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Strategic Interaction Between the EU and Russia in the Energy Market: A Game Theoretic Approach

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Abstract

This thesis examines the strategic game between the European Union (EU) and Russia in the energy market and applies a game-theoretic approach to analyze the energy market, focusing on the critical periods of 2014 and 2022. Traditionally, the Russian gas exports to Europe have been a major part of the EU-Russia economic relations, thus, representing the wider geopolitical interactions and strategic dependence. Annexation of Crimea in 2014 led to EU sanctions on Russia that drastically changed the energy trade flows and caused significant policy changes in the EU. The 2022 events, marked by the increased level of geopolitical tension and gas supply disruptions, further transformed the European energy security strategic landscape.

The paper begins with an overview of the theoretical principles of game theory as it is used in economics and political economy. It presents major concepts, including players, strategies, payoffs, and equilibrium, and the difference between one-shot and repeated games. Specific attention is given to cooperation, punishment, and credible threats and structured cooperation mechanisms, which are essential in the formation of strategic behavior in repeated interactions.

The thesis then investigates the European gas market and the reliance of the EU on the Russian energy resources in the two periods mentioned. It examines the political and economic dynamics that shaped EU-Russia energy relations, such as the sanctions in 2014, market adaptations, and the escalated energy crisis in 2022.

Based on this empirical background, a dynamic game-theoretic model of EU-Russia energy relations is developed in the study. This analysis shows the impact of strategic interdependence, political restraints, and economic incentives on the possibility of cooperation or conflict in 2014 and 2022. The results indicate that credible threats and structured cooperation mechanisms contributed to the reduction of possible conflicts, whereas unilateral actions and political pressures enhanced the threat of market distortions. The results are useful in understanding the connection between economic and political policies in global energy relations.

Introduction

The European Union (EU) and the Russian Federation have experienced a structural and deep-seated decline in relations since 2014. What had been defined by economic interdependence, especially in the energy sector, was slowly turning into a relationship of sanctions, countersanctions, strategic mistrust and geopolitical confrontation. The annexation of Crimea by Russia in March 2014 and the following outbreak of the conflict in Eastern Ukraine was a turning point that transformed not only the political relations, but also the economic and strategic interaction between the two actors.

The reaction of the EU to the actions of Russia was the imposition of a broad set of restrictive measures, also known as sanctions, on individuals, companies, financial institutions and major areas of the Russian economy, such as energy and finance. Russia, in its turn, implemented countermeasures, such as trade restrictions and strategic changes in its energy policy. These mutual moves formed a strategic space where both sides kept responding to the other, forming a complicated pattern of interaction as time went on.

This process needs an analytical framework that can capture strategic behaviour, incentives, expectations and responses. Conventional descriptive or purely institutional methods, though helpful, are frequently inadequate to provide a complete answer to why actors adopt particular policies, why cooperation fails, or why inefficient results are maintained despite economic losses on both sides. This is why this thesis uses game theory as its primary analytical tool.

Game theory offers a potent arsenal of instruments to examine the circumstances where the result of each actor is not only determined by their actions, but also by the actions of others. Sanctions and counter-sanctions in the context of EU-Russia relations can be viewed as strategic actions in a non-cooperative game, where both parties seek to maximise their respective payoffs within the context of political, economic and institutional constraints. The Nash equilibrium, dominant strategies, credible threats and repeated interaction are some of the concepts that can be used to provide a systematic explanation of the observed policy outcomes.

Game theory is especially applicable in energy economics. Before 2014, the EU and Russia were tied by a cord of close interdependence: the EU was extremely dependent on Russian gas, and Russia was extremely dependent on European markets to sell its exports. This interdependence

provided incentives to cooperate, but also weaknesses that could be exploited strategically. Sanctions, diversification policies, and energy weaponisation can thus be examined as strategic reactions in a dynamic game.

The primary aim of this thesis is to examine the worsening of EU-Russia relations since 2014 in terms of game theory, with a particular emphasis on sanctions, countermeasures and strategic interaction in the energy sector. The thesis will fill the gap between the abstract economic models and the modern international political economy by applying theoretical concepts to a real-life case.

To be more precise, the thesis aims to respond to the following research questions:

- What is the way to model EU-Russia relations since 2014 as a strategic game?
- What are the strategies of each player and what are their payoffs?
- Why has cooperation not been successful, and in what circumstances might it theoretically be reestablished?
- What is the effect of sanctions, mechanisms of punishment and credible threats on strategic outcomes?

The thesis is methodologically founded on a qualitative analytical methodology, which integrates theoretical modelling of game theory with the findings of academic literature on sanctions, international relations and energy markets. Instead of offering a strictly formal mathematical model, the analysis is based on conceptual clarity and economic intuition, which makes the framework easy to understand and analytically rigorous.

The thesis is organized in the following way. The initial chapter presents the theoretical background of game theory and strategic interaction, including its main concepts and applicability to political economy and international relations. The second chapter gives the background of EU-Russia relations and the contribution of sanctions and energy interdependence. The last chapters use the theoretical framework to the case of EU-Russia, addressing strategic behaviour, outcomes and policy implications. This thesis will help to understand the role of strategic interactions in the formation of economic and political results in the modern international relations by examining EU-Russia relations through the prism of game theory.

1. Theoretical Framework: Game Theory and Strategic Interaction

1.1. Introduction to Game Theory in Economics and Political Economy

Game theory is one of the most powerful analytical approaches in contemporary economics and political economy, offering a methodical approach to the study of strategic interaction of rational agents. In contrast to classical economic theories, which tend to consider individual decision-making in isolation, game theory explicitly takes into consideration the fact that agents are interdependent: the decision made by one agent does not only depend on the decisions made by the agent themselves, but also on the decisions made by other agents. It is this characteristic that renders game theory especially effective when it comes to the analysis of situations where incentives, expectations, and strategic behavior are of primary importance.

Game theory has its roots in the work of John von Neumann and Oskar Morgenstern, Theory of Games and Economic Behavior (1944), which established the mathematical basis of the discipline and introduced the concept that economic behavior could be described as a game among rational players. Game theory was originally created to solve issues in economics, but it quickly spread to other fields, such as political science, international relations, sociology, and law. It has become a fundamental instrument in the study of political economy in the interaction of political institutions, governments, firms, and individuals under conflict and cooperation conditions.

In its simplest form, game theory focuses on situations where decision-makers, also known as players, make decisions in a strategic manner and expect others to act in a particular way. The players are all assumed to be rational in the sense that they seek to maximize their respective objective functions, which are usually in the form of a payoff. Such payoffs can be in terms of profits, utility, political power, security or any other outcome that is relevant in the context of the analysis. Notably, rationality in game theory does not mean perfect foresight or moral judgment, but it means consistency in preferences and choices based on available information.

Among the most important contributions of game theory to economics is the fact that it formalizes the strategic behavior in markets that are imperfectly competitive. Unlike perfectly competitive markets, where agents are price-takers, most real-world markets are subject to strategic interactions among a small number of firms or actors. Examples of competition where the results

are based on mutual expectations and strategic reactions include oligopolistic competition, firm-worker bargaining, auctions, and regulatory interactions. Game theory offers the means to study such environments by explicitly modeling the reaction of agents to the decisions of others.

Game theory is an important aspect of political economy that is used to explain the influence of political processes and institutional constraints on economic outcomes. Strategic interactions between governments, voters, interest groups, and international actors affect policy decisions, regulatory structures, and resource allocation. As an example, the process of policy-making may be considered as a strategic game between politicians who want to be re-elected, voters who react to the results of the policies, and companies that want to be favored by the regulations. Game-theoretic models enable researchers to examine the emergence of equilibrium outcomes of these interactions and in what circumstances they are stable or efficient, structure on the concept of equilibrium formalized by Nash (1950, 1951).

One of the main assumptions of most game-theoretic models is that players develop expectations of how other players will behave and consider these expectations when making their strategies. This prospective feature separates game theory as compared to strictly descriptive methods and places it in the rational choice tradition of economics. Formally, a game is usually characterized by three components: a group of players, a group of possible strategies of each player, and a payoff function that gives a numerical value to each possible combination of strategies. Each player has a strategic problem of choosing a strategy that will maximize their payoff based on their beliefs about the strategies other players have chosen.

Mathematically, if there are N players indexed by $i = 1, 2, \ldots, N,$ each player i chooses a strategy s_i from a strategy set S_i. The payoff of player i is given by the function

$$u_i(s_1, s_2, \ldots, s_n),$$

which depends on the entire profile of strategies chosen by all players. The interdependence of payoffs is what generates strategic behavior: a change in one player's strategy can alter the payoffs of all other players.

Game theory shifts analysis away from focusing only on final outcomes and toward examining the strategic process that produces them. Instead of focusing only on final outcomes, it stresses how

those outcomes result from strategic choices and interactions. This perspective is useful in political economy because similar institutional arrangements can produce different outcomes when actors' expectations, perceived credibility, and strategic uses of power differ. For instance, a stated intention to impose sanctions or end cooperation can shape conduct even when no action follows, as long as the intention is seen as credible.

Game theory is useful in academic work because it provides a structured way to model strategic situations in which each participant's choices depend on what others may do. In some games, certain players have full knowledge of the rules and the situation, including what other players are trying to achieve. In many other games, players must make decisions without having all the relevant information available to them. This is particularly relevant in negotiations, voting processes, and international trade, where actors may be uncertain about other players' preferences, constraints, or intentions, and where information may be unevenly distributed among participants.

Game theory provides a framework for explaining how people choose actions in situations where the outcome depends on the choices of others. By stating information constraints directly, game theory supports a more realistic analysis of how decisions are made. Over the past decades, game theory has shifted from a mainly abstract set of models to a method used in many fields. Researchers have developed empirical and experimental methods to test predictions from game theory and to examine how people actually behave when they face strategic choices. Even when people do not act in fully rational ways, game-theoretic benchmarks still offer a useful baseline. They help clarify incentives and point to where inefficiency or conflict may arise.

Overall, game theory offers a clear framework for studying strategic interaction in economics and political economy. By focusing on interdependence, rational choice, and equilibrium reasoning, this approach fits the study of markets, institutions, and international relations, where outcomes depend on the strategic choices of several actors. For these reasons, it provides the main theoretical basis for the analysis in this thesis and sets the groundwork for later sections that examine specific applications in international relations and energy markets.

