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EU Decarbonization under Geopolitical Pressure: Changing Paradigms and Implications for Energy and Climate Policy

Filippos Proedrou

Faculty of Business and Creative Industries, University of South Wales, Newport NP20 2BP, UK; filippos.proedrou@southwales.ac.uk

Abstract: This paper aims to assess the impact of EU energy and climate policy as a response to Russia's war in Ukraine on the EU decarbonization enterprise. It showcases how the Russian invasion was a crunch point that forced the EU to abandon its liberal market dogma and embrace in practice an open strategic autonomy approach. This led to an updated energy and climate policy, with significant changes underpinning its main pillars, interdependence, diversification, and the focus of market regulation and build-up. The reversal of enforced interdependence with Russia and the legislative barrage to support and build-up a domestic clean energy market unlocks significant emission reduction potential, with measures targeting energy efficiency, solar, wind, and hydrogen development; an urban renewable revolution and electricity and carbon market reforms standing out. Such positive decarbonization effects, however, are weakened by source and fuel diversification moves that extend to coal and shale gas, especially when leading to an infrastructure build-up and locking-in gas use in the mid-term. Despite these caveats, the analysis overall vindicates the hypothesis that geopolitics constitutes a facilitator and accelerator of EU energy transition.

Keywords: Russia; Ukraine; war; markets; clean energy; solar; hydrogen; REPowerEU; European Commission; Germany

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1. Introduction

EU climate policy has been consistently internationally leading but insufficient to meet climate targets. The deepening urgency of the climate crisis has led the EU to bolster its climate policy ambitions and toolbox over the last five years and in the run up to the Russian war in Ukraine, still though at a mismatch with what is needed for the 1.5/2 global temperature increase [1]. The Russian invasion of Ukraine in early 2022 shook the energy field, removing certainties and undoing long-lasting assumptions about energy politics, policy, and security. More specifically, it undermined the liberal market dogma, pushing the EU to adopt an open strategic autonomy dogma and forcing fundamental changes in trade patterns deemed improbable for decades [2,3]. In this context, the question that naturally emerges is how the return of geopolitics to Europe and the EU decarbonization agenda are linked. More specifically, does the former enhance, upscale, and accelerate, or raise further obstacles to the latter?

Scholarly literature on energy transitions has focused on how the dominant economic/competitiveness mindset has shaped the direction and pace of the global energy transition. More specifically, it has showcased how prioritizing short-term competitiveness and efficiency is reflected on global climate negotiations and has ensured the advent of neo-liberalism in conditions of dwindling carbon budgets and sinks [4–6]. The changing geopolitical terrain, however, and renewed emphasis on geopolitics and security, create further incentives and stimuli for the global energy transition, not least by undermining the priority of competitiveness and efficiency and instead prioritizing security and

resilience [7,8]. In this changing context, Proedrou has formulated the hypothesis that a geopolitics mindset can serve as an accelerator and facilitator of the energy transition [6]. This is because energy transitions can consolidate energy security, understood as secure supply at affordable prices within a set carbon budget [9], minimizing external dependence and the associated threats and strings attached, as well as becoming operationalized to improve one's relative position vis-à-vis others both in political/diplomatic and industrial/global value chains terms, a substantive goal in a hardening geopolitical environment [6]. Proedrou applied this hypothesis to the case of Greece, demonstrating opportunities and low hanging fruits waiting to be reaped [6].

This paper aims to test this hypothesis empirically by assessing the EU energy and climate policy as a response to the war in Ukraine and more specifically its impact on decarbonization. To do so, the analysis first shows that a geopolitical paradigm indeed won over the liberal market one once the Russian army moved into Ukraine and led the EU to embrace an open strategic autonomy dogma in practice, a move breaking ground from a decade-long Russia first policy in EU energy policy despite the geopolitical risks this involved [10]. This is essential, as unless the EU indeed adopted a geopolitical paradigm, the hypothesis collapses. The paper subsequently explores in what ways the main pillars of EU energy policy, namely enforced interdependence, diversification, and the focus of market regulation and build-up, have undergone change since the Russian invasion of Ukraine. In doing so, it unpacks the impact of the updated energy and climate policy on decarbonization. On the basis of this analysis, the paper provides a first assessment of this hypothesis on a real-world case study. It needs to be noted that the analysis focuses on the impact of Russian gas substitution, as this is the cornerstone of the energy and climate impact of the war in Ukraine. It does not stretch to a discussion on the impact of the war on EU oil supply, as oil fungibility allows the operation of a global market despite heightened obstacles created by the war.

Methodologically, the paper follows the hypothetico-deductive pathway, with the return of geopolitics as a driving force of EU energy and climate policy since early 2022, the independent variable, the three pillars of EU energy policy, the mediating variables, and the impact on decarbonization, the dependent variable. The EU is chosen as a case study due to the massive impact the war had on its energy and climate policy and its colossal policy entrepreneurship to withstand and compensate for a gargantuan energy shortfall. The argument and subsequent analysis draw from and weave together international relations, EU foreign policy, energy politics and transition, and energy and climate policy literatures to construct a conceptual framework that will enable the extraction of findings relevant to the main hypothesis, thus contributing to the geopolitics–energy–climate scholarly nexus.

