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Geopolitical and climate risks threaten financial stability and energy transitions[#]

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Abstract:

We propose a framework to unravel the hurdles and opportunities for the renewable energy transition in contemporary crises to examine the interconnections between energy transition, climate risks, and geopolitical issues. The study focuses on Germany and emphasizes that neglecting climate-related risks leads to financial instability and hampers the energy transition. If Paris-aligned energy and financial policies are not in place, further cascade (negative) effects on energy transitions may occur. Uncertainty and instability caused by geopolitical crises intensify negative feedback loops. Climate mitigation is thus critical because climate concerns affect financial stability and the orderly path of energy transitions.

Keywords: climate change, climate-related financial risks, climate policy, energy transition, financial stability, geopolitical crisis

NONMENCLATURE

Abbreviations	
IEA	International Energy Agency
GHG	Greenhouse gas emissions
ECB/ERSB	European Central Bank - European Systemic Risk Board
LNG	Liquified natural gas

1. INTRODUCTION

Climate change has significant negative consequences globally, which are expected to grow drastically in the coming years unless urgent and far-reaching actions towards a zero-emission transition are implemented [1]. Massive financial investments will be required to accelerate a zero-emissions transition. The amount of money required will arguably exceed the resources and competence of public finance alone [2].

According to the International Energy Agency (IEA) [3,4], limiting global mean temperature rise to well below 2° Celsius would necessitate an "extraordinary breadth, depth, and speed" energy transformation, as well as $3.5 trillion in renewable and sustainable energy sector investments each year until 2050, almost double the current level globally.

To achieve sustainable development and net-zero emissions in the face of the climate crisis, it is critical to integrate the economy, the energy transition, and climate change. To achieve a decarbonization commitment, 196 countries signed the "Paris Agreement" in 2015. The accord aims to keep global warming below 2° Celsius, aiming at 1.5° Celsius, over pre-industrial levels. Many countries have made deliberate efforts to restructure their energy systems to reach this goal. However, since 2011, worldwide investments in low-carbon energy supply have remained stagnant [5].

Zero-emission transition plans shape the transformation of societies and economies worldwide and require massive investments along with climate, energy and financial policies. Since the energy sector produces roughly two-thirds of global greenhouse gas emissions (GHG), a shift in the direction and scale of investments devoted to a 100% renewable energy system is required to meet the climate change mitigation goals [6]. Moreover, annual energy supply investments should increase, and expenditures should expressly aim to sustain mitigation efforts [7].

This study offers a framework to investigate the hurdles and opportunities for the renewable energy transition and proposes to examine the complex interlinkages between the climate crisis, geopolitical energy crisis, financial stability, and energy transition. We address these relations and dynamics in the hope of contributing to the energy transition debates and offering suggestions for green (climate-aligned) policy developments.

The main results of our analysis applied to Germany and are as follows. First, the transition to a 100% renewable energy system might imply risks. On the one hand, changes in the financial system can affect the zero-emission transition by promoting or hampering the transition in the energy sector. On the other hand, a zero-emission

transition requires changes in the energy system that affect the financial system.

Second, the war in Ukraine has had an unanticipated impact on the energy transition plans worldwide. The implications range from the persistence of the oil market downturn to global energy supply chain disruptions [8]. Despite these drawbacks, more people call for a faster transition to a low-carbon or zero-emission future [9,10]. The rationale is that the rising risk of investing in fossil fuels, and the peculiar advantages of renewable energy, could offer new opportunities for energy transitions if adequately managed. Paris-aligned climate policies, energy transition plans and climate-related financial regulation play a key role in this context.

The study is structured as follows. We begin in Section 2 by reviewing the main issues of the materialization of climate-related risks and how they affect financial stability and energy transitions. In Section 3, we describe the proposed framework of analysis used in our investigation and the framework we develop to disentangle the obstacles and opportunities for the energy transition in contemporary crises, such as geopolitical and ecological crises. Section 4 presents the results of our analysis applied to the German case. Finally, Section 5 offers concluding remarks.

