied zones of Germany into the Federal Republic of Germany (West Germany), an opportunity to alleviate the energy crisis presented itself. As previously mentioned, the abundant coal reserves in the Ruhr Valley had the potential to provide a source of cheap energy to boost economic redevelopment. Following three major conflicts with Germany in the prior century, the French government sought to create a more conciliatory diplomatic arrangement in Western Europe through economic integration. Political momentum for such an initiative gained traction through the Schuman Declaration (named after French foreign Minister Robert Schuman), out of which was born the European Coal and Steel Community (ECSC), which was officially ratified by the signing of the Treaty of Paris in 1951.[35]

The foundational six powers consisted of West Germany, France, Italy, and the Benelux States. The ECSC was the foundational treaty of the modern EU and commenced political and economic integration in Europe. This treaty pooled the economically critical resources of steel and coal between these powers. Moreover, these nations delegated the management of these resources to the "High Authority." This supranational entity was vested with the authority to establish limitations on production, regulate prices of these commodities, and impose penalties on non-compliant firms.[36]

---

[34] Yergin 404
[35] Eur-Lex
[36] Eur-Lex

The efficacy of this program was made immediately apparent. Between 1952 and 1960, "iron and steel production rose by 75% in the ECSC nations, and industrial production rose by 58%."[37] The evident success of the program generated significant political momentum for further market and political integration. This culminated with the signing of the Treaty of Rome in 1957, formally establishing the European Community (EC). This umbrella program consisted of the ECSC, the European Atomic Energy Community (Euratom), and, most notably, the European Economic Community (EEC).

Energy was initially at the heart of European economic integration. Yet, the decades following the signing of the Treaty of Paris featured little in the way of supranational cooperation in energy procurement, aside from Euratom. However, civil nuclear energy never established a comparable market presence with hydrocarbons in Europe. Moreover, as the economies of member nations transitioned away from coal, the necessity of the ECSC waned. As such, the EEC was the core tenet of the European integration project. This, in turn, shifted the economic priorities of the EC from energy security to market integration. This functionally left member states to their own devices in procuring the bulk of their energy supplies.

The EU as an institution would not interject substantively in energy policy until the ratification of the 2009 Lisbon Treaty. Its absence provided broad autonomy to member-states, allowing diverse energy portfolios and policies to emerge across the EU. This may have ultimately contributed to the EU's current insecure energy model. However, this arrangement also yielded significant policies that contributed greatly to the bloc's energy security. Indeed, it allowed for the rise of renewable energy.

---

[37] EU Commission

B. Renewable Energy's Ascendance

According to the International Governmental Panel on Climate Change (IPCC), "systematic scientific assessments (that) began in the 1970s" have determined that current global warming trends are anthropogenically generated.[38] Moreover, the body has consistently concluded that fossil fuels are the primary contributor to climate change. Since, various governing bodies, private investors, and others have sought to develop alternative technologies to generate humanity's energy.

Renewable sources provide energy without concomitant GHG emissions. As mentioned, hydrocarbons have historically dominated total energy generation in the EU. Yet, key economic indicators suggest these sources of energy may soon surge in market prevalence. To properly contextualize these economic trends, this section will provide an economic and political history of renewable energy. Indeed, it is vital to understand how these nascent sources of energy have developed into the basis of an energy transition.

An array of renewable energy sources exists. However, wind and solar are widely considered the most likely form the future basis of global energy. As such, this section will largely focus on these two sources of energy. Regarding the former, wind has seen a surge in market competitiveness throughout the past two decades. From 2008 to 2020, the cost of generating wind energy fell from €1,640 per KW to roughly €730 per KW.[39] While the price of wind power (as with any other energy source) is regionally dependent, these averages are indicative of its broader market competitiveness.

---

[38] IPCC
[39] U.S Dept. of Energy

The plummeting price of wind energy enabled a surge in deployment throughout the EU. Indeed, from 2012 to 2021, installed wind capacity in Europe grew substantially, from 109 GW to 236 GW.[40] This, in turn, saw wind's share of energy production in the EU greatly increase. Within this timeframe, the share of electricity generated from wind grew by 124%, from a mere 6.45% to 14.4% of generated electricity.[41]

Solar power has similarly grown in market prevalence. Driven by the fact that the price of solar "projects declined by 88% between 2010 and 2021," this form on energy has also seen a growing market share.[42] Specifically, within this timeframe, generating electricity from solar power fell dramatically from €330 per MWh to €36 per MWh.[43] Indeed, solar power remarkably progressed from the single most costly form of electricity generation to the most inexpensive within a decade. This novel economic viability has contributed to a rapid deployment of solar energy throughout the EU. Within this same timeframe, solar power's share of electricity generation in the EU grew by 600%, from 0.79% to 5.53%.[44]

The 20% of the EU's electricity derived from these renewable energy sources may appear to be a paltry sum. Yet, these market trends experienced over the past decade are by no means an anomaly. The rapidly declining prices and subsequent surges in deployment of wind and solar energy show no signs of slowing. Rather, various economic signals point to the reality that these trends will likely only accelerate. These will be discussed thoroughly in chapter 3 but suffice to say that the longstanding hegemony of fossil fuels in the EU is by no means a future guarantee.

---

[40] Our World in Data
[41] Our World in Data
[42] IRENA
[43] Our World in Data
[44] Our World in Data

Importantly, solar and wind energy's novel competitiveness was not driven purely driven by market forces. Interventionist government policy rather greatly contributed to the rise of solar and wind energy. Indeed, Japan's Rooftop Solar Subsidy Program and the US' Energy Policy Act of 2005 were effectual in this regard.[45] Moreover, China's aggressive state-driven subsidies for renewable energies contributed greatly to their economic viability. However, European energy policy provided the most significant avenue for renewable energy to become economically competitive.

Specifically, revolutionary policies crafted by Germany enabled the declining prices of renewable energy. The 2000 Renewable Energy Sources Act (EEG) was designed to stem Germany's reliance on hydrocarbons by incentivizing consumers to opt for renewable energy sources. Specifically, the EEG introduced feed-in-tariffs covering wind, solar, and other sources of renewable energy. This allowed private actors to "to install solar panels and wind turbines, for which they would receive a premium price above the market price for selling their electricity back to the grid."[46] This program largely applied to energy providers and was initially set up to run for two decades.

Feed-in-tariffs allowed for Germany to become the first major economy in which renewables were functionally competitive with fossil fuels. The implications of this stretched far beyond the German, or even the EU economy. Indeed, these feed-in-tariffs were chiefly responsible for the plummeting costs of renewables previously mentioned. This was largely because the EEG enabled the rapid deployment of wind turbines and solar panels in the world's fourth largest, and energy intensive economy. Indeed, from 2000-2020, wind and solar energy's share of electricity

[45] Vox
[46] Rifkin 61

generation in Germany grew from under 3% of generated electricity, to 37%.[47] This investment from the German government provided manufacturers of renewable energies with a novel and lucrative market, thus allowing for these industries to mature. Whether by providing novel capital to procure necessary materials (cobalt, lithium, etc.) more efficiently, or by streamlining installation processes, the opening of the German market allowed for renewable energies to become economically competitive.

[47] AG Energy Balances

Chapter 3: The Risks of Markets, War, and Climate Change

The energy sector is omnipresent throughout the global economy and society. The ramifications of energy policies and dependencies permeate internationally. The EU's energy model detailed in chapter 1 has failed to provide energy security to the bloc. The EU's hydrocarbon dependence fails the three basic security tests discussed in the Introduction of this essay. Indeed, these three acute energy security risks to the EU include: hydrocarbon market turbulence, geopolitical risks, and climate change.

A. Markets

The Russian invasion of Ukraine is widely cited as the spark of the European Energy Crisis of 2022. This is merited, as will be discussed in the proceeding section. Yet, such assertions fail to address critical underlying economic forces that contributed to hydrocarbon price instability prior to the invasion. This section will discuss the practices of the fossil fuel industry, and how their behavior added to market turbulence and energy insecurity in the EU. Moreover, it will discuss the economic trends that guided hydrocarbon producers to alter their output, and the broader implications of such.

To properly gauge the indelible impacts of current hydrocarbon industry trends, identifying key aspects of these markets is vital. This specifically involves understanding the process of determining hydrocarbon prices. In Europe, benchmark oil prices are set by Brent Crude Oil while natural gas prices are set by the Dutch Title Transfer Facility (TTF). While oil and natural gas prices are not inextricably linked, both markets behave and respond to economic pressures similarly. As with any commodity, prices for petroleum and natural gas are based on global supply and demand. However, the balance between the two in these markets is particularly tenuous. Historically, deviations on either front have contributed to highly volatile hydrocarbon prices. There are numerous examples of such. Most recently, the 2014 “shale oil boom” in the US led to an increase of 3.5 million barrels per day (bpd) on global markets.[48] This subsequently contributed to a steep 50% decline in brent crude prices over the course of the year.[49]

A converse example of this hydrocarbon price instability came in 1973. On the backdrop of the Yom Kippur War, OPEC opted to impose an oil embargo on the US and other western nations in retaliation for supporting Israel in the conflict. Moreover, OPEC cut its output wholesale to account for this politically induced demand deficit. This resulted in a roughly 300% increase in the price of Brent Crude.[50] Suffice it to say that divestment from a near perfect correlation of supply and demand can have drastic implications on the price of hydrocarbons. It is also important to note that hydrocarbon markets are highly speculative. Indications of disruption to this balance of fossil fuel supply or demand often lead benchmark hydrocarbon prices to shift dramatically in kind. Indeed, this economic volatility was put on full display in 2020.

The Covid-19 pandemic profoundly altered the global economy. Necessary lockdown and quarantine measures massively depressed global economic activity. This standstill contributed to enormous reductions in global demand for oil and natural gas. Producers were caught flat footed as their rates of production contributed to a relative supply glut of hydrocarbons. As previously mentioned, a near perfect correlation between supply and demand in fossil fuel markets is imperative to maintain steady prices. If this tenuous economic balance deviates on either front, severe price-shocks often occur. Depression of global demand triggered by Covid-19 led to such

[48] Trading Economics
[49] Trading Economics
[50] Trading Economics

a scenario. This fully materialized in May of 2020, when Brent Crude and Dutch TTF futures prices plummeted, specifically declining 72% and 53% from the start of the pandemic respectively.[51]

Importantly, other benchmark oil prices saw even more dramatic declines. West Texas Intermediate (WTI) futures, the primary oil benchmark for North America, for the first time, traded at a negative value. Specifically, on April 20th, 2020, WTI futures traded at -$37 dollars per barrel.[52] While short-lived, this steep decline in oil prices has dramatically altered the economic outlook of oil producers globally.

This period of incredibly cheap hydrocarbons was not a sustainable model for producers. As a result, the market conditions prompted many fossil fuel multinationals and OPEC to limit output, thus bridling global supply and raising prices. After which, there was a trend of relatively steady growth in prices, which returned to €45 per barrel by the end of 2020.[53] Importantly, as the pandemic receded, there followed a rapid resurgence in global economic activity in 2021, thus drastically raising the demand for hydrocarbons. However, renewed demand did not lead to changes in oil and gas output from producers. Rather, the initial plunge in oil prices permanently remodeled the global hydrocarbon industry.