The paper proceeds as follows. The second section presents the main argument and develops a conceptual framework for assessment and analysis. The third section presents the updated EU energy policy across the interdependence, diversification, and market regulation and build-up pillars, and critically discusses what these mean for the EU decarbonization agenda and to what extent they enhance or impede it. The conclusions summarize the key points and the contribution of this article to the evolving geopolitics–energy–climate scholarly nexus and suggest further research pathways.

2. Materials and Methods

The market liberal dogma reflected a world where high politics was rescinding to the background, and competitiveness was emerging as the key issue in the fight against the stagflation challenging the West in the 1970s. In the International Relations discipline, this changing reality from the first decades of the Second World War was reflected in the development of the complex interdependence theory, which saw a flat world where a multitude of state and non-state actors would compete in the global arena across a number of interlinked issues, with hard security issues being of relegated importance [11]. While the theory was reformulated and updated in the 1980s in the background of (neo-)realist

critiques and in the context of the second phase of the Cold war, with neo-liberal scholars accepting the primacy of states as actors and of security as priority in some cases, the crucial aspect remained the focus on low politics, economics, and competitiveness as a key issue in the globalizing world [12–14]. The rescinding of geopolitics at the back of the end of the Cold War, the progressive creation of a globalized market, and the emergence of a new hotspot for global production (China), furthered the emphasis on economics and competitiveness vs. geopolitics, security, and resilience. Accordingly, supply chains have been crafted with an eye to ensure efficiency and competitiveness, not resilience against risks and shocks. This rationale both was grounded upon and reflected the main powers' preoccupation with increased welfare, as well as the belief that security issues and geopolitics, understood as "competition over access to strategic locations and natural resources … (encompassing) the relationships between geography, power, and international relations" [15] (p. 3518), would not stand in the way of profitable supply chains, as this would be detrimental to all parties [11,16].

While the liberal market dogma prioritizes and is underpinned by the principles of competitiveness and efficiency, the geopolitics mindset prioritizes resilience and security. Interdependence may be mutually beneficial, but more so for one party of the relationship, than for the other. Interestingly, relative gains matter because the party that benefits more can direct these resources against the other party of the interdependent relationship. Parties also systematically endeavor to use the leverage that emanates from this interdependent relationship to extract further benefits and concessions. Weaponized interdependence thus undermines the key goals of security and resilience, and is to be avoided [6–8,16].

Since its inception, the EU has been at the forefront in embodying the liberal market approach. Itself averse to deal with high politics, the EU immersed in market building both domestically as well as externally in its periphery, and with trade agreements with partners further afield [3,17]. This dogma prioritized competitiveness and efficiency and guided the Union's energy policy accordingly. More specifically, enforced interdependence with the most efficient energy partner (Russia) became a central element of EU energy architecture. The deepening gas partnership with Russia, in terms of infrastructure, contracts and associated regulatory framework, was premised upon the belief that the economy comes first, and that high politics would not interfere with trade structures [10]. The Eurasian gas market has been in compliance with this overall picture for decades. Even when political clouds were gathering, after the successive Ukrainian gas transit crises of 2006 and 2009, the Ukrainian revolution of 2013, the Russian annexation of Crimea in 2014, and the low scale hybrid warfare simmering underneath ever since, energy interdependence and cooperation continued apace, with both contractual transactions being on the increase, and new infrastructure negotiated and implemented (Nord Stream I and II) [9,18]. Competitiveness and efficiency concerns remained key goals for the EU.

At the same time, source diversification from Russia to reduce dependence was a centerpiece of EU rhetoric. In practice, though, diversification remained very limited to increased supplies from the other two main gas exporters (Norway and Algeria), depending on gas availability on their side. A fourth corridor from Azerbaijan opened up, although contributing only small quantities below 5% of EU overall gas imports. Further diversification schemes, like the EastMed pipeline, were shelved, and LNG imports remained low, in light of the increased costs compared to other sources of gas imports. Overall, hence, diversification, although widely promoted by the EU, did not alter the grain of EU energy policy [9,17,18].

Third, the focus of EU market regulation and build-up was on external energy governance with gas at the center of policy entrepreneurship. The emphasis was on the promotion and support of investment schemes via the nomination of projects of common interest, on funding tools and on internal market measures to withstand monopolistic practices and effects. The unbundling regulation and its interpretation and application to the German–Russian gas pipelines Nord Stream I and II have stood out as the thorniest issues [9,17,18].