2. BACKGROUND

Transition and physical risks are usually referred to as climate-related risks [11] and are a subcategory of sustainability risks, which include, besides the environmental risks, governance and social risks. Changes in the price of stranded assets (such as coal, oil and gas that will not be used during the fossil fuel phase-out) and economic disruptions caused by climate-related policies, technology, and preference changes during the transition to a zero-emission economy are all sources of transition risks. Damages from climate-induced extreme weather events are examples of physical risks.

Environmental, social, and governance challenges associated with sustainability risks can significantly impact the functioning of banks and the financial system as a whole [11]. Physical climate risks, such as environmental disasters, have resulted in significant losses for banks and insurers [12]. Social risks, such as protests and inequality, may persuade policymakers to promote household borrowing for consumption and might result in financial instability in the long run. The focus of the paper is on climate-related transition risks.

Financial risks from climate change are difficult to estimate, but most research points to trillion-dollar economic and financial costs. Since the 1980s, insurance losses from climate-related extreme weather events like droughts, floods, and wildfires have doubled. Asset values may not fully internalize climate risks and the shift to a zero-emission economy. Therefore, delayed awareness of these risks could result in jeopardizing financial stability. If fossil assets are effectively "unburnable," their value could plummet, and they could thus fail to generate the expected return [13]; in other words, they could become "stranded." This is problematic, as financing the energy transition is at risk in times of financial market instability [14].

The amount to which climate risks are correctly incorporated into risk-adjusted returns by financial system players, and hence the extent to which these risks are integrated into market and share prices, is crucial to the subject of stranding risk[1]. As reported by European Central Bank - European Systemic Risk Board (ECB/ERSB) [15], at the Euro Area level, exposures to physical climate hazards are concentrated at the regional level, with potential stranding risks. Instead, exposures to emissions-intensive firms are concentrated across and within economic sectors, leaving parts of the financial system vulnerable to potentially destabilizing financial market corrections.

Policymakers have various tools to implement mitigation strategies and governments are at the forefront of this effort. Because of the challenges posed by climate change to monetary policy and financial stability, central banks, financial supervisors, and regulators have begun to consider climate-related risks in their policymaking in the past decade [16,17]. Although their actions cannot replace adequate climate policy [12,18,19], they can still contribute to scale up green finance and tame climate-related financial risks, thus contributing to low-carbon transition.

Lower- and middle-income economies are typically characterized as being more exposed to physical threats and as being the most active in climate-related financial policymaking [16,20]. However, advanced economies have been engaged in climate-related financial policymaking since the early 2000s. Most emerging economies have only recently begun to engage in green financial policymaking [16]. According to D'Orazio [16], advanced economies, such as France and the United Kingdom, have mainly focused on climate-related disclosure requirements (primarily for non-financial institutions, pension funds, and insurance companies). They also use so-called "green" finance principles and guidelines aimed at aligning the financial market with climate change concerns. Furthermore, implementing these policies can

assist countries in achieving their mitigation objectives as climate-related finance strategies result in CO2 emissions reductions in G20 countries [21].

In this context, central banks' engagement can significantly impact – among others - the green bond market. Central banks can actively support the channeling of finance where it is most urgently needed to accomplish an orderly transition by issuing green bonds, which allow capital sources to be linked to renewable energy projects. Furthermore, giving incentives to reform the energy system decreases the dangers of a delayed or abrupt transition while also improving financial stability as a side effect[2].

Climate-related transition risks can also affect energy transitions; in the remainder of the paper, they are referred to as *energy transition risks*. These risks can manifest as a technological breakthrough that allows for rapid emission reduction, a change in climate policy that limits emissions or changes in expectations [22].