1.2. Key Concepts: Players, Strategies, Payoffs, Equilibrium (Nash equilibrium, dominant strategies, etc.)

In game theory, the fundamental elements of a game, which are players, strategies, and payoffs, play a significant role in the study of strategic interactions and the identification of outcomes. Formal models are based on these concepts and provide a systematic approach to the study of the phenomena of economic, political, and international relations.

Players are the decision-making entities within a game. In most economic and political uses, players are individuals, firms, or states. The players are all assumed to be rational and they will maximize their payoff based on the strategies of other players. The European Union (EU) and the Russian Federation are the main actors in the context of this thesis. Although the actors are internally heterogeneous, they are both represented as unitary decision-makers to simplify the analysis and concentrate on the macro-level strategic interactions.

Strategies are the full set of actions available to each player. A strategy defines the way a player will act in every possible situation within the game. As an example, the EU may either maintain cooperation, sanction, or diversify its energy supply. Russia, in its turn, can choose to either comply, partially accommodate, retaliate, or redirect its exports to non-European markets. Every strategy is a calculated course of action that considers possible reactions of the opponent player.

Payoffs are the results of each combination of strategies adopted by the players. Payoffs are the measures of the benefits or costs experienced by each player which may be economic gains or losses, political legitimacy, security gains, or reputational effects.

Mathematically, when there are N players, each having a strategy space S_i, the payoff function of player i can be expressed as:

$$u_i(s_1, s_2, \ldots, s_N), \qquad s_j \in S_j \text{ for all } j = 1, \ldots, N$$

Here, S_j is the set of strategies available to player j. It is the interdependence of payoffs that creates strategic considerations; the best decision made by a player is usually based on the expected behavior of others.

Another important game theory concept is equilibrium, which is a situation in which no player has a reason to unilaterally alter their strategy. The Nash equilibrium, named after John Nash, is the most popular concept of equilibrium. Formally, a Nash equilibrium is a strategy profile $(s^*_1, s^*_2, etc, s^*_N)$ such that, to all players i:

$$u_i (s^*_i, s^*_{-i}) \geq u_i (s_i, s^*_{-i}) \quad \forall s_i \in S_i$$

In this case, s^*_{-i} is the strategy profile of all players other than player i. In a Nash equilibrium, the strategies of the players are the optimal responses to the strategies of the other players. Notably, Nash equilibria can be inefficient, i.e. the overall result is not always optimal in social or joint terms.

A special case is dominant strategies, in which the optimal strategy of a player is the same one, independent of the strategies of other players. If a player has a dominant strategy, they will use it in any situation, which makes it easier to analyze. However, dominating strategies are quite uncommon in real world interactions that are complex like international diplomacy or economic sanctions.

The other related concept is the Pareto efficiency criterion, which evaluates whether an outcome can be improved for one player without reducing the payoff of another. While Nash equilibria explain stability of strategies, Pareto efficiency explains the desirability of outcomes. There can be stable equilibria in many strategic scenarios, such as EU-Russia relations, which are not Pareto-optimal, and which represent tensions between individual incentives and the common good.

These can be explained by a simplified example. Assume that the EU has two options Cooperation (C) and Sanctions (S), Russia has two options Compliance (C) and Retaliation (R).

Table 1: Payoff Matrix Between the European Union and Russia in the Energy Market.

	Russia: C	**Russia: R**
EU: C	(3, 3)	(1, 4)
EU: S	(4, 1)	(2, 2)

Source: Author's own construction based on Nash (1950), Baldwin (1985), and Dubey (1982).

The payoff of the EU is the first number in each pair in this matrix, and the payoff of Russia is the second. The Nash equilibrium is the situation in which the decision of each player is a best response to the other, e.g. at (S, R) when unilateral deviation decreases payoffs. In this case, the two actors modify their strategies by predicting the other player, which is the strategic interdependence that is the focus of game theory.

These are the main concepts: players, strategies, payoffs, and equilibrium, which give the tools of analysis and modeling of complex interactions. They are especially applicable to the analysis of strategic behavior in international relations and economic policy, as demonstrated in the following chapters focused on EU-Russia relations, sanctions, and energy markets.

1.3. Static and Dynamic Games: One-shot and Repeated Games.

A major difference in game theory is between a static and dynamic game, which differs in the time of decision-making by players and the form of interaction over time (Gibbons, 1992; Fudenberg and Tirole, 1991). This is especially applicable to economics and political economy where most strategic interactions in the real world are not one-off events but are carried out over a series of decisions based on previous behavior and future anticipation.

One-shot games, also known as static games, are games that do not have a time component. Players make their strategies either at the same time or without knowing what others have chosen, and interaction occurs only once (Gibbons, 1992). Within this context, the players do not have a chance to base their behavior on the past results, and they cannot count on the future interactions to reward cooperation and penalize deviation. As a result, the rationality of the opponent and the maximization of immediate payoffs are the two main factors that influence strategic behavior in one-shot games. One-shot games are useful in making analytical observations in modeling isolated decisions, abrupt policy changes, or unexpected shocks. As an example, a sudden trade embargo, a sudden sanctions package, or a unilateral policy announcement can be estimated as a static interaction. Under these circumstances, Nash equilibrium analysis is usually used to determine equilibrium outcomes, with each player choosing the optimal response based on their assumptions about the other player (Osborne and Rubinstein, 1994). Nevertheless, the relevance of the concept

of static games to international relations is limited, because the states rarely interact in a single, isolated setting.

By contrast, dynamic games explicitly use time, and strategies can change over several steps. Players can move in a sequence, see what has been done and modify their behavior. Dynamic games are thus more appropriate to examine long-term political and economic relationships where decisions made today affect future expectations and incentives (Fudenberg and Tirole, 1991). One of the key types of dynamic games is repeated games, where the same strategic interaction is repeated many times between the same players. Repetition fundamentally alters strategic incentives. Players can be ready to forgo short-term benefits in order to maintain long-term cooperation when they expect to interact in the future. This is an intertemporal trade-off that is characteristic of repeated games and is especially applicable in the international economic relations where credibility, trust, and reputation are key elements.

Formally, the payoff structure in repeated games is often modeled as a discounted sum of stage-game payoffs. Let $u_i(s_i^t, s^t_{-i})$ denote the payoff of player i in period t. The total utility of player i can then be expressed as:

$$U_i = \sum_{t=0}^{\infty} \delta^t u_i(s_i^t, s_{-i}^t)$$

where $\delta \in (0,1)$ is the discount factor reflecting the degree to which players value future payoffs. A higher discount factor implies greater patience and increases the likelihood that cooperative outcomes can be sustained over time (Osborne and Rubinstein, 1994).

The Folk Theorem is one of the most powerful outcomes in the theory of repeated games. It shows that, in some circumstances, especially when the players are patient enough, virtually any payoff structure that is individually rational can be maintained as a Nash equilibrium (Fudenberg and Maskin, 1986). Cooperation may be imposed by plausible threats of punishment, e.g. returning to a non-cooperative policy after a deviation. These punishment systems render opportunistic behavior unprofitable in the long run, although it would be profitable in a one-shot game.

This theoretical observation is particularly applicable to the study of sanctions, trade relations, and energy cooperation. Sanctions may be viewed as punishment mechanisms to discourage unwanted behavior, whereas counter-sanctions are messages that form expectations regarding future

relationships (Drezner, 1999). Such strategies are not only effective in terms of their short-term economic effect but also in terms of credibility and sustainability of enforcement in the long term. When it comes to the EU-Russia relations, the relations in the energy sphere and the overall economic cooperation can be viewed as the repeated games instead of the isolated decisions. Long-term gas contracts, infrastructure investments, and regulatory frameworks create a strategic environment where both actors continuously reassess their strategies based on past experiences and expected future reactions. The imposition of sanctions in 2014 and their escalation in 2022 changed the repeated-game format by adding the cost of cooperation and redefining incentives on both sides.

Reputation and commitment can also be analyzed in dynamic games. A player who always delivers on its threats or promises can have an impact on the beliefs of the opponent, thus, influencing future strategic decisions. Credibility in this sense is a strategic asset. In the case of the European Union, sanctions credibility depends largely on its ability to maintain internal unity and absorb economic costs. In the case of Russia, the response and the restructuring of strategies to other markets are used as a way of indicating resilience and minimizing vulnerability in future relations.

In general, the difference between dynamic and static games provides a critical analytical approach to this thesis. Although one-shot games provide important information on isolated strategic choices, dynamic and repeated games are more appropriate to reflect the changing character of international economic and political relations. They enable a more profound insight into cooperation, conflict, and strategic adaptation in the long-term, which is critical to the analysis of EU-Russia relations in the framework of sanctions and energy markets.

1.4. Cooperation, Punishment and Credible Threats

One of the main problems of game theory, especially studying repeated and dynamic interaction, is the maintenance of cooperation when there is no central authority that can enforce agreements. In most economical and political situations, players have a good motivation to break cooperative agreements to achieve short-term benefits. Game theory resolves this inherent conflict by analyzing how punishment strategies and credible threats influence the evolution of strategic behavior.

In game-theoretic context, cooperation does not mean altruism or legally binding coordination of players. Rather, cooperation is the result of equilibrium when each player has an individual incentive to follow a cooperative strategy, based on the anticipated responses of other players. In non-cooperative game theory, cooperative results have to be self-enforcing. This implies that no individual player will be willing to break unilaterally without considering the consequences in the future.

In games that are not dynamic or are played only once, cooperation is not easily maintained. In cases when the interaction between players is once, non-cooperation can lead to greater short-term rewards, and there is no further interaction where opportunistic behavior can be punished. The Prisoner dilemma is the most famous example of this reasoning because cooperation between the players results in the greatest overall payoff, but rational selfish agents prefer to defect. Consequently, non-cooperative equilibria are frequently observed in the one-shot games, although cooperation would be the socially optimal choice.

Repeat interaction essentially changes this incentive structure. In situations where the players anticipate interacting with each other over time, their present choices affect the future. The threat of punishment in the future generates motivation to avoid being opportunistic. Punishment strategies are contingent responses that are aimed at decreasing the payoff of a player who does not follow a cooperative course. Punishment strategies can rationalize cooperation as a stable result by increasing the long-term costs of deviation.

The trigger strategy is one of the most widespread punishment mechanisms in repeated games. In this strategy, players collaborate provided that all parties adhere to the cooperative agreement. In case of a deviation, the deviating player is penalized in later periods, and in many cases, by returning to a non-cooperative equilibrium. The threat of punishment discourages deviation so long as the discounted future losses of punishment are more than the short-term benefits of deviating (Osborne and Rubinstein, 1994).