The Russian attack on Ukraine, however, rendered the continuation of business as usual impossible, and removed any pretenses that trade patterns could be maintained under these circumstances. Competitiveness and efficiency ceased to be the main game in town, as the trade patterns that ensured them also threatened the vital goals of security and resilience. Interdependence was no longer viewed as mutually beneficial, but as weaponized and impossible among rival geopolitical aspirations. Figure 1 below captures the root causes of insufficient decarbonization before the war in Ukraine and links up the dogma and principles guiding EU energy and climate policy with its effects on decarbonization.

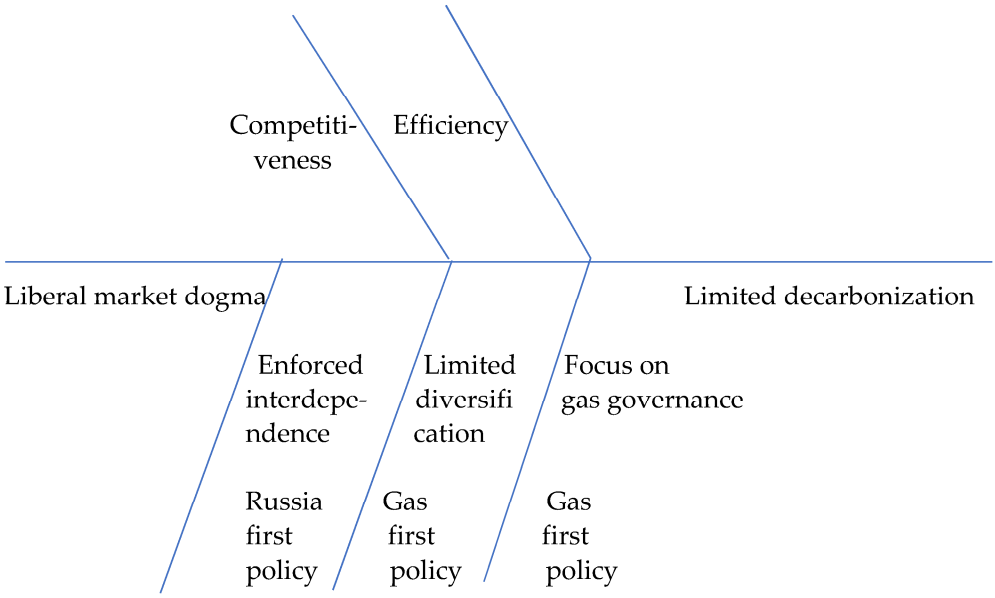

Figure 1. Limits to EU decarbonization enterprise under the liberal market dogma.

This return of geopolitics has led the EU to embrace the open strategic autonomy dogma in practice, so that dependence on unreliable partners is gradually terminated and does not threaten vital EU interests. While the EU formulated its strategic autonomy dogma as early as a decade ago, this has only been diffused to virtually all policy areas, including emphatically energy security and policy, from last year. Strategic autonomy as a concept draws from a hardening geopolitical environment in the early 21st century, in which limits to partnerships became evident, and comes down to the EU capacity to act autonomously across critical policy sectors, free from dependencies on third countries [19]. Open strategic autonomy differentiates slightly from the strategic autonomy dogma, in the sense that market principles are still important, and partnerships are sought out, but with an emphasis to secure EU supply and strengthen the EU ability to achieve its main global goals. Open strategic autonomy refers to "the capacity for Europe to act autonomously to safeguard its interests, uphold its values and way of life, and help shape the global future" [3]. To put it differently, the open strategic dogma embraces the principles of competitiveness and efficiency to the extent that they do not undermine the central goals of security and resilience. This dogma builds upon the development of the EU as a catalytic state [20] and a regulatory power [21] to maximize its potential, while ensuring the EU does not develop into a fully interventionist actor [2]. This dogma clearly echoes the strings attached that went hand in hand with EU dependence on Russian gas and reflects the EU's will in principle to break free. Before the war in Ukraine, however, jargon dwarfed deeds. EU energy policy continued to be premised upon the liberal market dogma, in the sense that economically efficient and competitive arrangements, as shown above, remained in place despite geopolitical risks and the limits they placed on EU capacity to act autonomously. Embracing the open strategic autonomy dogma would

amount to significantly lessening dependence on Russian gas to increase EU capacity to act autonomously, a development enacted only under the fierce geopolitical pressure the Russian invasion generated. The open strategic autonomy dogma promotes autonomous action and resilient supply chains, as opposed to efficient ones carrying geopolitical risks, and prioritizes security to competitiveness [2,16]. In this context, (energy) security is primed and not to be outsourced to external actors; trade partnerships can be considered secure only when they involve non-rival partners. In other words, open strategic autonomy emerges as the response to weaponized interdependence [16].

In this changing geopolitical context, EU energy policy has been reformulated radically. The cornerstone of EU energy policy architecture, enforced interdependence with the main gas supplier, has been removed, essentially tearing up the EU–Russia gas partnership. This move necessitated an extensive pursuit of source diversification, that included a host of exporters despite gas deliveries at much higher prices. Third, it also spearheaded a barrage of legislative entrepreneurship to build up and upscale at record times different aspects of the EU clean energy market, including solar, wind, energy efficiency, and hydrogen. This amounts to an extensive fuel diversification effort, to compensate for the massive amounts of Russian gas that have been removed from the EU market. Table 1 presents these changes and how they have been informed by a changing overall paradigm with different underlying principles and goals.