3. TOWARDS A FRAMEWORK TO ADDRESS RISKS TO FOSTER ENERGY TRANSITION AND TACKLE FINANCIAL INSTABILITY

3.1 Core components

We adopted the following approach to determine the factors that hamper or accelerate the energy transition in the current geopolitical environment characterized by war, rising prices, and increased climate risks.

We started by summarizing and evaluating the debate over climate risks and their implications for progress in the energy transition and financial stability (see Background section).

Second, we establish a framework to connect the four pillars of our analysis: (1) climate crisis, (2) geopolitical energy crisis, (3) energy transitions, and (4) financial stability. The framework allows us to highlight the obstacles and opportunities for the renewable energy transition in contemporary crises, such as the ongoing geopolitical and ecological crises.

Third, we apply this framework to analyze the current state of Germany's energy transition, recognizing the dangers that climate and current geopolitical challenges may pose to the energy transition and financial stability.

Fourth, recommendations for energy transitions are developed based on the identified challenges and opportunities, including strengthening climate-related and environmental financial regulations.

The aim of our proposed strategy is to disentangle the dynamics between climate and geopolitical energy challenges, financial stability, and energy transition. An overview of the micro, meso and macro components of the approach is provided in Figure 1.

Transition risks and geopolitical energy challenges affect financial institutions and energy firms on a micro level, resulting in the stranding of fossil-fuel-related assets or an increase in energy prices. Policymakers use energy, climate, and macroprudential policies to respond to current events at the macro level. On the meso level, climate risks and geopolitical energy challenges can result in lock-ins and energy market instabilities[3].

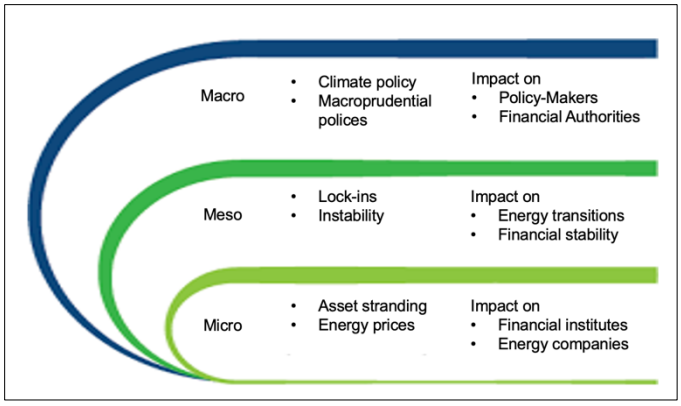

Figure 1.: Overview of the main components of the investigation approach.
Source: Authors' elaboration.

3.2 Framework development

This section presents the framework that we propose to investigate the relationship between the climate crisis, the geopolitical crisis, the energy transition, and financial stability. A graphical overview of the framework is shown in Figure 2. Four transmission channels can be identified to describe the dynamics between the climate crisis, geopolitical energy crisis, financial stability, and energy transition risks.

First, climate-related transition risk drivers, such as unanticipated changes in climate policies, technological change and consumer preferences, can materialize in the energy sector resulting in asset stranding, energy price increase or an increase in renewable technology

[2] These policies are especially important for developing countries. Green bonds can help projects with environmental benefits acquire funding at a lower cost and longer term. Furthermore, given the recent growth of green bonds as internationally accepted financing instruments with strong and well-known transparency and assurance measures, these instruments could effectively channel private capital (especially from foreign investors in developed countries) toward energy transition in developing country economies.

[3] While the three-level considerations were not meant to be exhaustive, they serve as the foundation for our framework and are offered to raise awareness of the perspective that we employed in our study.