Formally, cooperation can be sustained if:

$$\frac{\pi^C}{1-\delta} \geq \pi^D + \frac{\delta \pi^P}{1-\delta}$$

where π^C denotes the cooperative payoff, π^D the payoff from deviation, π^P the punishment payoff, and δ the discount factor. This inequality highlights the importance of patience and long-term orientation in sustaining cooperation.

The punishment strategies should be credible in order to be effective. A threat is perceived to be credible when the player who threatens has a reason to execute the threat in case the contingency in question occurs. When the cost of punishment is too high to the punishing player, the threat might be not credible and will not prevent deviation. Under these circumstances, rational opponents might opt to deviate, hoping that they will not be punished.

Credibility is thus a very important requirement to the success of punishment strategies in repeated games. The concept of commitment is close to credibility. A player who is able to make a promise that he/she can fulfill in the future can shape the expectations and behavior of others. Institutional constraints, reputational issues, or domestic political costs may help to support commitment, and it becomes expensive to back down when a threat is made. Credibility is frequently based on the track record of consistent action and the apparent readiness to take short-term losses in the name of long-term strategic goals in international relations, where formal enforcement mechanisms are weak or absent.

The Folk Theorem of repeated games formalizes the theoretical significance of punishment and credible threats. The theory shows that, in some circumstances, especially when the players are very patient, a vast variety of cooperative equilibria can be maintained as equilibrium solutions by suitable punishment strategies (Fudenberg and Tirole, 1991). The finding supports the notion that cooperation is not necessarily enforced by outside elements but may be endogenous due to strategic interaction in cases where future implications are significant enough.

Punishment strategies in political economy and international relations often consist of economic sanctions, trade restrictions or diplomatic steps. Game-theoretically, sanctions are institutionalized systems of punishment, which seek to change the incentive system of the actor of interest. Their main idea is not to simply penalize the previous actions but to prevent further deviations and provoke strategic change.

Sanctions are an effective punishment strategy subject to a number of factors. First, the costs imposed on the targeted actor must exceed the gains from deviation. Second, the initiator of

sanctions should be ready to incur the economic and political costs, i.e. loss of trade or increased domestic prices. Third, sanctions should be seen as long-term and credible. When the targeted actor anticipates that sanctions will be short-lived, unequally applied, or undermined by internal splits, then the deterrent impact is probably restricted.

In the context of EU–Russia relations, cooperation, punishment, and credible threats play a central role in strategic interaction. Before 2014, the cooperation (especially in the energy sector) was maintained by mutual economic benefits and the long-term engagement expectations. The imposition of sanctions was a move towards the use of the punishment strategies that would change the strategic incentives of Russia. The effectiveness of these measures depends on the credibility of the EU's commitment to maintain sanctions despite internal economic pressures, as well as on Russia's assessment of the long-term costs of continued confrontation.

In sum, concepts of cooperation, punishment, and credible threats offer a crucial connection between abstract game-theoretic models and policy tools in the real world. They provide a consistent pattern of conceptualizing the way strategic behavior may be manipulated in recurrent interactions and are a basis of sanction and energy relations analysis as constituents of a larger strategic game in the following chapters of this thesis.

1.5. International Relations and Energy Markets Game Theory.

Game theory has become one of the most important tools of analysis in international relations as it provides a methodological way of analyzing strategic interactions between states in situations where no centralized enforcement structures exist. The nature of international politics is always strategic: states take decisions and expect the reaction of other actors, and the results of these relations are shaped by expectations, credibility, and relative power. Game theory provides the conceptual instruments necessary to formalize such interactions and to explain why cooperation may arise in some contexts, while conflict persists in others even when it is collectively inefficient (Nash, 1950; Axelrod, 1984).

States can be modeled as rational actors aiming to achieve political, economic, and security goals. Although this abstraction simplifies internal politics, it helps the analysts focus on strategic

behavior at the international level. Diplomatic negotiations, forming alliances, trade agreements, sanctions, and military posturing are all activities that can be viewed as strategic games with each state gauging their policies by how others are expected to react. Nash equilibrium, credible commitments, signaling, and punishment strategies are some of the concepts that are central within these interactions (Fearon, 1997).

One of the aspects of international relations is that interactions are repeated. States do not often relate to each other in isolation, but they are involved in long-term relations with each other that include treaties, agreements, negotiations, and conflicts. Such a repeated-game form provides the possibility of long-term cooperation and the motives to manipulate the strategy. Reputation becomes a significant resource: states that are viewed as trustworthy associates can enjoy better cooperation, whereas those that are viewed as opportunistic or unpredictable can face sanctions or diplomatic isolation. Game theory captures these dynamics by modeling how past actions shape expectations and influence future strategic decisions (Axelrod, 1984).

Energy markets represent a particularly relevant domain for the application of game theory in international relations. Energy trade is characterized by long-term contracts, high sunk costs, low short-term substitutability, and asymmetric dependence between exporting and importing countries. These circumstances create a strategic environment in which economic transactions are connected with geopolitical factors and making market outcomes highly sensitive to political decisions.

From a game-theoretic perspective, energy trade can be described as a game between exporting and importing states. Exporters are interested in maximizing revenue and geopolitical power, while importers are interested in reliable and safe energy sources. When dependence is asymmetric, the stronger party may use energy as a strategic instrument through pricing strategies, supply restrictions, or credible threats of disruption, signaling power within a broader political interaction.

Strategic incentives are also influenced by energy security issues. Countries that are dependent on imports can diversify their suppliers, invest in alternative sources of energy or build strategic reserves to minimize exposure. These activities change the payoff and limit the strategy of exporters. On the other hand, exporters can respond by identifying new markets, diversifying by investing in other routes or change pricing strategies to retain power. These kinds of strategic

interactions are the perfect illustration of the intricate interactions of economics, politics, and security factors that are embodied by the game theory.

The interplay between the energy markets and economic sanctions highlights the strategic aspect of state behavior. Energy-related sanctions are aimed at imposing expenses on the targeted state and sending political signals. However, these sanctions also come at a cost to the sanctioning state particularly in cases where energy dependence is high. From a game-theoretic perspective, the effectiveness of sanctions depends on the credibility of commitments by the sender and the target beliefs regarding the long-term consequences of non-compliance.

The energy relationship between the European Union and Russia provides a clear illustration of the application of game theory to international relations and energy markets. The energy trade between EU and Russia before 2014 was characterized by interdependence and long-term collaborative agreements. This was changed by the introduction of sanctions and the following strategic changes, making it a dynamic game of punishment, retaliation, and struggle to reorganize dependencies. EU diversification policies and Russian seeking alternative markets may be discussed as the strategic actions in response to these changes.

Game theory is also used to explain the reason behind strategic changes in energy relations taking place gradually. The infrastructure investments, policy adjustments and trade re-alignments are associated with high costs and long-term horizons implying that inefficiency or losses in the short term are likely to prevail despite the actors working towards long term goals. This interaction supports the role of patience, credibility, and commitment in the realization of positive results in energy-based strategic relations.

Overall, the use of game theory in international relations and energy markets offers a logical analytical approach to the study of strategic interdependence, cooperation, and conflict. Focusing on the importance of incentives, expectations, and credibility, the game theory allows gaining a more profound insight into the overlap of economic and political goals, especially in such a situation as the relationships between the EU and Russia. This theoretical approach is the basis of empirical analysis and modeling that is provided in further chapters of the thesis.

1.6. Methodology and Research Design

This thesis follows a qualitative deductive research design founded on formal game-theoretic model and contextual analysis of political economy. The methodological aim of the research is not a statistical approximation to the trade flows or a purely descriptive historical account, but rather the creation of a theoretically based model of analysis that can be used to identify the behavior of rational actors under the conditions of strategic interdependence, political uncertainty, and altering outside options. The central assumption of the research design is that the interaction between the European Union and Russia in the field of energy trade can be interpreted as a strategic game in which both actors choose policies while anticipating the responses of the other side.

The deductive methodological approach is especially suitable in this study since the thesis starts with already known theoretical concepts in the field of game theory and political economy and transfers them to a particular empirical case. The analysis is based on the general theoretical principles, including Nash equilibrium, dominant strategies, repeated interaction, credible threats, punishment strategies, and commitment mechanisms, and the specific situation of EU-Russia energy relations. In this regard, the logic of the research shifts to case-study, where the strategic implications of abstract models can be tested with regard to real-world events in the European gas market, as well as the geopolitical evolution of the relationship following 2014 and 2022.

The main methodological tool of the thesis is the axiomatization of a non-cooperative game-theoretic model. This model is a simplified version of the strategic game between two rational actors: the European Union and Russia. The choice of game theory as the central methodology is justified by the nature of the research problem itself. The nature of energy trade between the two actors includes interdependence, presence of repeated bargains, asymmetric outside options, incomplete trust, infrastructure rigidity and the risk of sanctions and retaliation. These features correspond directly to the classical conditions under which game-theoretic analysis is most analytically useful (Gibbons, 1992; Osborne and Rubinstein, 1994).

The methodological framework combines theory-building and theory-applying functions. To begin with, Chapter 1 provides the theoretical basis of strategic interaction based on the discussion of the concept of static and dynamic games, equilibrium, and credible commitment. Second, Chapter 2 and 3 give the empirical and institutional background that is required to determine the

relevant players, strategies that are feasible, and structural constraints. These chapters are not strictly descriptive, but they play a methodological role in that they create the empirical assumptions later adopted in the formal model. Chapter 4 is based on the specification of the space of strategy and the order of payoffs by using the strategic relevance of the pipeline dependence, LNG infrastructure, sanctions, countersanctions, market concentration, and alternative export routes.

A significant methodological aspect deals with the formal model being stylized. The payoff matrices of the one-shot and repeated game are not meant to be econometric estimates or precise measurement of welfare outcomes. The numbers are rather simplified analytical forms of the relative ranking of the preferences between alternative strategic outcomes. The goal of the payoffs is ordinal and not cardinal precision in terms of methodology. What matters is the correct ordering of incentives: mutual cooperation must dominate conflict in joint welfare terms, while short-run opportunism must remain individually rational under specific conditions of dependence asymmetry. This stylization is in line with the methodological approach to the normal-form and repeated game, as applied in the study of political economy where the focus is on strategic reason and not numerical measurement.