Table 1. EU energy and climate policy pre- and post-Russian invasion of Ukraine and its impact on decarbonization (Source: Author's table).

Ideal Type of Energy Policy	Underlying Principles	Pillars of Energy Policy	Application of Energy Policies	Climate Implications
Energy policy under the liberal market dogma	Efficiency Competitiveness	Enforced interdependence	Enforced interdependence with geopolitically problematic partners (primarily Russia)	Locked-in gas use Missed opportunity to lower emissions
		Diversification	Limited diversification due to less efficient alternatives	No/marginal impact
		Focus of regulation and market build-up	External and internal gas market governance Development of domestic resources de-prioritized due to higher costs (renewables, efficiency)	Locked-in gas use Missed opportunity to lower emissions
Energy policy under the open strategic autonomy dogma	Resilience Security	Enforced interdependence	Reversal of enforced interdependence with problematic partners geopolitically (Russia)	Lower emissions
		Diversification (source) Diversification (fuel)	Fostering new partnerships with emphasis on resilience and no-strings attached (Norway, US, Algeria, Qatar etc.) Return to coal Build-up of clean energy markets	Variable impact Higher emissions from shale gas Higher emissions Significantly lower emissions
		Focus of regulation and market build-up	Build-up and regulation of internal clean energy market (renewables, hydrogen) External partnerships across the clean energy chain	Significantly lower emissions Significantly lower emissions

The next section presents how the three pillars of EU energy and climate policy have evolved since the war in Ukraine, unpacking the many initiatives the EU has taken with respect to each of them. The paper collected data through research on EU policy documents, peer-reviewed research articles on EU energy and climate policy since the Russian invasion of Ukraine, as well as gray literature, including articles from reputable newspapers and news agencies. The latter was essential due to the ongoing nature of policy entrepreneurship in light of the continuing war in Ukraine. The discussion that follows enables the assessment of the impact of these energy policy schemes on EU decarbonization and how far they facilitate a deeper and faster energy transition for the EU.

3. Results and Discussion

3.1. Reversal of Enforced Interdependence

In 2021, Russian gas exports to the EU amounted to 155 billion cubic meters (bcm) [22]. The EU aims to displace around two thirds of those within a year, with the rest following over the course of the next four years. This constitutes a groundbreaking move, essentially signaling the light for a full rupture with Russia in the gas sector. It is exactly the reversal of enforced interdependence that creates a huge lacuna in EU energy supply and gives rise to a plethora of diversification and market build-up initiatives to compensate for the Russian gas quantities in record times.

At the same time, this reversal has broader energy and climate implications for the EU, as it dislocates path-dependencies arising from the close EU–Russia gas trade partnership. With the most important gas supplier in the margins of the EU market, the future of gas in the EU market becomes more uncertain, with dynamics built up for its potentially smoother and earlier phase-out. As Kacper Szulecki puts it "the Commission's REPowerEU strategy busts the idea of gas as a transition fuel—and casts it in the role of a political and environmental problem, of which Europe must rid itself sooner rather than later" [23].

Second, in the years preceding the war in Ukraine, EU and Russia had kickstarted cooperation for the development of a hydrogen market. Germany was a staunch supporter of this scheme on the premise of the shared gas pipeline infrastructure and bilateral industrial cooperation, although Russia's potential as a producer of hydrogen was limited to the generation of non-green hydrogen in the near to mid-term [24]. While such a scenario could have helped the build-up of a hydrogen market, it would also have locked-in non-green hydrogen in the EU market, thus compromising decarbonization ambitions emanating from hydrogen use.

3.2. Diversification

Out of the around 100 bcm of Russian gas that are to be removed from the EU market within a year, the EU aims to compensate for 63.5 bcm through alternative gas imports [22]. While source diversification has been a constant in EU energy policy, rhetoric always dwarfed actual diversification with only slight addition of gas imports from non-Russian sources that hardly reduced the weight of Russia in the EU gas market [9]. At this critical juncture, though, and with the EU determined to do away with most Russian gas imports, decisive moves were made to bolster diversification [22].