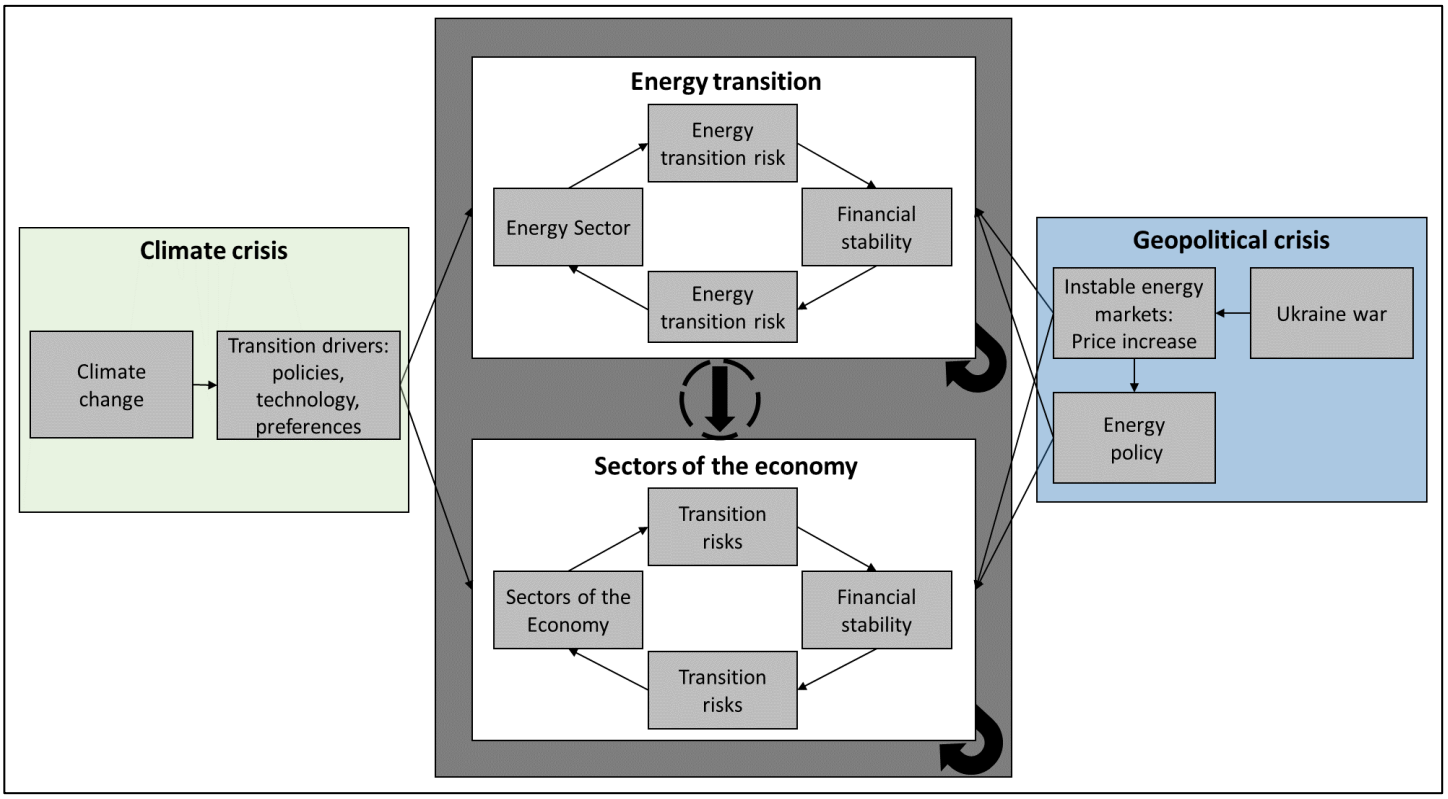

Figure 2.: The proposed framework.
Source: Authors' elaboration.

investment needs. The implications of corporate asset depreciation and profitability decline are financial or credit-market losses and market liquidity risks. Financial stability could be jeopardized, and a financial crisis could occur depending on the size and timing of the risk. All economic sectors are affected by this transmission channel. However, depending on a country's economic structure and financial system's sectoral exposure, the energy industry and other GHG emissions-intensive industries may play a significant role in this framework.