The derivation of the payoff ordering is based on the empirical evidence presented in Chapters 2 and 3. For example, the cooperative outcome is assigned the highest joint payoff because it reflects the historically efficient pre-2022 equilibrium of stable gas flows, long-term contracts, low transportation costs, and high export revenues. Comparatively, conflictual responses that entail sanctions, reduction in supply and emergency diversification are ranked lower considering they have been documented to be associated with volatility in prices, inflationary pressures, fiscal strains, and long-term infrastructure redundancy. In this way, the model remains methodologically connected to observable economic and political developments without claiming false numerical exactness.

The thesis also uses the case-study research logic based on EU-Russia energy relations as a strategically important example of asymmetric interdependence. This case is methodologically appropriate because it combines several features that are particularly suitable for formal strategic analysis: a small number of clearly identifiable actors, observable geopolitical shocks, repeated contractual interaction, infrastructure specificity, and measurable changes in outside options over

time. The case then offers a good empirical set up in which to exercise the game-theoretic concepts of cooperation breakdown, punishment credibility and path dependence of equilibrium.

Another methodological strength of the research design is its dynamic time structure. Instead of considering EU-Russia relations as a one-time event, the thesis clearly distinguishes three phases of strategic interaction: the short-run one-shot logic of immediate coercive incentives, the repeated-game logic of long-term cooperation supported by continuation value, and the post-shock restructuring phase conditioned by credible threats and irreversible commitments. This methodological significance of this temporal sequencing is that the thesis can be used to capture the time dynamics of equilibrium conditions as infrastructure, trust, and outside options adjust with time.

A counterfactual analytical element is also included in the methodology especially in Chapter 5. The model is employed to produce alternative equilibrium situations by different assumptions of timing, speed of diversification, institutional commitment, and outside option. This method enhances the soundness of the research design since it shows that the explanatory framework is not confined to retrospective description, but also capable of assessing plausible alternative strategic paths and policy options.

In a bigger political economy approach, the research design will be used to fill the gap between abstract formal theory and the actual institutional change. The thesis does not consider the geopolitical events to be completely exogenous shocks, but rather explains them as strategic signals that change the beliefs, continuation values and credibility of future actions. This methodological perspective is particularly valuable in the study of strategic sectors such as natural gas, where economic efficiency, national security, and long-term bargaining power are deeply interconnected.

The principal methodological contribution of the thesis therefore lies in demonstrating how a stylized game-theoretic framework can be used to explain the transformation of energy interdependence from a cooperative equilibrium into a conflictual and structurally decoupled strategic relationship. Rather than predicting exact quantitative outcomes, the methodology aims to provide an analytically rigorous explanation of the mechanisms through which rational

incentives, institutional constraints, and irreversible economic commitments shape the evolution of international energy relations over time.

2. Energy Trade and Geopolitics Between the EU and Russia

2.1. The Role of Energy in EU–Russia Economic Relations

The energy industry has been traditionally the structural core of the economic relations between the European Union (EU) and the Russian Federation. In addition to bilateral trade, energy became the main foundation of more general commercial, financial, and political relations. Over decades, the natural gas, crude oil, and petroleum products flows determined the trade balances, affected macro-economic stability, and predetermined the strategic decision-making on both sides (Stern, 2005; Henderson and Mitrova, 2015). The intensity of integration in the energy space generated an economically complementary relationship and a geopolitical sensitivity.

The EU-Russia energy relations were established in the late Cold War period and were developed significantly after the collapse of the Soviet Union. In the 1970s, Western European states started to import Soviet gas on long-term contracts based on the massive pipeline system construction (Stern, 2005). Energy trade continued despite the tensions between the ideologies since it was founded on sound economic principles. The European governments needed to have their imports of energy to keep their industries running and their economies growing, and the Soviet Union and, later, the Russian Federation needed to have the foreign-currency income through the export of hydrocarbons. This practical collaboration survived the political changes and became institutionalized by commercial agreements and interdependence of infrastructure.

The association was based on structural complement. The EU is a large industrialized economic block that has comparatively limited domestic oil and natural gas reserves. Despite the fact that some member states have hydrocarbon resources, overall production has not been enough to meet overall demand. The EU, therefore, has long been dependent on foreign suppliers to obtain the energy sources needed to produce electricity, manufacture, heat and transport (Eurostat, 2023; IEA, 2022). In comparison, Russia has one of the largest proven reserves of natural gas in the world, as well as, a large amount of oil resources. It has been heavily oriented toward the extraction and export of energy products. This asymmetry of structure created a self-reinforcing pattern of trade: European demand corresponded to Russia’s supply capacity (BP, 2022).

Natural gas became the most strategically relevant element of bilateral energy relations. The natural gas trade between the EU and Russia has been traditionally based on fixed pipeline infrastructure unlike oil, which is traded on a global market and shipped by tanker fleets. Major pipelines, like Brotherhood, Yamal-Europe, and subsequently Nord Stream, created physical connections between Russian fields of production and European centres of consumption. These networks involved large-scale capital investment and planning horizons, which could take decades to be realized. When these became operational, they lowered transaction costs significantly and enabled long-term and stable supply arrangements (Stern, 2005).

Long-term cooperation was strengthened by the economics of the pipeline gas trade. The switching costs were high on both sides due to infrastructure specificity. The importing economies built distribution systems, storage and industrial systems that were tuned to the flows of the pipeline gas. Countries that engaged in exports invested in extraction capacities and transportation corridors oriented toward European markets. Long-term contracts, often indexed to oil prices and lasting twenty to thirty years, provided predictability and reduced price volatility (Stern, 2005; Henderson and Mitrova, 2015). These contracts reflected a shared expectation of stability and consistency, entrenching the energy trade in the economies of both nations.

The oil trade also became the center of the EU-Russia economic relations. Russian crude oil had a significant share in the import of oil to the EU and European refineries were technologically tailored to refine certain blends like the Urals blend (IEA, 2022). This technological compatibility further institutionalized patterns of trade. Refinery structures and transport logistics, despite the inherent flexibility of oil markets as opposed to gas markets, do create adjustment costs. In line with this, energy trading between the EU and Russia was not merely commodity exchange but also technical integration and industrial alignment.

The export of energy has been a significant part of the Russian economy. In the past, hydrocarbon revenues have constituted a significant share of federal budget receipts and export earnings (World Bank, 2022; IMF, 2023). State-owned and privately owned energy companies play a central role in the national economic performance and financial stability. Public spending, social spending, and investment in infrastructure are supported by revenues of oil and gas exports. This has led to the long-term access to the European market being considered as a necessity in maintaining macroeconomic stability in Russia.

In the case of the European Union, the imports of Russian energy have added to the competitiveness of the industry and consumer welfare. Dependable and relatively low-cost gas supplies have served energy-intensive industries in chemicals, metallurgy, and manufacturing. In a number of member states, natural gas has been relied upon by households to heat their homes, and stable oil imports have helped to ease transportation and the overall economy (IEA, 2022). In this respect, energy trade with Russia was not only a commercial deal but a cornerstone contribution to the overall economic performance of the EU.

However, the interdependence that has been created through energy trade has not been entirely symmetrical. Although Russia has been relying on the European market to export its revenues, the extent of reliance in the EU has been significantly different among member states (European Commission, 2014). The dependence on Russian gas is more prevalent in countries in Central and Eastern Europe due to geographic location and the lack of diversification opportunities. On the other hand, western European states tend to have a more diversified supply portfolio, such as liquefied natural gas (LNG) imports and other pipeline sources. This diversity in the EU has affected internal policy discussions and created different views on strategic vulnerability.

Geopolitical considerations coexisted with economic logic of interdependence. Mutually beneficial flows of energy have also created possible sources of leverage. Due to the geographic immobility of natural gas infrastructure, any supply disruption, be it due to pricing conflicts, transit conflicts, or political conflicts, can have direct economic consequences. The instability of some of the supply routes was revealed by the episodes of gas transit conflicts with Ukraine in the mid-2000s, and the strategic aspect of energy dependence was highlighted (Pirani, Stern and Yafimava, 2009; European Commission, 2014).

There has also been expansion of energy cooperation in joint ventures, investment partnerships and cross-border corporate linkages. European energy companies have been involved in upstream projects in Russia and Russian companies have invested in downstream assets in Europe. Such business relations have strengthened economic relations and have led to the belief that energy interdependence would act as a stabilizing factor in the wider political relations. The implicit premise of such cooperation has been that intense economic integration would prevent conflict incentives.

However, even the extent of integration has increased the economic impact of political decline. With the intensification of geopolitical tension after 2014, energy trade was bound up in sanctions, regulatory actions, and strategic recalibration (Connolly, 2018; Council of the European Union, 2014). Even though the flow of energy continued initially despite the political differences, the structural dependence on energy cooperation exposed both sides to the adjustment costs. The inherent quality of energy infrastructure made quick decoupling economically complex and politically delicate.

In a more general political-economic sense, the EU-Russia energy nexus is a good example of what is known as strategic interdependence. The benefits of interdependence are the gains of trade but also the redistribution of power based on the relative costs of disruption. When a single actor is in a better position to absorb supply shocks or diversify markets, it can gain bargaining power. On the other hand, when the two actors suffer high disruption costs, cooperation can still be the prevailing equilibrium. In this way, the trade-off between economic rationality and strategic leverage has been the key to comprehending the development of EU-Russia energy relations.

Institutional and regulatory change in the European Union has also been affected by energy trade. The security of supply and market concentration have raised concerns that have led to reforms to liberalize gas markets, encourage competition and diversification (European Commission, 2014). Long-term strategic factors have driven the motivation of policies that favor renewable energy and LNG infrastructure (IEA, 2022). Such institutional reactions have slowly redefined the European energy market structure and changed the payoff structure of bilateral energy cooperation.

To conclude, energy has been a cornerstone in the EU-Russia economic relations, which have influenced trade patterns, investment flows, fiscal stability, and industrial competitiveness. The association is based on structural complement and strengthened by infrastructure, long-term contracts, and technological integration. Simultaneously, energy interdependence brings in aspects of strategic vulnerability and geopolitical sensitivity. This dual nature, economic rationality and strategic implications, is critical in the analysis of the further evolution of EU-Russia relations under the conditions of sanctions, market restructuring, and changing geopolitical relations that is discussed in the subsequent sections of this chapter.