This shift in approach is made evident through an analysis of long-term economic models of hydrocarbon producers. Examining the capital expenditures (CAPEX) of oil and gas multinationals shows that their business models and economic forecasts have changed. Specifically, following the 2020 crash, the leading five oil and gas companies—Exxon, Shell,

---

[51] Trading Economics
[52] Macrotrends
[53] Trading Economics

Chevron, TotalEnergies, and BP—cumulatively slashed reinvestment rates from €80 billion to €62billion.[54] For reference, CAPEX for these companies typically funds the extraction of known reserves and exploration of potential reserves of hydrocarbons. While CAPEX figures vary between firms, this action from leading companies is indicative of broader industry trends. Indeed, projected 2023 "capital spending by the world's top 500 energy firms is forecast to be only 9% above pre-pandemic levels," and far below peak expenditure.[55] Functionally, this dip in CAPEX entails firms limiting drilling and exploration expenditures, and thus depressing future output. This comes despite the availability of over 9,000 vacant approved drilling sites throughout the US, the world's largest producer of fossil fuels, and increasing energy demand globally.[56] While CAPEX of these firms rose in 2022, current reinvestment rates represent only roughly half of their 2013 peak expenditure of nearly €145 billion.[57]

OPEC behaved similarly in response to Covid induced economic trends. Following the 2020 collapse of oil prices, OPEC massively reduced production. Specifically, the cartel limited its output to 24.5 million bpd, down from its pre-pandemic rate of over 30 million bpd.[58] While extraction rates rebounded from this historic low, output has still yet to return to normality. In November of 2022, the bloc only produced 28 million BPD, and announced further cuts amounting to roughly 1 million bpd in early 2023.[59] While these production limitations from oil multinationals and OPEC may appear insignificant, they represent a dramatic macroeconomic upheaval. For reference, as previously mentioned, an introduction of 3.5 million bpd from shale oil producers in the U.S contributed to a 50% decline in Brent Crude prices. OPEC's novel

---

[54] Statista
[55] Foulis
[56] Forbes
[57] Statista
[58] YCharts
[59] YCharts & Reuters

supply cuts represent a similar alteration to oil markets, and its effects have rippled through global hydrocarbon markets.

Importantly, as mentioned, benchmark hydrocarbon prices are highly speculative. As such, investment decisions on the part of hydrocarbon producers are often highly influential in determining price, even before alterations to supply materialize. The resurgence of global economic activity in 2021 saw demand for hydrocarbons skyrocket. Yet, as discussed, producers' output did not respond in kind. Moreover, output projections from OPEC and oil multinationals—based on stated output cuts and CAPEX expenditures respectively—did not bode well for future hydrocarbon supply. This contributed to a dramatic increase in the price of fossil fuels. Even before the Russian invasion of Ukraine, Brent Crude oil prices peaked at roughly €81 per barrel in early 2022, representing an over 50% increase from the end of 2020.[60] Natural gas prices experienced an even more stark rise, with Dutch TTF prices peaking at €121 per MWh at the end of 2021.[61] For reference, prior to 2021, gas typically hovered around €18 per MWh, and rarely exceeded €27 per MWh.[62]

The rationale for this shift in behavior from hydrocarbon producers is indeterminate. Many speculate that poor economic performance by the energy sector throughout the past two decades may have been a primary motivating factor. Prior to the pandemic, energy consistently performed poorly in the S&P 500 rankings. Between 2008 and 2019, the energy sector saw an average year to date return (YTD) rate of just 2.1%, the lowest of any sector.[63] However, rising hydrocarbon prices in the wake of the 2021 economic rebound reversed this trend. In both 2021

[60] Macrotrends
[61] Trading Economics
[62] Trading Economics
[63] Novel Investor

and 2022, the energy sector was the highest performing on the S&P 500, with YTD of 54.6% and 38% respectively.[64] This market boom was the direct result of hydrocarbon supply limitations and subsequent price spikes during the post-Covid economic rebound. Both OPEC and private hydrocarbon producers have procured record windfall profits due to their supply limitations. However, solely attributing this behavior to increasing shareholder returns and government budgets neglects salient macroeconomic trends. Rather, oil producers have recognized the increasing economic competitiveness of renewable energy sources discussed in chapter 2.

Various economists have identified crucial markers concerning the prospects of global energy markets. Broadly, "[s]uccessful technologies follow an S-shaped adoption curve."[65] This means that as novel technologies enter markets, their initial rates of adoption are often slow. However, here, innovations reach a critical juncture that determines whether they will become economically prevalent. If these technologies reach a specific share of the market, they tend to rapidly surge in adoption.

The adoption of electric vehicles (EVs) in Norway serves as a pertinent example of this economic phenomenon. In 2009, EVs accounted for less than 1% of new car sales in the country.[66] However, by 2021, this figure rose to 86%.[67] While this may appear to be a minute example, this trend of adoption has vindicated the views of many economists concerning the expansion of EVs. Many argue that the watershed moment for this meteoric rise came in 2013, when EV sales hit 5% for the first time.[68] Moreover, they postulate that this figure serves as a

[64] Novel Investor
[65] Bloomberg
[66] Statista
[67] Statista
[68] Statista

broader “tipping point” for global EV adoption. Obviously, the specific percentages of what serves as the tipping point for mass-adoption of differing technologies vary.

Renewable energy sources are similarly reaching this critical juncture. A mass adoption of these nascent technologies akin to EVs in Norway has yet to materialize in any nation. Yet, a variety of groups have argued that energy markets have reached, or are on the verge of reaching, this threshold. While there is debate concerning the specifics of the critical market juncture for renewable energy, many posit that a share of electricity generation between 5%-15% will mark a point of mass adoption. For example, the Carbon Tracker Initiative, a think tank, argues that “the transitional moment is when 14% of global electricity is supplied by solar and wind.”[69] Bloomberg news meanwhile provides a more bullish estimation of 5%.[70] Irrespective of where this point of mass adoption is assured, current global energy trends reaffirm the validity of these economic reality.

Indeed, various economic markers of this energy transition materialized in 2022. As mentioned, stagnant capital expenditure from hydrocarbon producers has contributed to rising prices for such commodities. Critically, investment in renewable energy sources has only surged. Specifically, in 2022, “global capital expenditure on wind and solar assets grew from $357 billion to $490 billion, surpassing investment in new and existing oil and gas wells for the first time.”[71] This dramatic upsurge in investment has allowed for an unprecedented deployment of renewable energy sources. For example, 128GW capacity of onshore windfarms were installed globally in 2022, up 35% from the previous year. Solar power experienced a similar boom, with 268GW installed, up from 173GW in 2021. While some speculate that this surge in market share

---

[69] Carbon Tracker Initiative
[70] Bloomberg
[71] The Economist

was an anomaly, due in large part of the Russian invasion of Ukraine, forecasts of future energy markets reveal that renewables ascendency has only just begun to commence.

The International Energy Agency's (IEA) forecasts for global energy markets paint a grim picture for the prospects of hydrocarbons. In part spurred by the European and global Energy Crisis of 2022, renewable energy sources are set to massively expand in market prevalence. The Agency predicts that from 2023 onwards, "the world is set to add as much renewable power" from 2023 to 2028 as it did from 2002 to 2022.[72] This will see "renewables become the largest source of global electricity generation by early 2025, surpassing coal."[73] Such predictions upend previous assumptions of the global economy's inveterate commitment to hydrocarbons. Rather, the IEA's prognosis is indicative of renewable energy's novel economic competitiveness.

Hydrocarbon producers are aware of this reality. Their reductions in supply may in part be short-term economic maneuvers to restore investor confidence and reestablish a stable market presence. However, these economic trends in global energy markets pose dire threats to the current business models of hydrocarbon producers. As such, the reduction in reinvestment rates and output cuts on the part of hydrocarbon producers likely represent an early concession of the energy market. Indeed, by lowering output, fossil fuel producers have raked in record windfall profits as the prospects of their market share have withered away.

Recognizing these novel upheavals to the global energy economy is imperative of the EU. The economic viability of renewable energy sources is unquestionable, and the window for growth of hydrocarbon demand is slamming shut. For the reasons outlined above, relying on a return to pre-pandemic levels of output and reinvestment from fossil fuel companies and OPEC

[72] IEA
[73] IEA

is unlikely. As such, benchmark hydrocarbon prices are likely to remain above pre-pandemic averages, especially in the EU, due in large part to the limited domestic supply. Moreover, this will allow for renewable energy sources to further establish a stable market presence and usurp hydrocarbons in terms of cost-competitiveness. While this has not yet fully materialized, immediate action to prepare and encourage such an upheaval of energy markets is imperative.

B. Geopolitics

Underlying hydrocarbon market instabilities discussed in the previous section have limited oil and gas supply globally. While accompanying price increases were severe, acute energy shortages spawned from the Russian invasion of Ukraine blew the lid off the European energy sector. As discussed in chapter 1, the EU's member states are reliant on hydrocarbon importation because of limited domestic reserves of oil and natural gas. While each member state procures these energy sources differently, the Russian federation provided a substantial portion of the bloc's energy prior to the war, especially for natural gas.

The Soviet Union's commencement of oil exports to Europe in 1973 marked the beginning of an ill-fated dependency on foreign energy sources for these nations. As mentioned previously, 24% of the EU's generated energy in 2019 came from natural gas, of which, 43% was imported from Russia.[74] Moreover, 29% of the bloc's oil imports came from Russia.[75] In total, the EU imported 28% of its energy from Russia in 2019.[76]

[74] EU Council
[75] EU Commission
[76] EU Commission

This arrangement provided cheap energy throughout much of the early 21st century, with Dutch TTF hovering around €22 per MWh throughout the past two decades.[77] However, here, it is important to note a critical shortcoming of importing natural gas. For gas to be transported, it must be cooled into a liquified form. This makes gas deliveries costly, as pipelines and LNG carriers both pose significant costs upon the importing nation. In the case of the EU, much of its Russian gas was supplied through pipelines, such as Nord Stream 1 and Yamal Europe. The upfront costs of these projects were immense, with the former costing roughly €10.4 billion, while the latter cost a staggering €32.5 billion.[78] Once operational, such infrastructure allows for large quantities of inexpensive gas to be easily transported. However, these projects are massive investments for both suppliers and importers. Moreover, the risks to importers are often more acute, as suppliers ultimately control the influx of gas. If a supplier is unable to provide gas, these massive projects risk becoming incredibly costly stranded assets. Indeed, until 2022, this system was economically beneficial to both parties. However, geopolitical tensions permanently dismantled a once lucrative partnership.

On February 24th, 2022, Russia deployed nearly 400,000 troops into Ukraine. Predictably, many Western Powers, including the EU, levied immense economic sanctions against Russia in retaliation for what was widely viewed as an unprovoked attack on a sovereign nation. The perception of the EU's energy dependency on Russia quickly deteriorated from an economic asset to a geopolitical vulnerability. Speculations of acute energy shortages rippled throughout global hydrocarbon markets. This was specifically driven by fears that the EU's reliance on Russian hydrocarbons would be severely disrupted due to politically motivated

---

[77] Trading Economics
[78] Dempsey & Hydrocarbons Technology

energy sanctions. Whether imposed by Russia or the EU, hydrocarbon markets were anxious energy sanctions would contribute to broader global shortages.