The first move in this direction was to endeavor to reap most of the low-hanging fruits. An increase of gas imports from Norway by more than 10 bcm enabled the EU to increase gas supply in a reliable and relatively efficient way [23,25]. The turn to US LNG gas has been much more problematic from a decarbonization perspective, as it involves shale gas which emits significantly higher greenhouse gases compared to conventional natural gas [26]. Again, however, this move has been in line with the primacy of resilience and security. New contracts with exporters such as Qatar, Algeria, and Azerbaijan, on the other hand, reproduce the logic of the gas trade prior to the war eruption and create new dependencies exactly when the old ones on Russia are dying, thus sitting at odds with the EU open strategic autonomy dogma [27]. Critically, these agreements involve expensive

infrastructure measures, such as regasification terminals. Germany's diplomacy with Qatar is a good case in point. Germany signed the first long-term contract with Qatar after the Russian invasion that ensures gas supply up to 2041 [28]. Germany is also spending USD 3 bn to build floating LNG terminals to enhance the inflow of gas. Worryingly, the EU commits via its REPowerEU plan EUR 10 billion (bn) to gas projects of common interest and plans to invest in thirty gas projects [29]. Moreover, it has included gas in its green taxonomy, thus lowering the bar for what can be understood as green, and essentially switching on the green light for deals with gas exporters as a policy in line with its climate agenda, rather than at odds with it [29]. The EU has also created a joint purchasing platform to coordinate gas purchases for the bloc [2], a measure on the table for years but resisted by the Commission and many member-states consistently beforehand [17]. To add insult to injury, Hungary has agreed a new gas supply contract with Gazprom. To the extent that these measures span only a few years, their climate effects are controllable. However, sinking these investments now and cancelling them out before the end of the decade defies economic logic, and hence the risk of "embedding gas use medium-term and locking investment into new infrastructures thereby underpinning gas usage" is very real, while also leading "to more stranded carbon assets" [29] (p. 4). Some evidence from the other side of the Atlantic, nevertheless, points to the EU's reluctance to engage in long-term trade deals with US partners, exactly to avoid gas use very close to net zero dates [30].

Source diversification, however, constitutes only half the picture. Fuel diversification, switching away from gas to other fuels, is equally important. The return to coal in the aftermath of the Russian invasion of Ukraine has been the first step in this direction, with obvious effects that undermine EU decarbonization goals. More specifically, coal generation has been on the rise in the post-Covid era despite pledges for the partial phase out of fossil fuels just before Covid-19 broke out. This trend has been furthered with Russia's invasion of Ukraine, with the Czech Republic replacing many of its Russian gas imports with domestic coal and considering moving the coal phase-out date well into the 2030s. Germany, Austria and the Netherlands also lifted restrictions on coal-fired power generation as an emergency measure in the wake of the Russian invasion, although they did not move their phase-out target dates. These moves have been anticipated at the crunch point of dwindling Russian gas imports. Nevertheless, their effects are expected to be mediocre, last little, and be cancelled out by the triple effect of substantially increased renewable energy availability, a reformed carbon market, and increasing coal prices connected with Russian supplies [29].

On the other hand, the harnessing of clean energy fuels, such as electricity via solar and wind power, hydrogen and bio-methane, both domestically and in partnership with third countries across the clean energy value chain, constitutes an even more important pillar of fuel diversification. For this to come to fruition, however, significant entrepreneurship is needed in terms of market regulation and build-up, and it is these aspects the next sub-section turns to examine.

3.3. Changing Focus on Market Regulation and Build-Up

The EU aims to substitute 38 bcm of Russian gas by means of energy savings and efficiency and clean energy production [22]. In the wake of the war in Ukraine, the EU has produced an unprecedented volume of legislation to make up for this gargantuan shortfall of Russian gas imports. The cornerstone of this effort has been the REPowerEU plan that reshuffles the EU energy market, upscales support for energy efficiency and clean energy, and sets out a plan for the development of the hydrogen market. Side by side with this master plan lie initiatives to step up reform of the EU carbon market to increase the remit of carbon price and incentives, and of the electricity market model to lessen the criticality of natural gas in the final electricity prices.

First, as in all crises, the significance of energy efficiency and demand side measures become elevated. This is because:

> The cheapest energy is the energy you do not use … Avoided demand and energy efficiency measures are not only the most cost-effective measures, but also the most sustainable, secure, and the most immediately actionable response available … Lowering demand will immediately be reflected in lower payments, lower overall market prices, an easing of pressure on availability concerns during the gas filling season, and ultimately lower emissions from a reduction in the combustion of fossil fuels [31].

In this context, the Fit for 55 Package has been amended very quickly to feature an increase of ambition from 9% to 13% for energy efficiency targets. Germany leads the effort by having committed EUR 56.3 bn to bolster energy efficiency retrofits up to 2026. EU legislation has also been brought forward to ensure minimum energy performance standards for buildings. The decision to channel profits from the EU carbon market to the energy efficiency enterprise promises to strengthen energy efficiency gains. The 'EU Save Energy' strategy prioritized a short-term 5% reduction in gas and oil use emanating from behavioral change (such as lowering the thermostat and avoiding excessive and unnecessary energy use). Member-states have also agreed (with the exception of Hungary) to reduce gas demand by 15%, retaining flexibility on how to achieve the target [29,32].