Second, a lack of Paris-aligned financial policies, such as those addressing climate-related risks and boosting green financing, can jeopardize the zero-emission transition and exacerbate transition risks. Massive investments are required across all economic sectors to enable the zero-emission transition, particularly in the energy sector. If financial instability arises, resulting in a financial crisis, the zero-emission transition may become difficult to finance due to a shift in attention away from climate risks. Furthermore, if climate-induced financial instability manifests, the financial sector may be unprepared for a macroprudential response. As a result, a more cautious strategy is recommended, which includes embedding climate risks in both micro and macro-prudential settings.

Third, as many countries seek to reduce their reliance on energy imports from Russia and diversify their energy imports, the Ukraine war raises energy markets' instability, which manifests as rising prices and fluctuating supplies. The fiscal and energy policies implemented in this framework might put the energy transition at risk and contradict prior climate policies.

Fourth, energy transition risks resulting from climate-related transition risks such as asset stranding (channel 1), financial instability (channel 2), and fossil-based policies as a response to the Ukraine war (channel 3) have further reinforcing effects. Due to sector interlinkages, the spillover effect further influences other sectors' efforts for decarbonization enforcing transition risks. Especially hard-to-abate sectors, such as the steel or cement industry, are affected.

The spillover effects mentioned above and enforcing effects between the climate crisis**,** financial stability, and energy transition risks highlight the significance of taking the *whole picture* into account. Climate mitigation and the energy transition may be jeopardized if policies focused on restoring financial stability and mitigating the negative economic repercussions of the geopolitical crisis outweigh previously established climate policies. As a result, regulations and policies that postpone climate change mitigation will not promote financial stability. Climate mitigation and the energy transition are critical for resolving financial instability, climate change, and geopolitical crises**.**

4. ANALYSIS

In this section, we apply the proposed framework to the case of Germany and focus on two of the four channels exemplarily (transmission channel 1 and 4). Additionally, we discuss macroprudential and energy policies that are introduced and affect the respective transmission channel.

4.1 Transmission of risks to the financial system

Concerning transmission channel 1 - which describes the effect of climate-related energy transition risks on the financial system - recent empirical research shows that German banks are susceptible to transition risks. This research is based on sectoral and aggregate bank data and GHG emissions data [23]. The German financial sector is found to have significant exposure to climate transition risks. The exposure is calculated as 19.4 percent (Carbon Critical Sectors), 32.56 percent (Loan Carbon Intensity), and 25.17 percent (Climate Policy Relevant Sectors) of the total loan volume, depending on the estimation technique utilized. Moreover, the highest exposures are recorded for the manufacturing, energy, and transportation sectors[4]. This evidence emphasizes the need of considering potential financial stability implications while setting a roadmap for renewable energy policy and fossil-fuel-dependent exit methods, as well as international cooperation.

The energy sector is especially affected by climate-related transition risks and related (future) policies. This is because, since 1990, the energy sector has accounted for the highest share of emissions [24]. Additionally, Germany's new Climate protection law requires CO2 neutrality by 2045 and a GHG emissions reduction by 65% by 2030 compared to 1990 levels, which also affects the energy sector [25]. Despite the considerable increase in renewable energy investments in recent decades and the progressive reduction of GHG emissions, the country is having difficulty attaining the required targets [26]. Germany's *Energiewende* program aims at a 100% renewable energy system and is dedicated to a sustainable energy transition to meet climate change mitigation goals. After embarking on energy policy paths other than nuclear power, the government has steadily gained international recognition for its leadership in the energy transition [27]. Considering the remaining national emissions budget [28], it is argued that a phase-out of coal should be completed by 2030 [29] and emphasized the need to phase out fossil natural gas [30] by 2038 at the latest [31].