This trepidation was ultimately vindicated throughout the first year of the conflict. Indeed, 2022 saw a marked decline in the EU's importation of Russian gas. Specifically, pipeline deliveries of Russian gas fell from 140 billion cubic meters (bcm) in 2021 to a mere 62 bcm in 2022.[79] Moreover, the EU's importation of Russian oil plummeted from 4 million bpd prior the war, to 600,000 bpd in early 2023.[80] This disruption of trade was almost entirely generated from geopolitical friction. Gas supplies to the EU have dissipated as Eastward deliveries through major pipelines have entirely stalled. Both Nord Stream 1 and Yamal Europe have seen gas flows cease entirely. The Kremlin has cited various maintenance issues for the continued disruptions of supply. Yet, Western governments and independent analysts have argued such explanations serve as a mere pretext for geopolitically motivated energy sanctions. The EU's embargo on the majority of Russian oil products represents a similar disruption to hydrocarbon trade spawned from geopolitical tensions. The economic ramifications of these political measures were significant, as strains from disrupted hydrocarbon trade inflated benchmark prices. Indeed, by August of 2022, gas prices rose to €224 dollars per MWh, while Brent crude oil was trading at €100 per barrel.[81]

For geographical and economic reasons, the EU's reliance on Russian oil and gas initially appeared rational. With the largest proven natural gas reserves globally, and the 8th largest of oil, Russia possessed ample hydrocarbons to provide to the EU. Moreover, its simple geographic proximity to the EU allowed for inexpensive deliveries of hydrocarbons (aside from the upfront

[79] Reuters
[80] Trading Economics
[81] Trading Economics & Macrotrends

costs of natural gas pipeline construction). This simple arrangement made for five decades of cheap fossil fuel deliveries to European economies —as evidenced by the aforementioned relative price stability of hydrocarbons through much of the late 20th and early 21st centuries. Indeed, this appeared to be a sensible economic partnership for the EU and Russia alike. However, this viewpoint proved to be myopic, for the EU and its member states largely failed to adequately respond to alarming proclivities of Russian foreign policy. Specifically, even prior to its 2022 invasion of Ukraine, Russia displayed a propensity for leveraging its energy exports as a geopolitical tool.

Two often forgotten spats between Russia and Ukraine offered early signals of Russia's unreliability as a primary supplier of European energy. Gazprom's (Russia's state-owned gas giant) cutoff of natural gas deliveries to Ukraine in 2006 and 2009 displayed the nation's willingness to weaponize its gas supplies. The former incident arose after Russia accused Ukraine's state-owned gas company, Naftogaz, of failing to deliver payment and diverting gas intended for Eastern European nations to Ukraine.[82] When negotiations to resolve the dispute broke down, Russia opted to cease gas deliveries to Ukraine for 13 days. Importantly, the pipelines that fed Russian gas into Ukraine extended to various Eastern European nations, who often dispersed this gas further west. As a result of Russia's export controls, 9 EU member states saw gas deliveries from Russia plummet.[83] Russia's 2009 cutoff of natural gas deliveries to Ukraine arose from similar contractual disputes. Broadly, Gazprom refused to renew gas delivery contracts with Naftogaz until the Ukrainian firm paid off its debt to the company. After failed settlement negotiations, Russia entirely halted gas deliveries to Ukraine, and thus to various

[82] Reuters
[83] Reuters

Eastern European nations. This dispute collaterally impacted the energy supplies of 12 EU member-states for the 13 days gas supplies were terminated.[84]

These incidents may appear insignificant. Yet, Russia's willingness to leverage its energy exports to such a degree was an early indicator of the nation's unreliability as an energy supplier. These brief windows where Russian energy supplies to the EU were unilaterally terminated should have revealed the evident dangers of the bloc's energy model. Moreover, these events were hardly an anomaly. Russia's annexation of Crimea in 2014, interference with the territorial integrity of Georgia and Moldova in 2008 and 1990 respectively, and various other exertions of geopolitical aggression were evident precursors Russo-Ukrainian War of 2022. Yet, the EU and its member-states largely failed to heed these warnings and were caught flat footed as Russian troops rolled into Ukraine. Indeed, Moscow's disregard for the collateral damage of its energy sanctions on EU member-states proved to be a central element of the nation's irredentist foreign policy.

Some may still dismiss the war in Ukraine as a truly unique exertion of geopolitical aggression on the part of Russia, and that alternative foreign sources of hydrocarbons are viable substitutes. Such assertions are misguided. Divesting from Russian hydrocarbons in favor of other leading producers will pose an array of challenges to the EU. This is partly for economic reasons, as alternatives to Russian hydrocarbons (primarily in the form of natural gas) are invariably more costly for the EU. As mentioned, Russia's status as the world's second largest exporter of gas and its favorable proximity to the EU allowed for uniquely inexpensive deliveries to the EU. Only Norway and Algeria have similarly favorable conditions for hydrocarbon

---

[84] NBC

exports. Yet, neither possess comparatively ample reserves of fossil fuels, and thus cannot readily replace Russian gas and oil in the long term. However, geopolitical uncertainties present the most significant obstacles in finding replacement hydrocarbon exporters. Obviously, there is an extensive list of nations who could theoretically provide alternatives to Russian fossil fuels. However, relatively few have sufficient hydrocarbon reserves to adequately replace Russian fossil fuels. For the sake of expedience, this section will categorize these suppliers into two broad categories, OPEC, and the West.

OPEC consists of a diverse array of 13 member states, stretching from Venezuela to Iran. While each country has differing geopolitical aims and proclivities, the oil cartel is generally synchronized in terms of its energy policy. More specifically, as OPEC members, each state has surrendered national autonomy in terms of its energy exports. This arrangement allows OPEC to control the collective oil output from member nations. Indeed, OPEC's control of over 80% of proven oil reserves has enabled the bloc to effectively manipulate global hydrocarbon prices.[85] Moreover, while OPEC plays no part in coordinating natural gas supplies between member states, they still collectively control around 50% of global reserves.[86] As such, the bloc's members may initially appear to be viable alternatives to Russia. Yet, despite ample supply, the feasibility of a hydrocarbon energy partnership with many OPEC nations is limited.

The leading powers of OPEC have consistently been embroiled in military hostilities and deep geopolitical rivalries. Saudi Arabia is widely considered the functional leader of OPEC and is governed by an absolute and theocratic monarchy. The nation is the world's leading exporter of oil.[87] While the nation has historically possessed a conciliatory relationship to the EU and US,

---

[85] OPEC
[86] Statista
[87] Workman

its autocratic tendencies and ruthless manipulation of fossil fuel prices has recently strained this partnership. Iran is similarly governed by a theocratic autocracy. The nation is also a global leading hydrocarbon producer, serving as the world's 3rd largest gas producer, and 9th largest producers of oil.[88] Unlike the former, Iran's relationship with the West has been consistently adverse for the past five decades. Despite their mutual OPEC partnership, both nations have been involved in a variety of regional conflicts that have served as proxy wars between the two nations. Indeed, Iran and Saudi Arabia's interventions on opposing sides of the Yemeni and Syrian Civil Wars serve as recent examples of this brewing geopolitical rivalry. The inherent risks of an energy partnership with these nations are only further compounded by their previous use of energy sanctions in response to geopolitical pressures.

As mentioned previously, the Yom Kippur of 1973 saw OPEC limit oil output in response to Western nation's support of Israel. The Arab Oil Embargo contributed to a severe energy crisis and concomitant economic recessions in Europe and the US. While this may appear to be a distant example, its contemporary relevance should not be understated. Any nation's direct involvement in warfare incurs the risk of potential escalation. Just as Russia capitalized on regional instability to pursue an irredentist foreign policy, OPEC states' involvement in foreign conflicts may be an avenue for future aggression. Moreover, their entanglement in warfare presents inherent risks to trade. Whether in the form of direct attacks of energy infrastructure, collateral sanctions in response to military escalation (as seen in 1973), or other disruptions, OPEC states' involvement in civil and international conflict threaten to destabilize their energy exports.

---

[88] EIA & Enerdata

This inherent insecurity is not limited to the politics of Iran and Saudi Arabia. Other OPEC countries have been plagued by internal conflict throughout the past decade. Recent examples of such include, but are not limited to, the Second Libyan Civil War (2014-2020) and the rise of Islamic State (ISIS) in in Iraq. Obviously, the historical and political background of these wars are nuanced, and not directly analogous to Russia's geopolitical ambitions. However, the minutiae of OPEC states' conflicts are impertinent in the context of an energy partnership with the EU. This domestic instability, often compounded by weak economies and kleptocratic regimes, limits the viability of an energy partnership with these nations.

OPEC nations do not serve as viable alternatives to Russian hydrocarbons. The autocratic tendencies and political turmoil surrounding a majority of OPEC states presents an array of difficulties for a potential energy partnership with the EU. Indeed, the inherent risks posed by potential international military escalation and domestic political turmoil threaten to severely inhibit hydrocarbon trade. As such, the EU must look to history, and seek to procure its energy from more reliable trade partners to achieve energy security.

Western nations may initially appear to fill this need. The US is the world's largest exporter of both oil and gas, while Canada, Australia, and Norway are also global leaders in hydrocarbon exportation. Indeed, from a geopolitical perspective, an energy partnership with these nations is comparatively sensible to Russia or OPEC. Many EU member states are NATO members, and broadly cooperate with these nations in terms of foreign policy. Moreover, their affluence and common commitment to democracy and market capitalism limits the risks of domestic disruption to hydrocarbon deliveries. However, this does not entirely negate the geopolitical difficulties of hydrocarbon dependence of these nations.

The US' foreign policy presents legitimate risks to the EU in the context of a fossil fuel energy partnership. The nation's interventionist foreign policy has often contributed to regional destabilization. The US' invasion and prolonged occupation of Iraq in 2003 serves as a primary example of such. The deposition of Saddam Hussein's totalitarian regime contributed to a power vacuum in Iraq and the Middle East more broadly. The instability following America's departure in 2011 allowed for ISIS to occupy much of the country by 2014. Evidently, this incursion destabilized a leading fossil fuel exporter, and threatened other neighboring hydrocarbon producers.

Despite these potential risks, a dependence on Western fossil fuels is not an inherently insecure arrangement from a geopolitical perspective. However, the behavior of Western hydrocarbon producers discussed in the previous section necessarily limits the viability of this model. Moreover, the ever-looming threat of climate change invariably renders a dependence on hydrocarbons as an insecure energy model for the EU.

C. Climate Change

Alarming hydrocarbon industry trends in conjunction with an ever more uncertain geopolitical terrain have highlighted the evident failures of the EU's current model in providing energy security. However, even these such shortcomings represent only a fraction of the frailty associated with a hydrocarbon-dependent energy model. As mentioned, the looming threat of climate change is the most acute and daunting challenge incurred by the EU due to its reliance on fossil fuels.