2.2. EU Dependence on Russian Energy: Economic and Strategic Aspects

The economic dependence of the European Union (EU) on Russian energy resources before 2022 was one of the most structurally significant aspects of the EU-Russia economic relations. The development of the European energy infrastructure over several decades made Russian natural gas, crude oil, and coal the key determinants of industrial competitiveness, electricity production and energy security in households in many Member States. The reliance did not happen merely due to geography; instead, it resulted in massive infrastructure investments and long-term contracts and the use of cost-minimization policies after the Cold War.

Economically, Russian energy provided the EU with reliability, scale, and reasonably competitive prices. Large reserves in Siberia, long-established export corridors, and long-term contracts based on oil indexes made it possible to predict deliveries of hydrocarbons into the European markets. According to data from Eurostat (2023), the EU's overall energy import dependence fluctuated between approximately 57–60% in the period 2018–2021. Nonetheless, this reliance was significantly different depending on fuels and Member States.

Approximately 40 % of EU natural gas imports, 27 % of crude oil imports and almost 46% of coal imports in 2021 were supplied by Russia (European Commission, 2022; International Energy Agency, 2022). The most strategically important aspect of this dependence was natural gas. The gas trade through pipelines generates structural rigidity as compared to the oil market because oil is traded on international markets and can be diverted comparatively easily. Pipelines become economically expensive and technically limited once they are built and incorporated into national transmission systems. Significant infrastructure projects directly linked a number of Member States to Russian supply lines, thus cementing a long-term structural interdependence between exporter and importer.

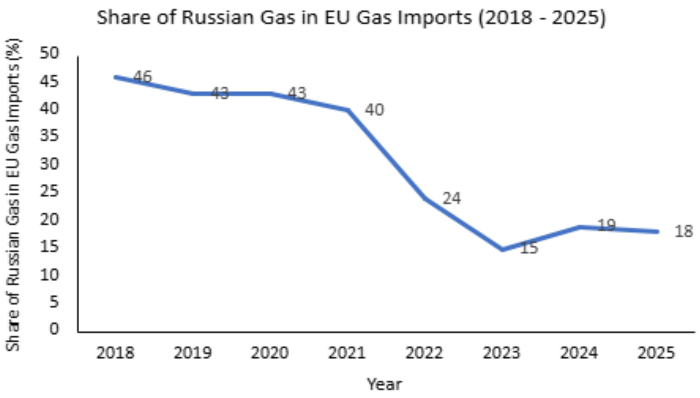
Energy import dependence can be measured quantitatively using the standard indicator:

$$Import\ Dependence = \frac{Net\ Imports}{Gross\ Inland\ Consumption} \times 100$$

This measure captures the share of domestic energy consumption covered by net imports. While the EU as a whole demonstrated high aggregate import dependence, individual Member States—

particularly in Central and Eastern Europe—displayed considerably higher levels of reliance on Russian pipeline gas, in some cases exceeding 70–90%.

Figure 1 – presents the share of Russian gas in total EU gas imports between 2018 - 2025



Source: Eurostat (2025), EC Quarterly Reports

Beyond aggregate dependence, supplier concentration provides an additional dimension of vulnerability.

The Herfindahl–Hirschman Index (HHI), calculated as

$$HHI = \Sigma s_i^2$$

where s_i represents the market share of each supplier, allows for an assessment of market concentration. Using approximate 2021 gas import shares — Russia (40%), Norway (24%), Algeria (13%), and LNG from various suppliers (23%) — the index equals:

$$\text{HHI} = 40^2 + 24^2 + 13^2 + 23^2 = 1600 + 576 + 169 + 529 = 2874.$$

Table 2: EU Gas Import Concentration (2021)

Supplier	**Share (%)**	**HHI Contribution s_i^2**
Russia	40	1,600
Norway	24	576

Algeria	13	169
LNG (multi)	23	~529
Total	100	HHI = 2,874

Note: HHI > 2,500 = "highly concentrated" (US DOJ standard)
Source: Eurostat (2023); EC (2022)

This calculation slightly overestimates concentration, as LNG imports originate from multiple suppliers. Common competition measures use the Herfindahl – Hirschman Index (HHI) to measure market concentration. A market structure characterized by high concentration is represented by an HHI of more than 2500. Using this measure on the 2021 gas import portfolio of the European Union, the analysis demonstrates a strong level of supplier concentration and a resultant high systemic vulnerability. In particular, countries that have such limited interconnection capacity or lack liquefied natural gas (LNG) infrastructure are especially vulnerable to supply shocks, increasing the structural exposure promoted by the HHI.

In efficiency-based terms, the reliance on Russian pipeline gas was mostly valid. Prices of Russian pipeline gas were generally lower than prices of LNG imports, particularly before the global development of LNG facilities (IEA, 2022). The indexation of long-term contracts to oil reduced the price volatility when compared to spot markets and provided price stability, which became necessary to energy-intensive industries like chemicals, metallurgy, and manufacturing. To these industries, foreseeable and consistent energy prices form the foundation of global competitiveness, and they protect continuity of production.

However, economic dependency has strategic implications. Energy is highly coupled with national security, industrial policy, inflationary forces and social cohesion (Keohane and Nye, 1977). Disruptions in supply or a rise in prices directly impact macroeconomic performance and may undermine political legitimacy. The 2006 and 2009 Russian-Ukraine gas transit conflicts were an illustration of how bilateral tensions can trigger far-reaching disruption in Europe and hence transform transit risk into systemic risk. The annexation of Crimea in 2014 was a turning point in how energy interdependence was viewed politically; the trade flows did not significantly change,

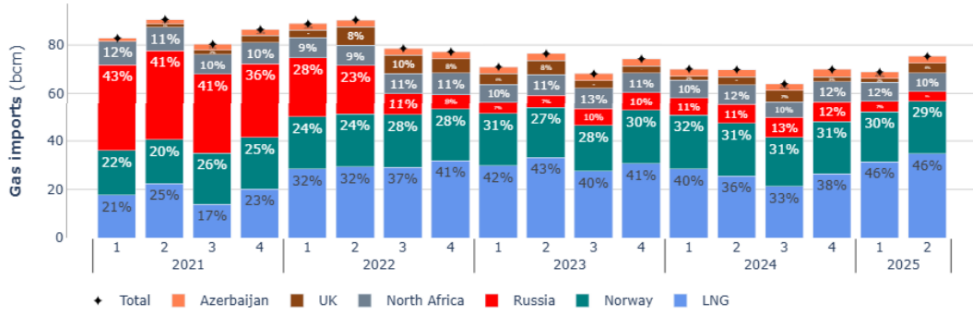
but the level of trust declined significantly. As a result, energy relations were reassessed based not only on an efficiency parameter but also on a geopolitical risk basis, which led to the EU engaging in diversification efforts embodied in the Energy Union strategy, the expansion of LNG terminals, interconnecting, and the increased investment in renewable energy.

It is possible to analyze the EU-Russia relationship within the framework of asymmetric interdependence suggested by Keohane and Nye (1977). Interdependence has two dimensions; sensitivity (the short-term cost of disruption) and vulnerability (long-term adjustment costs). Before 2022, the sensitivity of the EU was high as it could face a disruption in supplies and price shock, although its long-term vulnerability was moderate as it could switch to alternative suppliers, specifically LNG markets, Norway and Algeria at higher expense.

In contrast, Russia relied on European demand to make profits in exports and foreign earnings (IEA, 2022). In as much as short-term leverage was available through supply control, the long-term vulnerability of Russia was structurally greater which corresponded to the European market orientation of its export infrastructure. Therefore, despite the mutual interdependence, its capacity to adjust was asymmetric and as time went on the EU continued to show a greater capacity to diversify its supply base.

In 2022, especially the intensification of conflict in Ukraine sparked a sharp reorganization of EU energy policy. The EU sanctioned and introduced the REPowerEU program (European Commission, 2022), with the express goal of decreasing dependence on Russian fossil fuels. By 2023, Russian gas imports were already under 15 % of total EU imports, LNG imports had soared, and Norway had become the largest supplier to pipelines (European Commission, 2023). This rapid diversification reduced supplier concentration and strengthened supply resilience.

Figure 2 - EU imports of natural gas (share of pipeline imports by country and share of LNG



Source: ENTSO-G.

Nevertheless, the reorientation toward LNG increased exposure to global price volatility and intensified competition for cargoes, particularly in response to Asian demand fluctuations. Thus, systemic risk was transformed rather than eliminated. Strategic vulnerability shifted from bilateral dependence toward integration into a more competitive and volatile global gas market.

Dependence on energy found its echo in the internal integration of the EU. The degree of dependence differed between Member States, which created risk perceptions and policy preferences. Countries that relied on Russian gas extensively became more likely to take a more conservative political position, and countries that were less reliant became more willing to enforce severe sanctions. The institutional response to these internal divergences can be seen in the development of common energy policy tools, namely joint purchasing mechanisms, coordinated storage requirements, and financing of infrastructures.

The EU approach over the long term is growing more of a merger between energy security and decarbonization goals. Renewable energy growth, electrification, and the development of hydrogen and energy-efficiency policies all reduce the structural reliance on foreign fossil fuels. To this extent, the green transition is not only an environmental project but also a geopolitical project. The EU reduces its dependence on outside hydrocarbons, which increases its strategic freedom and limits exposure to foreign suppliers.

Overall, EU reliance on Russian energy before 2022 was economically sound according to the principles of cost minimization but strategically underestimated in terms of geopolitical risk. Systemic vulnerability was enhanced by high supplier concentration and structural rigidity, particularly in natural gas markets. Post-2022 restructuring represents the change in an efficiency-oriented energy policy towards a security-centered approach. Diversification, coordinated storage, and faster implementation of renewables have become tools of strategic independence, which is a rearrangement of the structure of the EU-Russia energy relationship, in the general framework of economics, infrastructure, and security in the European political economy.

2.3. The Structure of the European Gas Market

Over the past three decades the European gas market has experienced a radical institutional change, which has resulted in a shift of the nationally fragmented and vertically integrated monopoly market structures towards a liberalized, interconnected, and hub-based framework. Such change has radically modified price formation mechanisms, bargaining relationships, and distribution of strategic power between the European Union and external suppliers. In this sense, market design is not a technical characteristic that is neutral; it has a direct impact on incentives, leverage, resilience, and shock transmission.