Second, goals for clean energy development have seen a substantial boom since the war in Ukraine. More specifically, renewable energy development has been recognized as an overriding public interest. Accordingly, the target for renewable energy production has been increased from 40% in the EU energy mix (in the Fit for 55 Package) to 45% in the REPowerEU plan by 2030 [32]. The goal for solar energy has been doubled for as soon as 2025. Delivery on these targets will be facilitated by streamlined permitting regulations and a further investment of EUR 29 bn in electricity projects of common interest, such as cross-border interconnected grid infrastructure. EU institutions and member-states have committed gargantuan public funds to support the rapid uptake of clean energy development as alternatives to gas and oil imports [29]. The REPowerEU plan will make available overall EUR 210 bn to finance renewable energy development. Germany committed more than EUR 200 bn to this aim, closely followed by France [2]. Germany aims to cover 80% of its power generation through renewables, and has committed to 100% renewable electricity by 2035, thus cutting gas imports and coal use. The Netherlands and Italy are prioritizing significant increases of offshore wind capacity by 2030, while Belgium, Denmark, Sweden, and Germany will cooperate in the North Sea to produce substantive amounts of wind energy [29]. This legislative and policy-making entrepreneurship has been followed by record electricity amounts generated by renewable energy sources in several EU member-states during autumn 2022, alleviating some of the pressure on energy demand.

Furthermore, the role of Norway in the upscaling of the EU clean energy market is central. The EU signed a comprehensive energy agreement with Norway just before the Russian invasion that creates the framework for advanced bilateral energy cooperation. The urgency of the energy crisis is expected to accelerate energy cooperation to utilize Norway's potential to serve as the European grid's battery, facilitating the stability of the electricity network with its back-up capacity and yielding higher electricity and hydrogen exports to the EU [23].

Very interestingly, France appears to be at the forefront of a highly promising urban renewable revolution through legislation that mandates all car parks with more than 80 spaces to be covered over by solar panels [33]. This move follows the same logic as the measure enshrined in the EU REPowerEU to make the installation of rooftop solar panels mandatory for all new buildings [34]. The exploitation of variable surfaces to accommodate renewable energy production carries immense potential and can herald not only a substantive increase of available energy, but also different business models and a democratization of energy production, consumption and use that can enhance and consolidate energy security [9]. These moves further qualify the point that Kuzemko et al. made in terms of their assessment of EU energy and climate response to the war in Ukraine [29]. While they are right that "the need to act with urgency to solve a crisis can privilege

centralised, top-down, responses" with governments turning "to large-scale energy providers for assistance because they tend to have the resources to act quickly and because part of that which is being secured, i.e., energy supply, is delivered by them" [29] (pp. 2–3), the current energy crisis requires such an influx of energy that creates demand for the promotion of further opportunities and exploitation of bottom-up dynamics as well. Finally, the REPowerEU plan envisages a more than ten-fold increase in the production of bio-methane by 2030 [34].

The reshuffling of energy source development maps onto fuel end-use changes. The EU agreement to phase out internal combustion engine vehicles by 2035 is ground-breaking, as it will lead to phenomenal decreases in fossil fuel use and, in so doing, create massive demand for renewable energy to feed into a much more developed power network that will increasingly support the transport sector. Residential retrofitting will also decrease demand for gas, while a switch to heat pumps will mean that electricity (increasingly fired by renewables) will replace coal, gas (and oil) for these end-uses. Ten million new heat pumps are expected to be installed in the next five years with funds coming from the REPowerEU scheme, with many member-states doubling down on these funds with member-state level financial packages [29,34].

Third, the lacuna in the energy mix created by the decrease of Russian gas imports creates conducive ground for the development of the hydrogen market, furthering EU fuel diversification. The crisis may create exactly the demand base at scale that has been lacking to provide the necessary signals and incentives for the development of this market at scale. Side by side with solar and wind energy development, the REPowerEU plan places renewed emphasis on the development of hydrogen. The focus has largely been on the development of green hydrogen which is critical for decarbonization [35], as other types of hydrogen cannot be taxonomized as fully clean. The new 'hydrogen accelerator' plan enshrined in the REPowerEU scheme commits significant funds to the development of integrated hydrogen infrastructure, including port capacities and storage facilities, while also requiring solid partnerships with reliable partners. Germany's partnership with Australia features this priority to develop solid, geopolitical risk-free global value chains. The EU has opted for the development of three hydrogen corridors, with the one from the North Sea being politically reliable, the other two, though, from the Mediterranean and Ukraine facing political complexities and hence involving potential dependencies reminiscent of gas trade. Overall, hydrogen represents low geopolitical risk, unless emanating from non-friendly partners, or dependent on raw materials or equipment coming from such countries (e.g., electrolysers) [34].