Importantly, the negative externalities innately associated with hydrocarbon dependence are extensive, and range beyond climate change. Indeed, oil spills, degrading air quality, plastic pollution, and various other inescapable adverse effects associated with a fossil fuel-oriented economy represent negative externalities that all pose acute challenges to the EU. However, this section will solely provide pertinent estimations concerning the economic costs specifically associated with climate change. This is partly for the sake of expedience but is primarily due to the sheer scale of the threat posed by climate change. Moreover, the effects of climate change represent far and away the most significant negative externalities concomitant with hydrocarbon energy reliance. As such, concentrating on the effects of climate change in the EU alone is necessary for a comprehensive analysis of this topic.

Specifically, this section will focus on the most acute and, importantly, determinable threats posed by climate change to the EU. Unfortunately, accurately predicting the costs associated with certain key negative repercussions of global warming presents an array of difficulties. The destruction of global ecosystems, the forced exodus of large swaths of the human population, and the exacerbation of zoonotic disease serve as pertinent examples of such. There is little certainty in forecasting the scale and precise ramifications of ecological degradation, human migratory patterns, and the breakout of novel infections for various reasons. For instance, while the IPCC has provided high confidence that “zoonic diseases have increased” due to climate change, it has shied away from postulating future effects of this phenomenon.[89] Beyond the certainty that the degradation “of areas where animals used to live” due to climate change is indeed “facilitating the spread of zoonotic diseases,” the future effects of this on the EU or other countries are

[89] IPCC 2021 Report

indeterminate.[90] There is little use in attempting to predict when a zoonotic outbreak may occur, let alone the scale and economic ramifications of such. The same holds true concerning human forced migration and ecological degradation.

For these reasons, detailing all the various effects of global warming is overly exhaustive for the purpose of this analysis. As such, this section will rely on the effects of global warming itself and concomitant augmentation of extreme weather events to provide figures concerning why continued EU hydrocarbon dependance is mistaken. Admittedly, a significant degree of ambiguity still exists for these metrics. The extent to which climate change may incur harm on the EU will depend on future political, economic, and unforeseen climatological developments.

Yet, while this may seem to render the precise degree of this damage incalculable at present, differing warming scenarios provide insight into the future effects of climate change. The 2021 IPCC report provides for five broad series of developments concerning future GHG emissions based on an array of variable factors that may influence the severity of global warming. Specifically, these warming scenarios vary “depending on socio-economic assumptions, levels of climate change mitigation and” other narrower political variables concerning hydrofluorocarbon regulation (another GHG).[91] In short, within these models, the IPCC determined global warming will likely range from 1.4°C to 4.4°C warming from pre-industrial levels by 2100.[92]

The severity of climate change will vary heavily within these warming parameters. For example, the low end of this spectrum is hardly an increase from warming already experienced of roughly 1.1°C. As such, the frequency and severity of extreme weather events, while notable,

---

[90] Tanzi 40
[91] IPCC 2021
[92] IPCC 2021

will not be utterly cataclysmic. Yet, warming of or anywhere near 4.4°C will render "substantial areas of the planet biologically uninhabitable for humans" and initiate feedback-loops that will threaten to "turn the heating process into an unstoppable upward spiral."[93] However, these represent the relative extreme ends of these climate models. Future warming scenarios are likely to fall between these two extremes without a dramatic change in the provided variables. Given this, warming predictions based on continued hydrocarbon-dependence in the short and medium term provide an effective benchmark for calculating the costs of climate change in the EU.

The UN Environment Program's 2022 Emissions Gap Report provides warming predictions of such a scenario. Specifically, the report postulates if no upheaval to global energy markets materializes in the near-term, warming is likely to reach roughly 2.8°C above preindustrial levels by the end of the century. Obviously, an accelerated global transition from hydrocarbon dependencies, as advocated for in this essay, will serve to limit warming towards the lower end of these scenarios, while a perpetuation of current energy models will thrust humanity towards ever more severe warming. Yet, given the unpredictability of future government policy, the UN's prognosis provides for an effective benchmark for calculating the costs of climate change for the EU. As such, this section will rely on data based on this warming scenario to detail the potential ramifications of continued dependence on hydrocarbons for the EU.

The warming of Earth has already disproportionately impacted the European Continent. According to the World Meteorological Organization, "[t]emperatures in Europe have increased at more than twice the global average over the past 30 years – the highest of any continent in the world."[94] This has seen warming in the continent reach just under 2°C from pre-industrial levels,

---

[93] Lynas 171 & 210
[94] World Meteorological Organization

compared to a 1.1°C global average.[95] As such, if average global warming were to reach 2.8°C, Europe's land temperatures could rise upwards of 4°C. The implications of such acute levels of warming for EU member states are extensive, and regionally dependent. As such, this section will provide an overview of the permanent climatic changes likely to materialize within such a warming scenario. From here, it will detail the economic dangers associated with such levels of warming.

Regional climatic shifts are an inevitable consequence of climate change. The specific climatic effects of the wholesale warming of Earth on the EU are dependent upon preexisting climatic zones within the Continent. As such, in calculating the costs incurred by prolonged hydrocarbon energy dependence, properly accounting for such regional discrepancies is necessary. The European Environment Agency (EEA) provides for the broad effects of climatic shifts in Europe. Moreover, in doing so, the Agency stratifies the continent into various climatic zones. However, for the sake of expedience, this section will detail the impacts of climate change on the three largest of these climatic zones: Mediterranean, continental, and Atlantic.[96]

Warming of roughly 2.8°C from pre-industrial levels will devastate member states within the Mediterranean climate zone. Indeed, nations such as Greece, Spain, Portugal, Croatia, and Italy will bear the most severe burdens of climate change within the EU. This is because such a warming scenario will see "[d]esert-like conditions" extend to most of these nations, "completing an arc of aridification along… the Mediterranean shoreline."[97] The deleterious effects associated with the desertification of Mediterranean nations are extensive. For example, such warming will incur the loss of previously bountiful yields of olives, grapes, and other

[95] World Meteorological Organization
[96] The European Environment Agency
[97] Lynas, 137

cornerstone agricultural products of the region. Indeed, Mediterranean EU nations account for roughly nearly 70% of the world's olive supply.[98] Moreover, Italy and Spain are the 2nd and 4th largest global producers of grapes respectively.[99] Evidently, the current climate of the Mediterranean has allowed the region to prosper as a major agricultural exporter. Yet, novel desert-like conditions will render most of such land unsuitable for the cultivation of such crops, collapsing major sectors of the EU's Mediterranean economy. Moreover, such desertification will cripple already dwindling water supplies, meaning "[none] of these nations will have enough water to maintain their current populations."[100]

Such arid conditions will further intensify natural disasters that often afflict the region, mainly in the form of droughts. Regarding the former, the European Commission estimates that droughts already account for €9 billion in annual losses in the EU.[101] These largely stem from concomitant declines in agricultural productivity, energy production, and fresh-water availability.[102] However, alarmingly, if warming were to reach 2.8°C from pre-industrial levels, the Commission forecasts such economic damages could rise €45 billion annually.[103] Moreover, Mediterranean member-states would incur the majority of such losses. This is largely due to the fact that drought frequency will double over nearly 25% of the region, and increase in frequency over nearly 60% of the region.[104]

The Continental climatic zone of Europe will similarly experience radical economic disruption due to climate change. This region of Europe is extensive, spanning from Eastern

---

[98] Atlas Big
[99] FAO
[100] Lynas 137
[101] The European Commission
[102] The European Commission
[103] The European Commission
[104] The European Commission

France through Southern and Eastern Germany to much of Eastern Europe, including Poland, Czechia, Hungary, Romania, and others. Broadly, a global 2.8°C warming scenario will see "today's Mediterranean Climate… spread up into central and Northern Europe," including much of the continental region.[105] While such warming will not prove as disastrous as the desertification of the Mediterranean region, it will still be extensively damaging. More specifically, many of the harmful ramifications of global warming that afflict the Mediterranean region will impact the continental zone, although not to the same degree. Specifically, such a climatic shift will see an increase in the frequency and severity of heatwaves, thus causing intense and recurrent wildfires and droughts.

Within the continental zone of Europe, climate related losses will materialize in an array of economic sectors, from agricultural productivity to tourism. The continental region may not be afflicted by such ailments to the same degree as the Mediterranean. Yet, excessive heat waves pose acute problems that are largely distinct to the region. Indeed, the Summer of 2022, which was the warmest in European history, was symptomatic of this looming climatic shift and offered critical insight into the deleterious ramifications of a warmer world. Specifically, the severe droughts that followed threatened to severely inhibit a major artery of the EU's economy.

The economic significance of the Rhine River cannot be understated. The waterway, which flows from the Swiss Alps to the port of Rotterdam in the Netherlands, is an indispensable facet of the EU's economy. The Rhine's contemporary economic importance largely stems from trade. Indeed, the navigability of the Rhine allows for the inexpensive transportation of goods and services in the region. Specifically, more than 300 million tons of cargo,[106] equating to €73

[105] Lynas 137
[106] Posaner & Cokelaer

billion worth of trade, flow through the River annually.[107] While significant, this figure is actually an underrepresentation of the Rhine's economic significance. Its economic utility is broad, from the generation of energy in the form of hydro and nuclear power, to recreation. This vitality has contributed to the significant development of the Rhine's basin.

The "European Megalopolis" is a highly concentrated population and industrial center that forms the backbone of the EU's economy.[108] Hosting a population of nearly 50 million and numerous lucrative industries, this economic super-region is of paramount importance to the EU's economy. Within the EU, this mega-region accounts for €2.2 trillion in output, or roughly 15% of the bloc's total GDP, despite only comprising select areas of 5 member-states.[109] Importantly, much of this economic activity is largely dependent on the Rhine. Whether for trade, energy generation, or simply freshwater, the population and industries of this region rely on the continual flow of this waterway. However, the looming challenge of climate change threatens to severely disrupt this indispensable economic region.

The Rhine has displayed an alarming susceptibility to droughts in the face of ever rising temperatures. Throughout the Summer of 2022, the Rhine's water levels reached critically low levels. Specifically, stretches of the Rhine, such as the Kaub Checkpoint in Western Germany, reached record low water levels of 30 cm.[110] This drought severely inhibited European trade, as such low water levels rendered commercial shipping largely economically unviable.[111] Barges were forced to limit carried cargo to navigate the exceptionally low water levels, leading to a widescale diversion of trade from the region. Losses from this drought have yet to be calculated

---

107 Wilkes et al.
108 Florida
109 Bloomberg
110 Reuters
111 Posaner & Cokelaer

but are expected to exceed the €5 billion losses from less severe, although still significant, droughts in 2018.[112]

Crucially, as global warming intensifies, droughts within the continental climatic zone in Europe will become ever more frequent and severe. Global warming of 2.8°C by the end of the century is an existential challenge to the economic viability of the Rhine for this reason. Indeed, such a warming scenario presents the possibility of prolonged desiccation, for weeks or even months at a time. Such disruptions to the flow of the Rhine will upend the heart of the EU's largest economic center. The precise losses from such may be incalculable at present. Yet, droughts inhibiting over €7.2 billion worth of annual trade is an evident economic drawback of hydrocarbon dependence.[113] Moreover, consistent disruption to the flow of the Rhine will force much of the industry that depends on such to abandon the region, threatening nearly 15% of the EU's GDP. Importantly, the Rhine is not the only inland waterway threatened by such warming. The Danube, Oder, and various other inland waterways of the Continental region will similarly experience critical droughts, costing the EU billions of Euros annually.