Until the late 1990s, European gas markets were largely characterised by vertically integrated national incumbents which dominated transmission, storage, distribution, and retail supply. Cross-border trade was limited and was mostly managed using long-term bilateral contracts. The imported gas, especially that of Russia, Norway and Algeria, was usually bought according to oil-indexed contracts that lasted between twenty and thirty years (European Commission, 2019). These arrangements were historically justified by the need to secure capital-intensive upstream investments and to provide predictable revenue streams for suppliers while ensuring supply security for buyers (Stern, 2005). Although such contracts contributed to price stability and long-term planning, they limited competition and reinforced structural supplier–buyer dependence. The formation of prices was largely based on negotiated formulas as opposed to competitiveness in the market.

This structure was gradually eliminated through the liberalization pathway facilitated by the successive EU Energy Packages (European Commission, 2009). Ownership unbundling, third-party access to the infrastructure, and the creation of independent regulatory authorities were aimed to ensure that influential players could not dominate both the infrastructure and the downstream markets. Cross-border interconnection requirements further strengthened market integration. The objective was to replace monopoly-based pricing with a market-based price discovery mechanism consistent with EU competition principles.

Another structural change occurred with the rise of gas trading hubs and the abandonment of oil-indexed contracts in favor of hub-based pricing. European natural gas pricing came to be based mainly on the Dutch Title Transfer Facility (TTF) among other major hubs like Trading Hub

Europe (THE) in Germany and Central European Gas Hub (CEGH) in Austria. In this type of system, the price of gas is set through competitive spot and short-term deals, and forward and future markets include an element of prediction of future supply and demand levels (IEA, 2022). As a result, the bilateral contractual negotiation was replaced by decentralized market interaction in pricing authority.

From a formal economic perspective, this institutional redesign transformed the strategic environment. Under oil-indexed long-term contracts, the price P could be represented as:

$$P = \alpha P_{oil} + \beta$$

where α captures indexation intensity and bargaining weight. Supplier profits were given by:

$$\Pi_S = (P - c)Q$$

and pricing outcomes resembled a repeated bargaining equilibrium in which leverage was embedded within negotiated formulas.

By contrast, in a hub-based system, the benchmark price emerges from market-clearing conditions:

$$Q_D(P^*) = \sum_{i=1}^{n} Q_{S,i}(P^*)$$

Suppliers no longer directly determine prices but instead strategically choose quantities:

$$\max_{\boldsymbol{Q_i}} (\boldsymbol{P(Q)} - \boldsymbol{c_i})\, \boldsymbol{Q_i}$$

This structure resembles a Cournot-type quantity competition embedded in an integrated market. Strategic leverage shifts from negotiated price-setting toward volume decisions, infrastructure constraints, and supply withholding. While hub pricing reduces the scope for bilateral price discrimination across countries, it simultaneously increases exposure to aggregate market volatility.

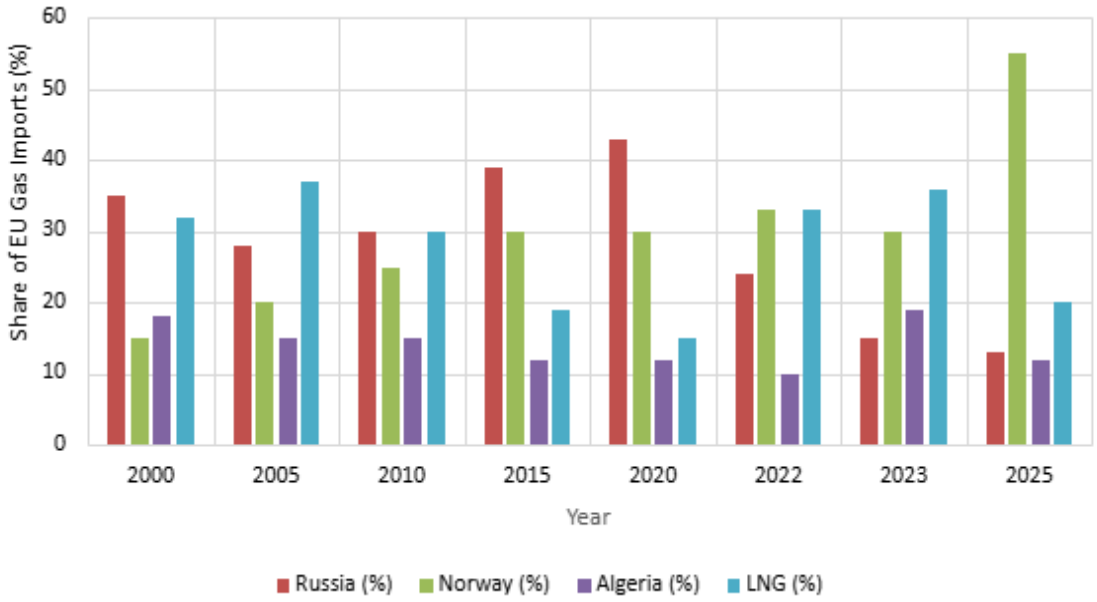
Table 3: Hub Trading vs. Long-Term Contracts (2010-2025)

Year	Hub/Spot Share	Oil-Indexed Share	TTF Volume (TWh)	Volatility (€/MWh)
2010	20%	80%	500	5.2
2015	35%	65%	1,200	6.8
2020	50%	50%	1,800	12.1
2022	85%	15%	45,000	**132.8**
2025	95%	5%	>60,000	36.5

Sources: OIES (2025); ETE Scorecard (2025)

Despite liberalisation of the European energy market, there is indeed a structural reliance on imports in the European Union. There has been gradual production reduction in the EU, with the most recent event being seismic threats forcing closure of the Groningen gas field, which was the largest onshore gas field in Europe (Dutch Ministry of Economic Affairs, 2018). Before 2022, Russia was supplying around 35-40% of the gas imports to the Union, with Norway 20-25%, Algeria and liquefied natural gas (LNG) contributing roughly 20% (Eurostat, 2023; IEA, 2023). This reliance on imports makes the external supply conditions central to the internal price movements, yet the susceptibility not only depends on the concentration of suppliers, but also on the flexibility of the infrastructure and the integration of the market.

Figure 3 – EU Gas Import Evolution 2000 – 2025

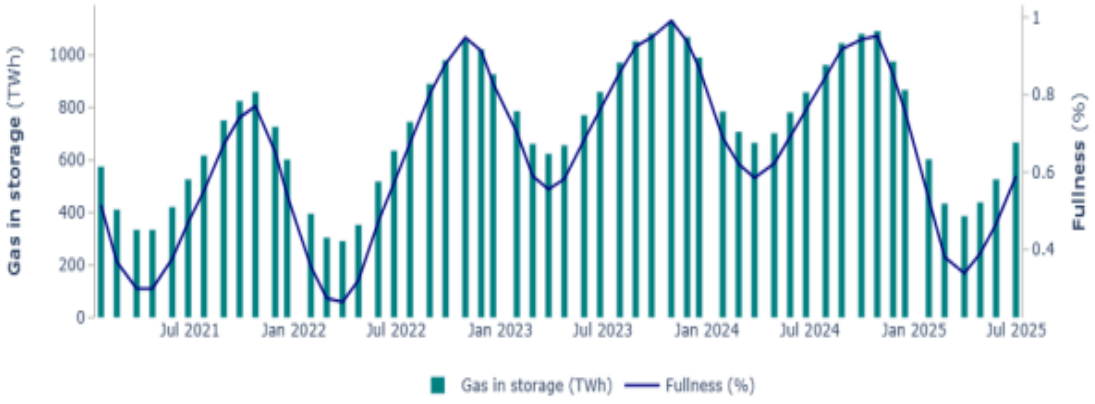


Source: Adapted from Bruegel dataset (2026), Eurostat (2025), EC Quarterly Reports

The European transmission network is characterized by extensive cross-border interconnection, specifically in Western Europe. Interconnectors facilitate arbitrage between national markets and help bring convergence of prices between hubs, a measure which is often used as an indicator of integration. Prior to 2022, price dispersion between the key Western European hubs was relatively small, which indicates the presence of efficient arbitrage and sufficient capacity. However, infrastructural asymmetries still exist particularly in parts of Central and Eastern Europe, where historical reliance on single suppliers has increased vulnerability to supply shocks (ENTSOG, 2023).

Storage capacity plays a very important stabilizing role in this architecture. Gas demand in Europe is very seasonal and reaches its maximum in winter season because of heating needs. Underground storage facilities allow injections in summer and withdrawals in winter, thus, leveling seasonal variations. Following the 2022 supply shock, mandatory storage-filling targets were introduced under EU regulation to enhance collective resilience (European Commission, 2022).

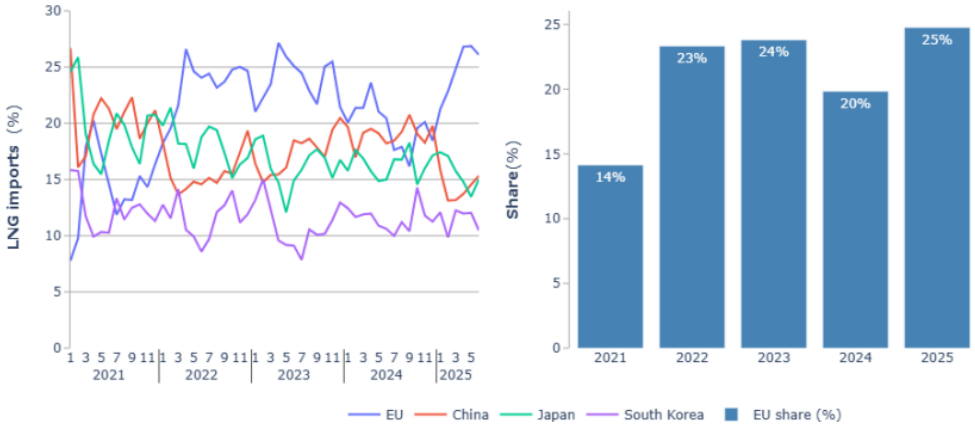
Figure 4 – Gas storage levels by quarters



Source: Gas Storage Europe AGSI+ Aggregated Gas Storage Inventory

The other structural change has been the growing role of LNG. LNG enables natural gas to be transported by sea in liquefied form, reducing dependence on fixed pipeline corridors and expanding the geographical scope of supply. The growth of regasification capacity, such as the quick deployment of floating storage and regasification units in Germany and other Member States after 2022, significantly added to the diversification capacity. Nevertheless, the markets of LNG are globally integrated; consequently, European prices are affected by the demand situation in Asia and global constraints in supply. Diversification thus increases flexibility and at the same time it exposes the European union to world price competition.