In total, the EU's goal is the doubling of the pre-existing commitments from 5 to 10 million tons of domestically produced hydrogen, with a further 10 million being supplied externally. Adequate supply of hydrogen is critical, as it can leverage the increasing electricity production from intermittent sources, thus providing the necessary balancing of national and European power grids [29]. It is also essential for the decarbonization of hard-to-decarbonize sectors, such as the steel industry. While the war in Ukraine provides the context for a much-needed increasing demand that can bolster hydrogen production and trade, additionality criteria need to be set out, so that hydrogen and other clean energy sources do not directly compete but supplement each other [34]. The need to deepen supply chains, from the production/trade of electrolysers to agreements for securing raw materials and recycling schemes, emerges as one challenge, together with the urgent need for a trained workforce in this emerging sector [36]. Crucially, the percentage of green hydrogen within the emerging EU hydrogen market will determine how much this measure will impact on EU decarbonization.

Fourth, two further market developments merit scrutiny. The first regards the reform of the EU carbon market. The crisis in Ukraine precipitated a fast prioritization of this policy dossier, with EU member-states agreeing at the end of 2022 to step up reform of the EU carbon market. The main pillars of the reform are the increasing coverage of sectors and emissions percentage, and the abolishing of free allowances [37]. These changes will

increase the importance of carbon pricing across the market, push for further and deeper decarbonization at a faster pace, while also generating further revenues that can support the bolder climate agenda the EU has embraced, with priority given to financing energy efficiency schemes as we saw above. Second, the EU is closing in on reforming its electricity market, with the merit order system being replaced, so that the most expensive fuel contributing to the electricity mix (currently natural gas) does not define the final electricity price [38]. While this measure will undercut the influence of Russia in the EU energy market via its remaining gas imports, renewable energy generators warn that it will undercut their profits and hence price signals for further investments in renewables. Stimuli packages for renewable projects and ensured demand for electricity via switch to electricity-powered end-uses, though, warrants that sufficient incentives are in place for the renewable sector. This, together with increasing clean energy generation at small-scale in vacant spaces (car parks, rooftops, etc.) and extensive regulation mandating higher energy efficiency standards means that the decarbonization enterprise should not be threatened by the electricity market reform. On the contrary, lessening the impact that the gas price has on electricity prices will alleviate societal pressure for concessions that may threaten the disentanglement from Russian gas.

Overall, the EU's energy and climate entrepreneurship as a response to the war in Ukraine seems to vindicate the assumption that a return of geopolitics facilitates and accelerates the Union's decarbonization enterprise. While the response has included both positive and negative measures for decarbonization, the former outweigh the latter in terms of budget allocation, number and depth of policy interventions, and tools and expected impact on overall emission reduction. More specifically, the reversal of enforced interdependence with Russia casts doubt on the future of gas in the EU energy market in general, and has thwarted the potential for non-green Russian hydrogen in the EU energy mix. Source diversification has led to higher emissions due to the higher share of shale gas compared to pre-war levels, as has fuel diversification in terms of the return of coal. Both these developments, however, may turn out to be limited in terms of both time and extent, thus bearing limited unwelcome effects on the EU decarbonization enterprise. On the other hand, fuel diversification enacted by a comprehensive clean energy market and build-up unlocks substantial decarbonization potential and can lead to significantly lower overall emissions. The EU has stepped in decisively to cater for a vibrant clean energy market in the making, including the development of the hydrogen market, coupled both with supply-side and demand-side measures that warrant that the demand for clean energy will be flamboyant.

More specifically, even if LNG imports of a multitude of more than 50 bcm are materialized, and accounting for their higher emissions to the extent they also involve shale gas, close to 40 bcm of Russian gas are to be replaced with a combination of energy savings, introduction of heat pumps, rooftop solar, and large-scale deployment of wind and solar energy. On top of these, bio-methane production can replace a further 4 bcm of gas [34] and plans for the development of the hydrogen market could replace a further 27 bcm of gas, with its impact on decarbonization hinging on the primacy or not of green hydrogen promotion [22,34]. The evolution of the urban renewable revolution, the utilization of vacant surfaces and the switch to bottom-up, decentralized renewable energy generation at scale adds further immense potential either to replace the remaining Russian gas imports or to counter the need for maintained LNG imports from other gas producers in the near future. Table 2 below captures the decarbonization potential of the EU's updated energy and climate policy.

Table 2. Overall gas substitution potential emanating from the EU's updated energy and climate policy.

Initiative	Tools	Compensated Gas Quantities
Energy efficiency	Mandated demand reduction Retrofitting schemes Higher energy efficiency of new buildings Electricity market reform Carbon market reform	38 bcm
Renewable energy	Nominated as EU public interest Mandate for solar panels in rooftops, car parks and other vacant spaces Simplification of permitting processes Electricity market reform Carbon market reform	
Hydrogen	Indigenous production External partnerships	27 bcm
Bio-methane	Indigenous production	4 bcm
		69 bcm

2022 hence represents a watershed moment for EU energy and climate policy, as the ambition and policy toolbox have been scaled up significantly within record timeframes. EU energy and climate entrepreneurship since the war has led to a much more consistent agenda linking up sectors and providing a greater edge to EU policy-making and regulation. It also mirrors a different logic of energy market build-up, prioritizing spending on infrastructure and stocks rather than commodities and flows. This represents a break with the past and with the business-as-usual focus on near-term profitability and cedes renewed emphasis on the resilience of the domestic economy and on competitiveness in the medium term [31]. Such a prioritization was dismissed previously under the pressure for short-term profits and due to aversion to short-term losses implicated in market/technology shifts and alternative infrastructure build-up [39]. Russia's war in Ukraine, nevertheless, rendered these losses inescapable, thus reducing resistance to the alternative logic of energy markets build-up (infrastructure and stocks vs. commodities and flows).