The Atlantic region of Europe will face turbulent climatic change due to global warming. For reference, this climatic area covers much of Western France, the Benelux states, Northwestern Germany, and Denmark. This region has historically hosted a relatively stable and precipitous climate, largely due to the flow of the Atlantic Gulf Stream. Yet, global warming threatens to generate unprecedented turbulence in the region's climate. Specifically, sea-level rise and compound flooding pose the most acute challenges to Atlantic EU member states.

---

[112] Muller
[113] Bloomberg

Broadly, global warming of 2.8°C will contribute to "a 50% chance of sea level rise of just over one meter by the end of the century."[114] This will occur largely due to the melting of polar ice sheets and glaciers in conjunction with thermal expansion.[115] For clarity, the latter refers to the tendency of water volume to expand in warmer temperatures, which has contributed to roughly half of sea-level rise already experienced.[116] Importantly, sea-level rise is not the only contributing factor to an increased risk of coastal inundation due to climate change. Indeed, the aforementioned Commission report identifies an increase in extreme precipitation as a likely ramification of climate change in the Atlantic Climatic zone. The EEA further postulates that such storm surges can contribute to extreme sea-levels.[117] Moreover, the Agency projects storm surges "to increase along the northern European Atlantic coastline," contributing to "[n]otable increases in high tide levels…for the North Sea and the German Bight."[118]

The negative economic ramifications of such sea-level rise in the Atlantic climatic zone are extensive. Importantly, such damages are highly variable, largely depending on national efforts of coastal flooding preparedness. Such efforts typically involve funding infrastructural projects, mostly through the construction dykes. The Commission's report on "Climate Change and Coastal Flooding" accounts for this. Specifically, within a 2.8°C warming scenario, the report estimates that coastal flooding will cost the EU €111 billion annually by 2100.[119] Moreover, it also projects that nations in the Atlantic climatic zone of Europe are particularly exposed to such

---

[114] Lynas 128
[115] NASA
[116] NASA
[117] European Environment Agency
[118] European Environment Agency
[119] The European Commission

coastal flooding. Indeed, the Commission postulates that "largest absolute damages are projected" to fall on France, Germany, Denmark, and the Netherlands.[120]

Warming of 2.8°C will cripple the Mediterranean, threaten the heart of Europe's economy, and decimate the bloc's coastline. The billions in losses detailed above incurred from unabated warming are directly attributable to hydrocarbon energy dependence. Moreover, the extent of this damage is likely to be an underrepresentation. As mentioned, the effects of climate change are extensive and varied, and the majority of such are not accounted for in this essay. As such, the EU's divestment from a fossil fuel-oriented economy is necessary to limit climate change and thus ensure energy security. However, the EU as a whole is only the world's 3rd largest emitter of GHGs, and accounts for only 7% of global emissions annually.[121] As such, domestic decarbonization will have a limited efficacy in limiting warming. Fortunately, the EU's economic heft provides the bloc with an avenue to abate climate change beyond its borders.

Chapter 4: The EU as a Source of Global Regulation

The EU is currently in a unique position to exert its economic influence to spur global decarbonization efforts. As mentioned in the previous section, to truly stave off future energy insecurity, international climate abatement is imperative. The bloc must utilize all avenues to achieve energy security. This section will discuss the EU's outsized market influence and how this has allowed the bloc to export its environmental and energy regulatory regime. Much of this discussion will be based on Anu Bradford's book *The Brussels Effect.* Her astute analysis provides an effective picture of the limitations and extent of the EU's regulatory power.

---

[120] The European Commission
[121] European Parliament

Moreover, her postulations provide a salient framework in determining whether this regulatory influence makes for an effective means to spur global decarbonization.

A. Extent of EU Regulatory Power

The EU is an economic powerhouse. Overall, the bloc has a GDP of €14.5 trillion, accounting for around one-sixth of the global economy.[122] Moreover, its population of roughly 450 million with a GDP per capita of roughly €35,000 provides the bloc with a large and relatively affluent consumer base.[123] In turn, businesses from around the world have a vested interest in maintaining a market presence within the EU. Yet, importantly, a firm's compliance with EU regulation is a necessity to operate within the bloc or in any member state. As such, firms often choose to abide by EU regulatory standards out of economic pragmatism. This is because the overall benefits of maintaining a presence in the EU often outweigh the costs of adhering to the bloc's regulatory regime.[124] This, in turn, frequently leads to EU regulatory standards being implemented throughout the global marketplace. Critically, however, the "Brussels Effect" is not absolute.

Specific economic and political circumstances are necessary for this occurrence to materialize. Bradford lays out five specific parameters in this regard: "market size, regulatory capacity, stringent standards, inelastic targets, and non-divisibility."[125] The former three prerequisites are contingent upon the EU, while the latter two are dependent on the goods or services being regulated. As mentioned previously, the EU's market size is second only to the

---

[122] European Union
[123] Macrotrends
[124] Bradford 33
[125] Bradford 25

United States. Thus, the EU's single market is a necessary and lucrative asset to many multinational firms. The bloc's regulatory capacity and stringent standards (specifically concerning environmental and energy policy) will be discussed in the next section of the chapter.

Understanding the latter two categories is essential, as these limits define the extent to which the EU can exert its regulatory influence to encourage global decarbonization. The inelasticity of the regulatory target refers to their ability to avoid jurisdictionally issued regulations.[126] This covers firms whose business models are location dependent and are thus "tied to a certain regulatory regime."[127] Summarily, inelastic targets are often businesses which provide goods and services directly to regulated consumer markets. As such, firms are forced either to comply with issued regulations or abandon the market altogether.[128] However, this alone does not allow for the externalization of regulation.

Non-divisibility is another imperative of the "Brussels Effect." This refers to when firms opt to alter their business practice in compliance with the most stringent existing regulatory standard. This may be done for a variety of reasons—as will soon be discussed. Generally, however, this occurs when the process of complying with separate regulatory regimes is overly complicated or costly to the point where opting to adhere to the most stringent regulatory standard is preferable.[129] Bradford provides three scenarios of non-divisibility: technical, legal, and economic. She notes that economic non-divisibility is the most commonplace of these. As such, for the sake of relevance and expedience, this essay will primarily focus on this form.

---

[126] Bradford 50
[127] Bradford 48
[128] Bradford 50
[129] Bradford 54

Economic non-divisibility "is perhaps the most common reason why manufacturers opt for a global standard."[130] This is broadly due to the fact that the standardization of the production process is often an economically indispensable practice for multinational corporations. Indeed, most of these firms rely on integrated-global supply chains, and thus have an extensive global presence. By operating in such scale economies, corporations often buy raw materials in bulk, which are typically procured at lower costs than in smaller quantities. As such, regulations that prohibit certain materials or facets of a manufactured good often lead firms to buy from suppliers who adhere to such regulations.[131]

The same holds true concerning the production process itself. Multinational firms often decide to standardize manufacturing and production operations to minimize fixed-costs and maximize general efficiencies. Specifically, such systemization allows firms to use the same equipment and manufacturing techniques across their global production sites. This greatly lowers costs and enables the economic competitiveness of international firms. As such, government regulations from relevant markets concerning the production process are often effective in altering business practices. Indeed, dividing manufacturing processes to accommodate various regulatory regimes negates the inherent benefits of standardization.

Broadly, providing differing products to numerous jurisdictions on the basis of adhering to various regulatory regimes is typically a poor business model for internationally operated firms. For the reasons discussed above, dividing supply chains and production processes often limits a firm's cost-competitiveness. As such, firms often adhere to a single regulatory regime throughout their global operations. Moreover, this economic reality incentivizes firms to structure their

---

[130] Bradford 58
[131] Bradford 59

manufacturing processes in compliance with the most stringent regulatory regimes to which they provide their goods or services. Opting for such importantly does not exclude vital markets, nor incurs unnecessary costs by dividing production processes in compliance with various regulatory regimes. The EU often serves as this vital market. Its regulatory proclivities and market size enable the conditions for regulatory externalization described above.

A recent example of this phenomenon came in the form of the EU's Common Charger Directive. This law's overarching mandate is that various consumer electronic devices (smartphones, tablets, headphones, etc.) utilize USB-C charging ports. Following the promulgation of this rule, Apple decided to configure all its newest iPhone models with USB-C charging ports, irrespective of whether they were sold in the EU. When asked whether the EU's Common Charger Directive was responsible for this alteration, Apple's VP of Worldwide Marketing noted, "we'll have to comply; we have no choice."[132]

Significantly, the externalization of EU regulatory standards can materialize in a variety of forms. Moreover, this process often varies in terms of the scope of adoption of EU regulatory standards. To account for this, Bradford provides two avenues through which the "Brussels Effect" most often arises. The *de facto* "Brussels Effect" occurs when regulated industries simply opt to adhere to EU regulation for the reasons discussed above. As such, these firms adhere to these standards, irrespective of whether their host nation imposes similar regulatory burdens. However, this arrangement tends to favor companies that purely operate domestically, and thus have no incentive to abide by foreign regulatory standards. This can lead to the *de jure* "Brussels Effect." This largely occurs when multinational corporations lobby their host nations to adopt

---

[132] Dascalescu

equally stringent regulatory standards, equivalent to those of the EU. The *de jure* "Brussels Effect" is largely motivated by international firm's desire to remain cost-competitive with their domestic counterparts. The subsequent formal introduction of legislation often mirrors that of preexisting EU regulations for this reason. Concrete examples of this occurrence in the context of environmental and energy policy will be provided in the next section.

B. Examples Pertaining to Environmental & Energy Regulation

The EU's record of externalizing environmental and climate policy provides salient examples of the bloc's capacity to externalize such policies. Understanding the complexities of these examples will provide a framework of the limitations and avenues for the EU to unilaterally spur a global energy transition. This section will examine three pertinent examples: EU Aviation Directive, Restriction of Hazardous Substances Directive (RoHS), and the Authorization and Restriction of Chemicals (REACH) program. The varying degrees of success in the externalization of these policies will be discussed below.

The EU Aviation Directive was issued in 2012 and sought to include foreign airlines in the EU's ETS. Specifically, this directive required any airline landing in or departing from any EU member state to buy emissions permits. Importantly, airlines were required to buy emissions permits covering the entirety of these flights, not just the portion of the flight over EU airspace.[133] The wider policy goal was designed to prevent "carbon leakage" from the ETS and to ensure that domestic airlines were provided a competitive market space. As participation in

[133] Bradford 220

the ETS was compulsory for EU airlines, they were put at an economic disadvantage due to the imposition of carbon prices. This regulation sought to ameliorate this fiscal burden by mandating foreign airlines partake in the ETS, and thus be subject to the same economic pressures as their domestic counterparts.