Figure 5 – The most important global LNG importers and evolution of the EU's annual LNG imports share



Source: European Commission calculation based on LSEG (Refinitiv) and ENTSO-G.

The 2022 crisis was a structural stress test of the liberalized system. Flows through Russian pipeline flows reduced dramatically, even through the Nord Stream channel, leading to a record jump in the benchmark prices at the Title Transfer Facility (TTF), reaching more than 300/MWh in August 2022. The hub-based pricing mechanism enabled quick price discovery and supply reallocation, which brought in record LNG inflows and accelerated intra-European trade flows. Meanwhile the same market integration relayed price shocks across Member States in a rapid and consistent fashion exposing the volatility of spot-based systems.

The episode showed both the advantages and disadvantages of the existing market design. On the one hand, liberalization and interconnection allowed quick diversification, trans-national solidarity and effective price signaling. Conversely, overdependence on market-driven pricing systems increased volatility and subjected households and industry to high economic prices. The system was flexible and not resistant to severe shocks.

The European gas market today can be described as liberalised, unbundled, hub-priced, highly-import-dependent, and more diversified, but still asymmetrical in infrastructures. This structure has immediate consequences on strategic interaction with the outside suppliers. Hub-based pricing limits bilateral price manipulation but does not eliminate strategic behavior; it only changes the strategic leverage of price-formula bargaining to volume choices, infrastructure management, and supply restrictions. Market design thus defines not only the commercial results but also the geopolitical dynamics, the level of strategic freedom and strength that the European Union has.

Overall, the shift to the integration-based hub market, which straightened the formerly nationally segmented monopolies, is a fundamental reorganization of the external energy relations of the European Union. The European gas market is not a pure commercial system but is an institutional structure which combines competition law, infrastructure regulation, energy security policy, and geopolitical strategy. Its structure defines the way prices are created, how shocks spread and how the bargaining power is distributed in the wider relation of EU-Russia in energy.

2.4. Russia as a Strategic Energy Supplier.

Russia has traditionally played a strategic role in the European energy system, as one of the largest external suppliers of natural gas, crude oil, and coal to the European Union. The magnitude of Russian hydrocarbon reserves, coupled with the vast pipeline network that links Russian sources to European points of consumption, has rendered Russia a structurally important player in the European energy market. Such a role has not been restricted to a strictly commercial purpose; it has encompassed both economic capacity of supply and strategic and geopolitical application. This is why the role of Russia as an energy supplier has been long considered not only as in the context of international trade but considered as well in the context of strategic interaction between states.

Russia has among the biggest known natural gas fields in the world, estimated at about 37 trillion cubic meters, which is close to a quarter of the global reserves (BP, 2022; IEA, 2023). The resources are also concentrated in Western Siberia and Yamal Peninsula, which have been the main centre of production and the main source of export pipelines to Europe. The richness of the natural gas reserves has influenced the Russian economic paradigm where exports of hydrocarbons serve as a cornerstone in fiscal revenues, foreign exchange earnings and the macroeconomic stability. Before 2022, energy export constituted about 45 percent of federal budget revenues and over 50 percent of total export revenues in Russia (IEA, 2022). As a result, the Russian economic system has relied on the availability of big and consistent external markets.

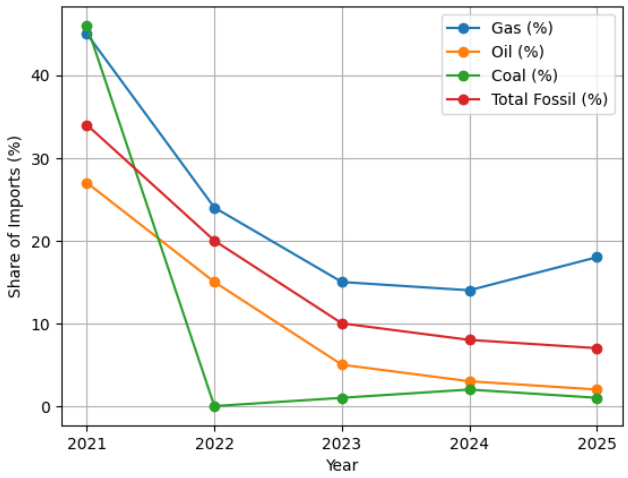
Historically, the European Union was the most critical destination of Russian energy exports. The physical location of Russia and Europe, as well as the establishment of extensive pipeline systems under Soviet rule and since the collapse of the Soviet Union, resulted in a high level of infrastructural interdependence. Gas trade between Russia and European markets relied on major pipeline systems like the Brotherhood, the Yamal-Europe, the Nord Stream and the TurkStream. Such pipelines were able to transport very large quantities of gas at comparatively low marginal cost after infrastructure was already in place. This made Russian gas in the pipeline one of the most competitive suppliers of gas to the European consumer over a number of decades.

Figure 6 – Major Russian Gas Pipelines to Europe

Source: Statista/ENTSOG (2022–2025); Adobe Stock vector

Prior to the geopolitical shocks of 2022, around 35 – 40% of all EU natural gas imports were provided by Russia, making it the biggest foreign supplier to the European market (Eurostat, 2023). Russian crude oil constituted a significant portion of EU oil imports, and Russian coal was also significant in a number of electricity production systems. The magnitude of these flows suggests that Russia was not a mere supplier among others but a structurally dominant participant in some parts of the European energy system.

Figure 7 – Russia's Share in EU Energy Imports (2021-2025)



Sources: Eurostat (2025); EC Quarterly Reports (2025); Bruegel dataset (2026)

Economically, the cost benefits of transportation by pipeline and long-term contractual relationships gave Russia a stronger position as a supplier. In the past, long-term oil price-linked contracts to supply gas to Europe were in place. These agreements gave the Russian exporters predictable sources of revenue and ensured that the European importers could depend on the supply. Such contracts usually lasted between twenty and thirty years, and this indicated the long-term nature of investment in upstream production and pipeline infrastructure.

Within these agreements, gas prices were commonly determined using an oil-indexation mechanism of the form:

$$\boldsymbol{P = \alpha P_{oil} + \beta}$$

where P represents the contractual gas price, P_{oil} represents the benchmark oil price, and α,β capture indexation parameters negotiated between buyers and sellers.

This mechanism stabilized prices and reduced short-term volatility, but it also embedded bilateral bargaining power within contract structures.

Meanwhile, the Russian supply policy implied a large state participation in the energy industry. Historically, huge energy corporations like Gazprom and Rosneft enjoyed strong institutional connections with the Russian state, which enabled energy policy to be somewhat aligned with the most general national strategic priorities. With natural gas exports, Gazprom had the dominant status in pipeline export infrastructure and long-term supply contracts with European firms. This organizational form enabled the Russian government to continue shaping the direction and magnitude of export flows to ensure the energy policy is linked to the foreign policy concerns.

The concept of market power can also be used to examine the strategic significance of Russia as a supplier. In energy economics, a supplier has a market power when it can determine prices through changes in supply volumes. In a simplistic Cournot model, suppliers decide on the quantity of output to produce and expect to have their competitors respond. The profit function for supplier can be expressed as:

$$\max_{\boldsymbol{Q_i}} \left(\boldsymbol{P(Q) - ci}\right) \boldsymbol{Qi}$$

where Q_i is the quantity supplied, c_i represents marginal cost, and $P(Q)$ is the market price determined by total supply.

In such a setting, a supplier with a large market share can influence equilibrium prices by adjusting production or export volumes. Prior to 2022, Russia's large share in EU gas imports gave it potential influence over market conditions, particularly in segments of the market where alternative supply routes were limited. The strategic location of Russia in European energy system should be considered in the context of interdependence. At the same time the European Union was depending on Russian energy imports they were also depending on the EU as being their main export market.

The pipeline system linking Russian production areas with Europe is designed based on the westward flows, which means that the redirection of exports to other markets would require huge investments in new pipeline capacity or liquefied natural gas (LNG) capacity. Therefore, this structural aspect limited the short-term operational flexibility of Russia and created an asymmetrical interdependence between supplier and consumer.

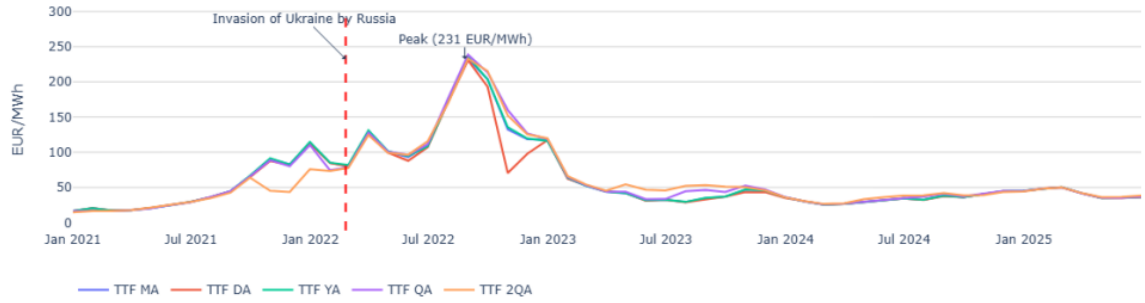
Although this interdependence is present, the position of Russia as a key supplier has increasingly become a disputed issue in the European policy discourse, especially since the geopolitical conflicts arose after the seizure of Crimea in 2014. There were concerns about the possibility of using energy exports as a tool for political leverage. Despite the Russian government reiterating that its export of energy was commercial in nature, a sequence of transit crises with Ukraine in the 2000s revealed how European supply chains were dependent on the whims of geopolitics.

The role of Russia as an energy supplier of strategic value has been further tempered by the changing structure of the European gas market as already mentioned. The shift of oil-indexed contracts to hub-based pricing schemes reduced the ability to negotiate bilateral price agreements and increased the effect of market-based price discovery. With the growth of the European gas hubs, producers started competing on a more integrated market basis. This change shifted the channels by which suppliers would be able to exercise influence, as the strategic interaction shifted to be based on volume regulation, infrastructure utilization, and supplier flexibility.