The stranding of fossil-based assets represents a key energy transition risk [32] and, thus, a major challenge for energy transitions [33]. On a global scale, up to 50% of fossil fuel assets might strand in a net-zero scenario by 2026 [34]. However, since research on calculating energy assets stranding is still in its infancy [35], there is hardly any calculation in the German case. Especially coal and gas assets could be affected; it has been calculated that $400 Billion in coal and gas capacities might strand by 2040 ($90 Billion by 2030) [10]. Breitenstein et al. [36] estimate a stranded asset value related to phase-out coal by 2038 of €0.4 billion. A phase-out by 2030 might lead to asset stranding of €14.7 billion. Kemfert et al. [37] identify investments in the expansion of natural gas infrastructure as a threat to the energy transition, as leakages and the climate impact of natural gas are underestimated and purely considered. Investments imply fossil-related lock-ins and economic risks hindering climate goals. Also, investments in repurposing the natural gas grid for future admixture of (blue) hydrogen might imply similar risks [38].

This is problematic because Germany's natural gas investment plans are the second highest in the EU [39]. The investments and related risk might increase as Germany, as a reaction to the geopolitical energy crisis, is now allowed by a new law to build 11 Liquified Natural Gas (LNG) terminals under fast permission to import fossil natural gas until 2043 to reduce energy dependencies from Russia [40].

The extent and scope of the described transition risks on financial stability also depend on existing macroprudential policies. However, analyzing the inclusion of ESG perspectives in the existing micro and macro-prudential frameworks, we argue that they do not adequately consider climate risks, nor do they handle crucial aspects of climate risks, namely, the cross-sectorial, global, and systemic dimensions [41]. This is true for both the national and the supra-national regulations, as Germany is a member of the Basel Agreements. Current debates highlight that Basel III is still far from adequately including climate risks in its three Pillar structure, thus causing concerns for climate-induced financial instability [20].

Focusing on the engagement at the national level, we observe that Germany has followed the same path as other advanced economies implementing mainly soft climate-related and environmental financial measures in the past decade. As reported in Figure 3, these measures go in the right direction since they help create favorable conditions for green finance to spread, but they do not immediately address climate risks.

Year of adoption	Instrument	Name of the Law/Regulation	Authority responsible	Classification for bindingness
2011	Green finance guidelines	German Sustainability Code	German Council for Sustainable Development	Mandatory
2015	Disclosure requirements for non-financial institutions	Supervision of insurance undertakings requires pension funds to report on Ethical, Social, and Ecological considerations	Bafin	Mandatory
2016	Disclosure requirements for non-financial institutions	Amendment to the German Commercial Code (Section 289b)	German Federal Government	Mandatory
2019	Green finance guidelines	BaFin Guidance Notice on dealing with sustainability risks	Bafin	Guideline
2020	Green bonds	Green Federal Bond	German Federal Government	Mandatory
2021	Green finance guidelines	Guidelines on sustainable investment funds	Bafin	Mandatory
2021	Green finance guidelines	Sustainable Finance Strategy	German Federal Government	Guidelines

Figure 3.: Climate-related financial policies adopted in Germany as of December 2021.
Source: Authors' elaboration.

4.2 Transmission of risks to the energy transition

Transmission channel 4 describes the impact of the geopolitical energy crisis on the energy transition. If this crisis is to become a momentum for accelerated climate mitigation and energy transitions, depends on current energy policy. The Ukraine crisis unexpectedly exacerbated energy market uncertainty, impacting the energy transition. The current geopolitical energy crisis related to the Ukraine war sets energy markets under pressure. Governments discuss energy policies, such as building LNG terminals, to diversify energy imports, and decrease energy dependencies on Russia, aiming to secure energy supply. This is not without implications for energy transitions and the financial system. Indeed, in the German context, in response to the Ukraine war, the financial regulator (i.e., BaFin) announced the decision to postpone the planned policy for sustainable investment funds due to the volatile regulatory, energy, and geopolitical environment [42]. Additionally, the German government passed a law for building 11 LNG terminals to allow gas import until 2043 [40].