The efficacy of this policy in spurring the "Brussels Effect" is indeterminate. Following the promulgation of the Aviation Directive, an assembly of international actors fiercely protested the measure. China threatened to terminate its contracts with Airbus, a French airline, and cease all orders of its planes if the regulation were implemented. Moreover, the country's Civil Aviation Administration banned all domestic airlines from partaking in the ETS in 2012. Similarly, "America threatened noncompliance if the EU required all flights to take part" in the ETS.[134] China and the US were not alone in challenging the EU Aviation Directive, as 21 nations all called for the reversal of this policy.[135]

This diplomatic spat prompted the EU to pursue a multilateral approach in an effort committed to reducing the aviation sector's carbon emissions. A group of airlines encouraged their host governments to seek negotiations with the EU to create a global regulatory standard in this field. Through the UN's International Civil Aviation Organization (ICAO), a novel international agreement was reached on this matter. The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) has been agreed to by over 107 nations as of 2022 and applies to over 60% of global aviation GHG emissions.[136] While the program does not provide as stringent of standards as did the EU Aviation Directive, it's functionally the same

[134] Economist
[135] Bradford 220
[136] ICAO

structure. In fact, CORSIA similarly requires airlines to buy carbon credits covering emissions from international flights.[137] However, as part of this agreement, the EU opted to abandon the Civil Aviation Directive in 2016.

The ramifications of the EU Aviation Directive sketch out the limitations of the "Brussels Effect" in attempting to abate climate change. At face value, the establishment of CORSIA appears to be a manifestation of the EU's regulatory power, and the *de jure* "Brussels Effect" more specifically. Indeed, the EU's promulgation of the Aviation Directive spurred multilateral action on establishing a carbon market for international aviation. However, the fierce diplomatic response to this program highlights a critical constraint on the EU. Specifically, it displays that nations are aware of the market power of the bloc and are prepared to take drastic action to limit its influence if an EU regulation is deemed undesirable. The US' and China's coordinated efforts at noncompliance serve as examples of such. Moreover, it is worth considering that the EU did ultimately cave into this international pressure. The bloc's decision to abandon the Directive shows that nations effected by EU regulations have the propensity to enact meaningful retaliatory measures against the "Brussels Effect."

However, such setbacks are not indicators that any EU regulatory action to stem climate change is doomed to fail. Rather, it emphasizes the need for the EU to be selective in its issuance of policy designed to be externalized. The examples discussed below provide effective templets for the EU, as they were successful in externalization, without similar international challenges.

The RoHS was first promulgated in 2003, and broadly sought to limit hazardous products in electronic devices. Ten substances are specifically regulated under the RoHS, including lead,

---

[137] ICAO

mercury, cadmium, and others. Each regulated substance poses unique environmental and health hazards, especially when improperly disposed of. As such, this directive restricts the presence of these hazardous substances in any product with an electrical component, barring a narrow range of exceptions.[138] Importantly, while the EU was not the first to regulate these hazardous materials, the RoHS is uniquely stringent. This allowed for the regulation to be broadly externalized. Indeed, various governments adopted similar policies to appease multinational firms adhering to the RoHS. Nations such as China, Brazil, India, and others opted to impose similar regulations.[139] Moreover, other countries, such as South Korea, directly modeled their regulatory regimes after the RoHS.[140]

REACH was initially issued in 2007 and serves as the EU's primary regulatory mechanism for chemical products. As with the RoHS, the EU has placed the burden of gathering data concerning health and environmental impacts of chemicals on manufacturers.[141] Broadly, REACH requires that "manufacturers and importers of chemicals… identify and manage risks linked to the substances they produce and market."[142] This specifically mandates that relevant firms provide human health and environmental assessments of the chemicals they produce or import to the European Chemical Agency (ECHA). This regulatory structure is similar to RoHS. However, REACH is far more extensive in terms of regulated substances. In total, 59 categories of substances are regulated under reach, "involving more than 1000 substances."[143]

---

[138] European Commission
[139] Bradford, 223
[140] Bradford, 224
[141] ECHA
[142] ECHA
[143] CIRS

Since its initial passage in 2007, REACH has provided the most stringent regulatory standards concerning chemical regulation. Importantly, the relative inelasticity of chemical suppliers, and the non-divisibility of most covered entities allowed for the "Brussels Effect" to broadly materialize. Indeed, the *de facto* "Brussels Effect" saw various leading private entities announce their REACH compliance across their global operations. This included an array of firms, from massive chemical companies like Dow Chemical to cosmetics companies like Unilever.[144] This contributed to the materialization of the *de jure* "Brussels Effect." Nations such as China, Japan, Turkey, and others have since adopted regulatory measures modeled—and often named after—REACH.[145]

Both REACH and RoHS are evident examples of the "Brussels Effect." The regulatory structures of these policies effectively capitalized on the necessary market conditions for their broad externalization. This merits their emulation in other EU policies designed to influence global regulatory standards. Indeed, future EU climate policy designed to ensure the bloc's energy security would greatly benefit from similar regulatory mechanisms.

[144] Bradford, 197
[145] Bradford, 203

Chapter 5: Policy Recommendations

The European Energy Crisis of 2022 has revealed any long-term reliance on fossil fuels is untenable for the EU. As discussed in chapter 3, such an energy model is inherently tenuous due to alarming hydrocarbon market trends, geopolitical uncertainties, and, most importantly, climate change. As such, an upheaval of the bloc's current energy supply is imperative. Facilitating and encouraging the transition away from hydrocarbons must be a focal point of EU energy policy until this is achieved. Fortunately, there are a multitude of policies that could be effective in this capacity. These include infrastructural reform, industry selective decarbonization mandates, and seeking novel trade alliances for key materials, to name just a few. However, as mentioned previously, the EU has limited authority for such sweeping reform. Nonetheless, the EU wields immense power to encourage a broad transition to renewable energy sources. This section will outline key policy recommendations that will allow the EU to leverage this authority to its fullest extent. The first section will detail policies that will allow the EU to encourage domestic decarbonization. The second section will discuss how the EU can wield the "Brussels Effect" to its fullest potential and encourage similar energy transitions abroad.

A. Domestic Energy Reforms

Ensuring energy security in the EU will require an ambitious and rapid transition to decarbonized energy sources. Importantly, a wide range of policy instruments will ultimately be necessary for such. However, national carbon pricing schemes and subsidy packages for alternative energy technologies are broadly the most impactful in this aim. Moreover, such policies are within the scope of the EU's institutional prerogatives discussed in chapter 1. Indeed, the EU has already implemented such policies in the form of the ETS and various green subsidy packages. Yet, these policies have proven insufficient in providing energy security to the EU.

For the reasons discussed in chapter 3, curtailing member-states' fossil fuel energy dependencies is an immediate imperative of the EU. However, the bloc's energy transition has not proven sufficiently ambitious. As mentioned in chapter 1, the EU is still broadly reliant on a hydrocarbon oriented, and thus energy insecure model. This will expose the EU's economy to the volatility of hydrocarbon markets and ever-increasing international instability in the near-term. Moreover, according to the Climate Action Tracker (an independent scientific organization), the EU's current energy policies are "insufficient" to limit global warming to under 1.5°C and are set to contribute to global warming of roughly 2°C.[146] Given the unpredictability of international climate and energy policy, this may prove to be an underrepresentation of global warming over the next century. As such, ambitious reforms to the energy makeup of the EU are necessary in the short and long term.

Current EU policy has largely failed to provide energy security to the bloc. Yet, the ETS and the green subsidy programs in the EU have the potential to scale renewable energies and related technologies rapidly and effectively in the bloc. Importantly however, as alluded to in chapter 1, these policies both possess critical shortcomings that limit their efficacy in this aim. As such, crafting novel and overarching energy policy is not necessary for the EU to achieve energy security. Rather, ameliorating these critical defects represents the most viable pathway to achieve energy security in the EU.

---

[146] Climate Tracker Initiative

The ETS is perhaps the most important tool for the EU to spur decarbonization. As mentioned, the efficacy of this policy, and cap-and-trade programs more broadly, is well documented. However, in its current iteration, the EU ETS' shortcomings will limit its utility in achieving energy security. The ETS is limited in scope, covering only roughly 45% of the EU's GHG emissions.[147] While many of the 10,000 installations regulated by this policy are "in the energy sector and manufacturing industry," limiting climate change wholesale is necessary to achieve energy security. Including a broader range of GHG emitting sources within the scope of the ETS is thus a necessity to achieve energy security for the EU. Transportation, shipping, agriculture, and other sectors cumulatively account for 55% of the EU's annual GHG emissions. Moreover, nascent technologies—such as EVs, green hydrogen, and vertical farming—are legitimate threats to incumbent hydrocarbon-oriented technologies within these industries. As such, effectively pricing GHGs provides a substantive incentive for these industries to explore opportunities to develop and implement such technologies. However, most importantly, abating this substantial portion of the bloc's emissions is necessary to decarbonize the EU's economy. The ETS' extension to these economic sectors is therefore a necessity to achieve such.

As mentioned in chapter 1, the ETS broadly operates under self-prescribed "trading periods" that gradually limit annually allotted carbon emissions permits. While these are broadly linked to the EU's GHG emission reductions targets, further synchronization of such is necessary. As of the writing of this essay, the amount of ETS permits allotted has been determined through 2030. Indeed, "the overall number of emission allowances will decline at an annual rate of 2.2%" throughout the fourth ETS trading period.[148] This may provide covered

[147] EPA Ireland
[148] European Commission

industries with an effective timeline to decarbonize. However, as mentioned, EU policy is currently “insufficient” to limit warming to under 1.5°C. ETS encouraged emissions reductions, while noteworthy, are not in line with the EU’s stated climate change targets. Indeed, to limit warming to under 1.5°C, the EU has set targets to reduce “emissions by at least 55% by 2030 compared to 1990 levels” and achieve climate neutrality by 2050.[149]

In practice, ths will entail limiting annual carbon emissions to roughly 3 billion tons by 2030.[150] Decarbonizing to this degree would likely be sufficient for the EU to achieve energy security. However, the ETS’ current emissions standards are not in line with this necessary target. As of now, the ETS’ annual 2.2% decline in carbon allowances will not prove sufficient to reduce emissions in covered industries to these levels, let alone throughout the EU’s whole economy. At such levels, this will functionally permit well over 1 billion emitted tons of carbon in currently covered industries alone.[151] As such, in conjunction with broadening its scope, the ETS must set more ambitious standards for emissions reductions.