The breaking point in the upscaling of climate legislation, hence, has been the Russian invasion in Ukraine. Never before has the EU endorsed so many legislative reforms within such a tight timeframe, in many cases updating goals agreed only a few years ago. The Russian invasion created a lacuna in energy needs that needed to be covered by alternative sources within record times, thus providing the stimulus for the go ahead of bold clean energy development plans. At the same time, it impressed the need for reliability, resilience, and security in the energy design on top of affordability and competitiveness concerns, essentially pushing for long-term investments that short-term profit theorizations and business-as-usual energy modelling had rendered obsolete for so long, despite the mounting climate imperative [39]. The main preoccupation with the rising geopolitical obstacles to energy security and the implications of energy supply for broader foreign policy considerations meant that the build-up of domestic supply was privileged, and external supply configurations took stock of the need to build partnerships on solid political grounds. The exception has been contracts with autocratic and potentially unreliable gas partners, which however in the current context are considered preferrable to Russia, and hence are preferred as a temporary fix. Should they be extended well into the future,

however, they will also sit at odds with and may undermine the EU's open strategic autonomy dogma and capacity for action.

4. Conclusions

This paper explored the impact of the updated EU energy and climate policy as a response to the war in Ukraine on the EU decarbonization enterprise. More specifically, it tested the hypothesis that the return of geopolitics, enshrined in the EU case in the adoption in practice of an open strategic autonomy dogma, served as an accelerator and facilitator of EU energy transition and decarbonization. It found convincing empirical evidence to back this hypothesis, although a number of caveats also need to be raised.

On the positive side, the EU has invested massive amounts of public money to generate unprecedented amounts of clean energy that will replace fossil energy use. Besides the welcome emphasis on energy efficiency and savings as the perpetual hidden fuel, the drop in gas imports, together with end-use measures, ensure demand for clean energy will remain high, thus providing the essential incentive for the continued and upscaled generation of clean energy. This also extends to the production of hydrogen and bio-methane, although the color of hydrogen and market configurations will be crucial determinants of the extent of hydrogen's contribution to decarbonization. Carbon and electricity market reforms will also ensure that the mainstay of EU climate policy remains centered around pushing carbon-intensive practices outside of the EU economy and thwarting the pressure gas prices apply on final electricity prices. In the context of the reversal of enforced interdependence with Russia, the changed focus of market regulation and build-up constitutes a far-reaching fuel diversification that upscales the EU energy transition.

On the other side, source diversification remains problematic for two reasons. First, it involves shale gas, which emits much higher emissions than conventional gas; second, it creates the dynamics for the construction of new gas infrastructure and hence reproduces the economic logic for gas use that contravenes the gist, ambition, and timeframes of EU climate policy. Such measures will neither negate nor brake the further decarbonization of the EU after the war in Ukraine, but can water down and brake deep decarbonization potential in short timeframes, especially if they compete with attempts at upscaling further clean energy generation. The return to coal, on the other hand, as another means of fuel diversification, although very real in some member-state settings, most probably will have limited impact and not last for too long.

The significance of this work lies in the weaving together of international relations, energy transition, and energy and climate policy streams of the literature. More specifically, it shows how geopolitical developments emanating from a hardening geopolitical terrain challenge established business practices and links, as well as the underlying principles of global value chains, effecting a profound overhaul of public policies to ensure security, resilience, and reliability. The impact of the war in Ukraine on EU energy and climate policy, and in particular on enforced interdependence, diversification, and the focus of market regulation and build-up pillars, constitutes a first order real world case study and a test of the hypothesis that geopolitics constitutes an accelerator and facilitator of the energy transition. The findings support this hypothesis, opening interesting avenues as to the underlying conditions that can accelerate and deepen decarbonization. Last but not least, by means of linking up the return of geopolitics with energy transitions and decarbonization, the paper draws the bigger picture of the links between open strategic autonomy and green strategic autonomy [23], conjoining EU foreign policy adolescence with the EU progressive climate agenda.

Future research is invited to assess the development of EU decarbonization under the lasting impact of the reshuffling of the EU energy and climate playbook, especially since most of the measures undertaken will show results over the following years. Moreover, research is welcome to explore in depth some of the policy initiatives unpacked in this paper, with the urban renewable revolution and decentralized, bottom-up energy

generation and the defining color of the hydrogen market (will it be green?) meriting particular attention and further research.

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