Because of the Ukraine war, Germany aims to decrease its energy dependencies. There are two main strategies: to diversify energy imports and to decrease energy demand [43]. The latter is because the less energy is needed the less has to be imported. Until recently, half of Germany's gas imports are from Russia. To diversify gas imports, Germany plans to build seven offshore and six onshore LNG terminals to import lignified natural gas. These fixed terminals will be built with accelerated permissions and allow imports of gases until 2043 [40].

The Ukraine war led to an increase in energy prices, which affects the productive and consumer sector and might cause social conflicts because the high prices for heating and petrol hurt especially low-income households. Therefore, the German government decided to spend almost 30 billion € on measures such as cheaper public transport tickets or so-called energy money to support the households in early summer [44]. Further reactions from politics are expected. A decrease in energy demand through energy efficiency or sufficiency is also crucial. Speed limits, car-free Sundays, increasing the use of public transport, or reducing room temperature are sufficient options [45].

The downside of the energy crisis might be turned into opportunities for the energy transition. The key point is to raise a new awareness for energy-saving and sufficiency in society, which is challenging. Aiming at a 100% renewable energy system also helps decrease fossil-based energy dependencies and increase energy

efficiency. The challenge is that the current energy policy does not hinder mid- and long-term energy (transition) goals. In this context, fixed LNG terminals are controversially discussed [46,47], for example in the German case [48].

From a climate goal perspective, these terminals might turn into energy transition risks and stranded assets and impede energy transitions through infrastructure lock-ins. Considering the need for a fossil natural gas exit by 2038 at the latest [31] and Germany's remaining emission budget [28], using LNG terminals until 2043 would be a serious economic and energy transition risk. As our analysis showed, current energy policies that are not in line with climate goals and previous climate policies put financial stability and energy transition at risk and will not pay out in the long run.

Energy transition risks can and should be limited and mitigated in at least two ways. First, Vermeulen et al. [49] recommend reducing the vulnerability of financial institutes by performing stress tests that consider the energy sector's role. Since climate-related stress testing is a relatively new and immature research field, it comes with challenges. An alignment of the financial sector with the Paris Agreement's goals is advisable in this context [50]. Second, effective climate policies and their timely implementation can help to prevent massive asset stranding. Sudden developments in energy transitions come with high energy transition risks with cascading implications for the economy. Early climate policies prevent the future need for abrupt and disruptive climate action.

5. CONCLUSIONS

This study provided a comprehensive review of the dynamics between energy transition, climate risks, and geopolitical challenges and developed a framework to investigate these dynamics. In particular, we focus on the global and German progress on energy transitions and on analyzing how climate-related risks affect financial stability and energy transitions. The proposed analysis framework helps to disentangle the obstacles and opportunities for the green energy transition in contemporary crises, such as geopolitical and ecological crises. Overall, the results of our analysis of the German case contribute to understanding energy transitions in the context of financial stability and call for considering climate risks in financial and energy policy-making.

The main results of our study are as follows. First, the analysis emphasizes that neglecting climate-related risks, especially energy transition risks, might lead to financial instability. Second, financial instability has a cascading effect on energy transitions due to a possible carbon bias and/or lack of capital and Paris-aligned financial policies. Third, the geopolitical crisis associated with the Ukraine war enforces climate-related risks and governmental policies that might delay energy transitions. In particular, policies aimed at securing financial stability and reacting to the energy crisis put climate mitigation and energy transition at risk when not aligned with climate goals.

We conclude that regulation and policies that delay climate mitigation cannot safeguard financial stability, and that climate mitigation is key to addressing potential financial instability, the climate and geopolitical crisis. Considering the gaps in existing micro-and macro-prudential frameworks, more work is needed to address climate-related risks and align the financial sector to the Paris Agreement goals. On the energy policy level, potential energy transition risks, such as asset stranding or fossil-based lock-ins, should be taken seriously into account and considered in the decision-making. It is crucial that short-term energy policies responding to the geopolitical energy crisis do not outweigh sustainable energy goals in the long run.

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