The ETS must be modified to better facilitate this decarbonization. Specifically, the ETS’ system for allocating carbon permits must be clearly aligned with the bloc’s stated climate targets. As such, with an expanded scope, the ETS should allow for roughly 3 billion tons of carbon to emitted throughout the EU by 2030. Moreover, the ETS’ carbon permit allowances through 2050 must be clearly promulgated. While the EU’s current target for climate neutrality by 2050 is legally binding for member states, such soft emissions targets are often ineffectual in encouraging decarbonization. Conversely, the ETS presents an opportunity to firmly establish

---

[149] European Parliament
[150] EEA
[151] EEA

these climate targets through efficient economic policy. This can be done by clearly establishing the number of GHG emission permits to be allotted through 2050. Such an initiative will drastically increase the costs of emitting carbon over time. Moreover, it will provide effected industries with a clear timeline for their expected emissions reductions and will allow for better long-term planning of such an economic landscape. While this will be effective in curtailing the EU's current hydrocarbon dependency, its effect on proliferating decarbonized technologies will be limited.

Fiscal stimulus for green technologies will truly enable a transition from a hydrocarbon-oriented economy in the EU. The fiscal stimulus provided to renewable energies and related technologies in the EU has been significant. The vast subsidies conferred by the EU and its member states should theoretically be effective in fueling an energy transition. However, the sheer number of green subsidy programs available in the EU presents crucial difficulties. Namely, this elaborate arrangement inevitably produces significant bureaucratic inefficiencies. Indeed, "[t]o have a chance at tapping one of the many pots, startups often have to hire pricey consultancies to help them write grant proposals." This reality often deters market participation from green tech startups in the EU. Moreover, "[o]nce an application is filed, it can take months, or years, before a decision is made" concerning subsidy grants. These bureaucratic inefficiencies inhibit the streamlined flow of funds to firms producing green tech.

If left unamended, this decentralized and uncoordinated approach will significantly delay or even entirely prevent the EU's divestment from hydrocarbons. The vast amount of fiscal stimulus already provided should serve to make the EU's capital markets unparalleled for green tech. However, this has not proven the case. China still firmly dominants the production of renewable energies, thanks in large part to favorable state-aid. Moreover, the billions provided to green tech through the US' Inflation Reduction Act will allow the nation to surge as a manufacturing hub for green tech.

The EU's and member-state's existing green subsidies are generally similar in scale to these comparable foreign programs. Yet, the US and China's subsidies benefit from the relative simplicity of large, and centrally operated programs. Conversely, the inherent bureaucratic inefficiencies associated with the vast number of programs in the EU threaten to massively stall the EU's development of green tech. As such, amalgamating the majority of these programs will remedy these evident defects. Centralizing REPowerEU, NextGenerationEU's funds for green tech, the EU Innovation Fund, and all other EU green subsidy programs under one umbrella scheme is imperative. Moreover, accessing member-states' green subsidy programs should be made available through the EU's overarching Green Umbrella Program.

Some may argue that such a policy is an infringement on the political sovereignty of EU member states. Yet, as mentioned, the 2009 Lisbon Treaty allows for the EU to interject in energy policy to "promote… the development of new and renewable forms of energy."[152] As such, centralizing the various green subsidy programs in the EU is legally permissible. Moreover, this harmonization of green policy will greatly benefit the bloc as a whole. Indeed, processing and permitting the vast majority of applications for green subsidies through a singular EU entity will make this process far more efficient. Streamlining the permitting of green subsidies throughout the EU will allow for capital to flow to green startups readily and attract incumbent firms from abroad seeking to capitalize on newly available cash. Broadly, the

[152] Lisbon Treaty Art. 194

harmonization of EU green subsidies will expand the bloc's collective capacity for hosting and growing green firms.

The policy recommendations detailed in this section do not represent a dramatic upheaval to EU energy policy. These ameliorations to current policy may appear to be relatively modest, especially given the scope of the challenge of securing the EU's energy security. However, the impacts of these reforms will prove immensely consequential in this regard. Indeed, through more effectively deterring GHG emissions through the ETS, and promoting alternative decarbonized energy sources through the Green Umbrella Program, the EU can greatly improve its prospects of achieving energy security. However, these domestic reforms in isolation are insufficient in this regard.

B. Projecting Decarbonization

The policies detailed in the previous section will be effective in sparking a domestic energy transition. This will largely shield the EU's economy from the current volatility of hydrocarbon markets and an ever more uncertain geopolitical terrain. While this would represent a dramatic improvement from the bloc's current energy model, it would not ensure the EU's energy security. As mentioned, the EU's share of annual GHG emissions, while historically significant, is ultimately insubstantial from a current global perspective. Due to this, the EU's unilateral divestment from fossil fuels will not necessarily guarantee energy security for the bloc. An international energy transition is necessary to prevent the most deleterious effects of climate change from materializing in the EU.

Indeed, global climate abatement represents one of the most complex challenges ever faced by humanity. Reconciling the varied and nuanced political and economic interests of all nations to facilitate a transition to decarbonized energy sources is a monumental feat. Addressing the minutia of this reality is outside the scope of this essay. Moreover, no climate policy issued by the EU could possibly serve as a panacea for climate change. Rather, as mentioned, this essay's purpose is to maximize the EU's role in providing energy security. The EU's limited competences to coordinate the bloc's foreign and economic policies dramatically narrows the avenue through which it can encourage global decarbonization.

However, these inherent limitations do not entirely inhibit the EU's ability to spur a global energy transition. As discussed in chapter 4, the EU's regulatory power derived from the "Brussels Effect" is globally encompassing. This represents the greatest opportunity for the EU to broadly limit climate change and thus ensure energy security. Indeed, the bloc's history of externalizing environmental and energy policy provides salient context for the limitations and nuance of the "Brussels Effect" with regards to climate policy. Specifically, REACH and RoHS serve as effective templates for the EU in crafting climate regulatory policy designed to be externalized. Importantly, the legal mechanisms and regulatory approaches of these policies are generally suitable for the EU's internationally targeted climate policy.

The EU should seek to model its internationally targeted climate policy based on key elements of REACH and RoHS. As mentioned, these regulatory measures serve as prime examples of the "Brussels Effect," as both were widely emulated internationally following their promulgation in the EU. Indeed, these policies have functionally set the global market standard for chemical and electrical hazardous substance regulation. This was largely enabled due to the regulatory approach of these policies. As mentioned in chapter 4, the inelasticity and non-divisibility of regulatory targets are an imperative for the materialization of the “Brussels Effect.” Critically, REACH and RoHS largely cover firms who operate under such economic constraints.

REACH and RoHS simply prohibit various dangerous chemicals and hazardous solid materials from entering the EU’s single market. This regulatory approach capitalizes on the relative inelasticity of producers and importers, as covered entities have little alternative but to provide their goods to the EU’s lucrative market. Moreover, most covered firms rely on heavily integrated and efficient global operations to provide their goods to the EU. This non-divisibility forced major producers globally to alter their production processes in compliance with REACH and RoHS. This approach, irrespective of original intention, serves as an exemplary template for EU policy designed to be externalized.

With regards to EU climate policy, critical facets of REACH and RoHS should be emulated to ensure its externalization. Key regulatory mechanisms employed by these policies capitalized on the inelasticity of non-divisibility of covered entities. Specifically, both policies simply rely upon required reporting in conjunction with industry selective regulation. Each of these provides the EU with an array of advantages as a regulator. Moreover, they enabled the globalization of REACH and RoHS without substantial international and private-sector resistance. As such, these approaches should be employed by the EU through novel climate regulatory policy.

Both REACH and RoHS place the onus of ensuring regulatory compliance on producers. Specifically, these directives both mandate that regulated entities independently certify their compliance with these directives. This is largely done through compulsory compliance documentation submitted to relevant executive agencies of the EU (namely the ECHA). While the EU often independently audits and monitors firms in case of undetected violations, the burden of proof for regulatory conformity is largely placed upon producers and importers. This system has proven to be an efficient means of regulation. Alternative policies employing a proactive command and control regulatory system incur greater fiscal and bureaucratic burdens on regulators. Such a system would be untenable for the EU, especially given the scope of these policies and the aforementioned fiscal limitations of the EU. As such, in formulating energy policy designed to be externalized, the EU should employ a similar required reporting system.

Evidently, the aim of REACH and RoHS is to limit, or entirely prohibit, the presence of dangerous substances in products sold within the EU. In doing so, the EU benefits from regulating a relatively narrow list of covered industries. As mentioned, RoHS' regulation of electric and electronic equipment covers few select industries. Moreover, while generally more extensive in coverage, REACH requirements primarily concern chemical producers and importers. This arrangement was intentional, as tailored regulatory specification was employed in crafting these policies. Specifically, such specification allowed for both REACH and RoHS to regulate substances that were largely economically uncomplicated to replace. As such, this arrangement minimally disrupted the business outlook of effected industries. Importantly, this allowed for the broad externalization of these policies without significant resistance from the international community and private entities.

EU climate policy should largely be modeled with these key regulatory advantages of REACH and RoHS in mind. Broadly, this EU Carbon Regulation Directive must prohibit scope 3 GHG emissions—GHGs generated from travel, waste, and other sources from across a firm's value-chain—above predetermined thresholds for individual products sold in the EU. Such limitations can be roughly derived from the aggregated data of expected GHG emissions reductions from covered industries. Specifically, in a given year, differing sectors should be prescribed a legally permitted scope 3 GHG emission ceiling. From here, self-reported data from covered firms concerning the gross number, and carbon-intensiveness, of their products sold in the EU can be collected. Through these metrics, the EU can set regulatory standards for permissible levels of carbon emissions associated with the production of the various goods provided in the EU.

Importantly, these limitations on carbon emissions must be generally synced with necessary GHG emission reductions to adequately stem climate change. This would entail a gradual decline in the amount of associated GHG emissions permitted in products sold in the EU over time. Moreover, covered entities must ultimately be responsible for collecting and reporting such data accurately. This baseline policy will serve to externalize the EU's climate goals. However, this plan alone is insufficient in this aim.

Importantly, there are certain necessary caveats to maximize this policy's ability to be effectively externalized. Specifically, this would entail the EU employing a sectoral approach to regulating carbon emissions. Certain industries, such as electricity generation and certain forms of transportation, have viable alternatives to established fossil fuel technologies. However, there are currently few substitutes for hydrocarbons in sectors such as aviation. Indeed, the immense resistance to the EU Aviation Directive previously discussed was largely due to this reality. As such, the EU Carbon Regulation Directive should be tailored to the economic realities of covered industries. Functionally, this means providing more stringent emission reduction standards to firms in more favorable economic positions to decarbonize and vice versa. However, importantly, all sectors must ultimately be subject to the eventual expectation of carbon-neutrality by 2050. Yet, the timelines for emissions reductions should vary on a sectoral basis.

Further exemptions must be carved out for small firms covered by this policy. Collecting data for scope 3 emissions is often economically burdensome for smaller firms. This is largely because firms often have to hire pricey consultants to accurately estimate scope 3 emissions. While this presents little difficulty for large internationally operated firms, smaller entities can often be overly burdened from such data collection. As such, small-sized firms should only be required to report their scope 2 emissions.

Obviously, the EU Carbon Regulation Directive would greatly benefit from further specification and nuance. The future efficacy of this policy will largely depend on an innumerable number of legal and political technicalities. In crafting such a monumentally important policy, every detail is critical. However, this broad policy recommendation detailed above should provide a substantive foundation for future EU climate regulations. This is imperative for the EU to finally achieve energy security. Externalizing the relatively aggressive GHG emission reduction standards of the EU through the "Brussels Effect" will massively limit the threat of climate change in Europe. This reality has grown ever more apparent in Brussels. Importantly, the impetus for the EU to act as a global leader in divesting from hydrocarbons has recently surged.

Critically, the EU has already recognized the vitality of the "Brussels Effect" in abating climate change. As mentioned, CBAM has the potential to serve as a catalyst for a global energy transition. The stated goal of this facet of the ETS is to prevent "carbon leakage" and to ensure EU firms are competitive with their global peers. Indeed, by mandating firms who provide goods and services in the EU partake in the ETS, irrespective of their established location, the EU hopes to establish a global “cap” on covered industry GHG emissions. As such, the externalization of the ETS is the primary goal of CBAM.

This globalization of EU climate policy may at first appear to be structurally distinct from REACH and RoHS. CBAM requires covered firms to partake in a carbon emission cap-and-trade program, whereas the latter policies simply prohibit dangerous substances in certain quantities. Some may argue that this technical difference will inhibit the EU’s ambition of entrenching ETS carbon standards on a global scale. However, CBAM relies on mechanisms that functionally share some similarities to the potential EU Carbon Regulation Directive. CBAM does not expressly prohibit associated carbon emissions from products. However, by setting and subsequently lowering the carbon emissions cap, CBAM effectively prohibits such excess emissions from covered industries. This program regulates GHG emissions on a broader scale than the EU Carbon Regulation Directive. Yet, these differing approaches to decarbonization may ultimately be interpreted by effected firms in the same way, so long as the product-based standards roughly equate to the emissions cap of CBAM. However, CBAM’s limited sectoral reach will ultimately limit its efficacy in spurring global climate action. As such, the EU may at least benefit from launching the EU Carbon Regulation Directive as a broader companion program to CBAM.

The EU’s potential phase-out of fossil fuel powered vehicles serves as another example of recent EU attempts to externalize the bloc’s climate standards. The details of this policy are in flux as of the writing of this essay. However, if passed, this policy will broadly ban the sale of gas-powered non-commercial automobiles by 2035. Such a policy serves as an exemplary template for the EU Carbon Regulation Directive. As alluded to in chapter 3, EVs have recently plummeted in price and are likely to surge in market prevalence. Indeed, lithium-ion batteries serve as viable alternatives to the incumbent internal combustion engine. As such, the clearly promulgated ban on the latter by 2035 provides the industry with ample leeway to decarbonize. Moreover, this policy capitalizes on the "Brussels Effect" effectively. The EU's status as the third largest market for cars globally compounded with the inelastic and non-divisible nature of car manufacturing enables such. Other products, such as heating systems, could largely be regulated in a similar manner. However, further specification concerning intermediate carbon-intensity may be useful for other technologies.

The EU's regulatory influence must be central in crafting future climate policy for the bloc. The EU's propensity for entrenching its regulatory standards globally presents a unique opportunity to spearhead significant climate action. While the future of climate change is indeterminate, the EU must maximize its immense, and often overlooked, economic power to limit the anthropogenic warming of Earth. The broad policy structures provided above will be impactful in this aim. If implemented, the EU Carbon Regulation Directive could prove to be the most significant step the EU has taken to ensuring its own energy security.

Author's Note

Through this essay, I have attempted to highlight the immense challenges the EU is currently facing due to its dependence on hydrocarbons. As OPEC and oil multinationals rake in record profits due to their own supply limitations, citizens of the EU have been squeezed by the broader inflation this generates. This was further compounded when Russia's irredentist foreign policy came to the fore, and massively disrupted hydrocarbon supplies in the EU. On top of this, climate change poses the most daunting challenge to the world's reliance on fossil fuels.

Despite these challenges, I believe the EU can emerge from its current energy crisis with an exemplary energy model. Divesting from hydrocarbons and establishing renewables as the foundation of the EU's energy model will allow for such. Moreover, through the "Brussels Effect," the EU can encourage similar energy policies abroad. In doing so, the EU will leverage its institutional and economic powers to its fullest extent in attempting to achieve security.

I chose to write this essay following Russia's 2022 invasion of Ukraine, as the EU's economy was uniquely hampered by burgeoning energy prices. Moreover, after reading Anu Bradford's truly impressive work concerning the "Brussels Effect," I was inspired to research its implications with regards to climate and energy policy. In doing so, I realized the EU was in a truly unique position to become a paragon of renewable energy installation. As hydrocarbon prices rose, Europe has begun to address the critical flaws of its current energy model. Citizens and political institutions within the EU have begun to embrace renewable energy as a safer, cleaner, and ultimately more secure foundation for the bloc's energy model.

I was inspired by EU's unique political willingness to address climate change, even before the Russian invasion of Ukraine. Given this, I hope this essay will provide a basis for the EU to export these standards globally. The flaws of fossil fuel energy-dependence are not unique to the EU. I believe most nations globally will ultimately benefit from an upheaval of current hydrocarbon-oriented energy models. The EU as an institution is in a unique position to kickstart this necessary transition. As such, for the sake of limiting climate change to the greatest degree possible, reducing inflationary pressures associated with turbulent hydrocarbons markets, and creating energy models that are resilient to geopolitical shocks, I hope the EU adopts the policies detailed in this essay, and thus encourage a global reliance on renewable energy.

Bibliography

- Abnett, Kate, “EU Approves Effective Ban on New Fossil Fuel Cars from 2035.” *Reuters*, 2022.
- Articles 194 and 107 (2009), Treaty on the Functioning of the European Union
- Atlas Big, “World Olive Production by Country.”
- Bradford, Anu. “The Brussels Effect: How the European Union Rules the World.” Oxford University Press, 2020.
- Bloomberg, "Clean Energy has a Tipping Point, and 87 Countries have Reached it." (2022)
- Bloomberg, "Historic Drought Threatens to Cripple European Trade." by William Wilkes et al. (2022)
- Cambridge Press, "Fragile Futures: The Uncertain Economics of Disasters, Pandemics, and Climate Change" by Vito Tanzi (2021)
- Chemical Inspection Regulation Service, “REACH Restriction.”
- Climate Action Tracker, “The European Union.”
- Climate Transparency, “The G20 Transition Towards a Net-Zero Emissions Economy.” 2019
- Dascalescu, Ana, “’We Have no Choice,’ says Apple About USB-C Charging.” TechTheLead, 2022.
- Dempsey, Judy, “Gazprom Plans to Reroute Controversial European Pipeline.” The New York Times, 2007.
- Enerdata, “Natural Gas Production.”
- Enerdata, “Study on Energy Subsidies and Other Government Interventions in the European Union.” 2022
- Environmental Protection Agency of Ireland, “The EU Emissions Trading System.”
- Environmental Protection Agency of Ireland, “The EU Emissions Trading System.”
- Eurostat, The European Commission. “From Where do we Import our Energy?”
- Eurostat, The European Commission. “Where does Our Energy Come From?”
- European Chemicals Agency, “Understanding REACH.”
- European Commission, “From where do we Import our Energy?”
- European Commission, “Impacts of Climate Change on Droughts.”
- European Commission, “Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS).”
- European Council, “Where does the EU’s Gas come from?”
- European Environment Agency, “EU Emissions Trading System (ETS) Data Viewer.”
- European Environment Agency, “Extreme Sea Levels and Coastal Flooding.”
- European Environment Agency, “Total EU Greenhouse Gas Emissions, 1990-2016.”
- The European Commission, “Agricultural Production – Crops.”
- The European Commission, “Carbon Border Adjustment Mechanism.”
- The European Commission, “EU Emissions Trading System.”
- The European Commission, “Expiry of the European Coal and Steel Community (ECSC) Treaty.”

- The European Commission, “Financing REPowerEU.” 2022
- The European Commission, “Revision of Phase 4 (2021-2030).”
- The European Commission, “The European Climate Law.”
- The European Parliament News, “Fit for 55: Parliament Adopts Key Laws to Reach 2030 Climate Target.” 2023.
- The European Union, “EU Investment Support.” 2022
- The European Union, “NextGenerationEU: Make it Real.” 2022
- Eur-Lex, “Treaty establishing the European Coal and Steel Community, ECSC Treaty.”
- Florida, Richard, “The Real Powerhouses the Drive the World’s Economy.” Bloomberg, 2019.
- Food and Agriculture Organization of the United Nations, “Countries that Produce the Most Grapes.”
- Foulis, Patrick, “A Whole New Global Energy System is Emerging.” The Economist, 2022.
- Free Press, "The Prize: The Epic Quest for Oil, Money, & Power" by Daniel Yergin (1992)
- Hirs, Ed, “9,000 Permits, Windfall Profits Tax, Keystone XL, and Russian Oil.” Forbes, 2022.
- Hydrocarbons Technology, “Yamal- Europe Gas Pipeline.”
- International Civil Aviation Organization, “Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).”
- International Energy Agency, “World Energy Outlook 2022.”
- International Panel on Climate Change, “Climate Change 2014 Synthesis Report Summary for Policymakers.”
- International Renewable Energy Agency (IRENA), “Sweden Energy Profile.”
- Muller, Natalie, “Plans to Deepen Rhine River hit Resistance.” *Deutsche Welle*, 2022.
- NASA, "How Warming Water Causes Sea Level Rise."
- Organization of Petroleum Exporting Countries, "OPEC Share of Crude Oil Reserves." (2021)
- Our World in Data, "Electricity Production by Source: European Union."
- Our World in Data, "Why did Renewables Become so Cheap so Fast."
- Reuters, "Gazprom says Europe set to Struggle to Fill Gas Storage for Next Winter." (2023)
- Reuters, "TIMELINE: Gas Crisis Between Russia and Ukraine." (2009)
- Reuters, "Rhine Levels at Kaub." (2022)
- Scheltens, Liz, "How Solar Energy Got So Cheap." Vox, 2023.
- Statista, "CAPEX of Oil Supermajors Worldwide in 2021."
- Statista, "Market Shares of Electric Cars in Norway from 2009 to 2021."
- St. Martin's Press, "The Green New Deal: Why the Fossil Fuel Civilization Will Collapse by 2028 and the Bold Economic Plan to Save Life on Earth" by Jeremy Rifkin (2019)
- St. Martin's Press, "The Third Industrial Revolution: How Lateral Power is Transforming Energy, the Economy, and the World" by Jeremy Rifkin (2011)
- The Economist, "The Struggle to Put a Carbon Price on a Flight." (2022)

- The Working Group on Energy Balances, "Gross Generation of Electricity by Source in Germany 1990-2020."
- Trading Economics, "Brent Crude Oil."
- Trading Economics, "EU Natural Gas."
- Trading Economics, "European Union Crude Oil Imports from Russia."
- U.S Energy Information Administration, "Poland Primary Energy Data." 2019
- United States Department of Energy, "Wind Market Reports: 2021 Edition."
- United States Energy Information Administration, "What Countries are the Top Producers and Consumers of Oil?"
- Weisberg, Joseph. "Russia Upside Down: An Exit Strategy for the Second Cold War" *Public Affairs*, 2021.
- YCharts, "OPEC Crude Oil Production."