The 2022 happenings were a significant turning point in the involvement of Russia in the European energy system. Geopolitical tensions and sanctions led to a decrease in the flow of Russian pipeline

gas. Prices on the Dutch TTF hub rose to levels above 230 per megawatt hour amidst the peak of the crisis in August 2022 (IEA, 2023). These trends boosted the process of diversification of EU, such as increased LNG imports and faster deployment of regasification facilities.

Figure 8 – TTF day-ahead prices compared with TTF month-ahead and year-ahead prices (monthly averages).



Source: S&P Global (Platts).

The fall of Russian gas supplies significantly restructured the European gas market, reducing the share of Russia in imports to the EU to less than 15 percent by 2023 (European Commission, 2023). Despite still being a significant world energy producer, Russia has lost a significant portion of its influence in the European market compared to the pre-2022 situation. This metamorphosis is a vivid example of the way geopolitical shocks could redefine old energy trade relations within a short period of time.

In short, the three factors that had historically sustained the role of Russia as a strategic energy supplier to the European Union include: the availability of hydrocarbon resources, the pipeline infrastructure and the long-term contractual terms. These factors created a network of strong economic interdependence that supported consistent trade over decades. At the same time, the bulk of supply and the strategic importance of energy to both parties introduced the element of geopolitics to the seemingly commercial transactions. The reorganization of the European gas market in 2022 shows that the position of energy suppliers is shifting and changes depending on institutional changes, the restructuring of the market, and the geopolitical processes. It follows that Russia is not only a significant historical supplier on the European energy system but a promising

case study of how economies, infrastructure, and power relations on the international energy markets converge in the global markets.

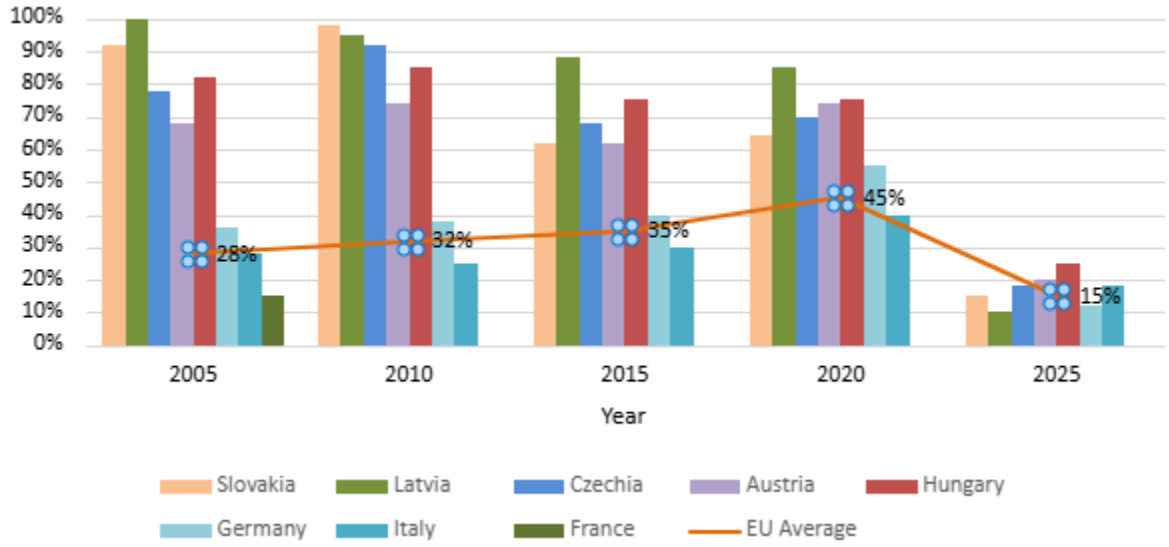
2.5. Energy as a Geopolitical Instrument

Energy functions not only as a traded commodity but also as a strategic asset that influences the bargaining power of states in international relations. In the EU–Russia relationship, energy trade can be interpreted as a strategic interaction in which both actors attempt to maximise economic gains while maintaining geopolitical leverage. The interaction between supply security, infrastructure dependence, and state interests creates a strategic environment in which energy flows affect the bargaining outcomes between the European Union and Russia. As a result, the idea of energy as a geopolitical tool takes a central stage in the academic examination of European energy security and the international political economy.

Theoretically, the geopolitical nature of energy can be viewed in the context of strategic interdependence. When two actors depend on each other for access to critical resources, their interaction can be modelled as a strategic game in which each player attempts to maximise its payoff under conditions of mutual dependence. In the EU-Russia relations, the European Union has been relying on Russian hydrocarbons to keep its industries running and households consuming energy, and Russia has been relying on the earnings of its energy exports to the European markets. This interdependence creates a strategic setting in which cooperation in energy trade coexists with incentives for strategic defection.

Before 2022, Russia was the largest supplier of natural gas to the European Union, supplying about 35-40 percent of all EU gas imports (Eurostat, 2023). These flows were so large that any major disturbance in supply had the potential to cause economic and political consequences throughout the European economies. Meanwhile, Russian state revenues were highly dependent on hydrocarbon exports that represented a significant share of federal budget revenues and export revenues (IEA, 2022; BP, 2022). These circumstances are typical of the classical design of asymmetric interdependence as explained by Keohane and Nye (1977) in which both parties are interdependent but can have different degrees of vulnerability and adjustment costs.

Figure 9 – Intra-EU Russian Gas Dependence Evolution (2005-2025)



Source: Eurostat; Bruegel

Figure 9 reveals significant heterogeneity in Russian gas dependence across EU member states. Central and Eastern European countries such as Slovakia, Austria and Hungary historically exhibited dependence levels exceeding 90 percent, making them particularly vulnerable to supply disruptions. By contrast, larger economies such as Germany experienced peak dependence levels of around 55% before initiating diversification strategies under the REPowerEU framework. These differences illustrate how the EU average level of dependence masked substantial regional asymmetries, which could be strategically exploited by the supplier through differentiated pressure across national markets..

The share of Russian gas in EU imports remained substantial until 2022, highlighting the structural dependence that characterised the EU–Russia energy relationship.

However, this dependence was not uniform across the European Union. Central and Eastern European countries historically relied much more heavily on Russian pipeline gas than many Western European states. Countries such as Slovakia, Hungary, and the Czech Republic had limited access to alternative suppliers due to geographical and infrastructure constraints, whereas countries with access to LNG terminals or diversified supply routes were less vulnerable to supply

disruptions. This uneven distribution of dependence created asymmetric vulnerability within the EU energy system itself.

Table 4 – Strategic Outcomes in the EU–Russia Gas Trade Interaction

Strategy	EU Payoff	Russia Payoff
Stable gas trade	Energy security	Export revenues
Supply restriction	Energy shock	Political leverage
Diversification	Reduced dependence	Loss of market share

Source: BP (2023); IEA (2022); European Commission (2022)

From a game-theoretic perspective, such asymmetric interdependence can be represented as a strategic interaction in which the supplier and the consumer face different adjustment costs. The exporting country may attempt to use supply reductions as a strategic move, while the importing region attempts to diversify supply sources in order to reduce vulnerability. The resulting strategic behaviour can be simplified in a payoff structure representing cooperation in trade versus strategic restriction of supply.

The geopolitical aspect of energy trade is particularly acute when there is a political crisis or tension. The first example of such a phenomenon was the gas transit conflicts between Russia and Ukraine in 2006 and 2009. These conflicts led to temporary disruptions of gas supplies to a number of European states, thus demonstrating the fragility of pipeline-based supply chains. Even though the conflicts were officially connected with the pricing and transit conditions, the ensuing upheavals proved the way in which geopolitical tensions may influence the operations of energy markets and supply stability.

From a strategic perspective, the presence of a transit country introduces an additional actor into the interaction between the exporter and the consumer. Disputes between the supplier and the transit state may therefore create negative externalities for importing countries, transforming the bilateral energy trade relationship into a more complex multi-player strategic setting

Energy infrastructure itself is a determinant of geopolitical dynamics. In contrast to most of the traded commodities, natural gas is delivered by fixed pipelines which demand long term capital investment and a geographical commitment. When this kind of infrastructure is in place, suppliers and consumers are in some way locked into certain supply paths, a phenomenon commonly referred to in economic literature as infrastructure lock-in. Large pipeline systems like Nord Stream, Yamal-Europe, and Brotherhood established direct links between Russian areas of production and European markets in the EU-Russia context, which strengthened the structural relationship between the two parties.

Because pipeline systems cannot be easily substituted in the short run, they create structural bargaining power for the supplier within the strategic interaction. A supplier holding a large share of supply infrastructure can theoretically affect market conditions by changing volumes, postponing deliveries, or divert exports.

As demonstrated in Section 2.4, the strategic behaviour of suppliers in hub-based gas markets can be represented through a quantity-competition framework in which exporters adjust supply volumes in response to market prices. In this context, the supplier is capable of manipulating equilibrium results by changing the amount of production or exports. Despite the growing use of hub-based pricing mechanisms in the European gas market, large suppliers with a large market share can still influence the dynamics of prices by making choices about supply.

The strategic explanation of Russian energy exports came to the forefront of European policy discussions after the annexation of Crimea in 2014. Even though the energy trade between the EU and Russia did not stop because of this event, there were increased concerns about the fact that energy could be employed as a means of geopolitical influence. European institutions started to focus on diversification policies, interconnectivity of infrastructure and creation of alternative sources of supply. These policies became a part of the Energy Union framework that sought to enhance supply security and minimize overreliance on individual external suppliers (European Commission, 2019).

These dynamics were greatly exacerbated by the events of 2022. Russian gas exports to Europe fell drastically after the intensification of the war in Ukraine. The market shock was reflected in unprecedented price volatility in European gas hubs, with benchmark prices reaching historical

highs during the crisis (IEA, 2023). The steep increase in prices reflected a sudden shift in market expectations and strategic supply behaviour.

The crisis triggered a rapid re-alignment of the European energy policy. The European Union has implemented the REPowerEU strategy, which aims at reducing reliance on Russian fossil fuels by diversifying imports, increasing LNG capacity, speeding up the use of renewable energy sources, and improving energy efficiency (European Commission, 2022). In a relatively short period of time, the percentage of Russian gas in EU imports decreased significantly as other suppliers increased their supplies.

These events demonstrate that geopolitical shocks can quickly destroy established energy trade relationships. Russia had long been a major player in the European energy system; the crisis showed that market structures, policy reactions, and infrastructure investments can redefine strategic dependencies in the long run. As a result, the idea of energy as a geopolitical tool does not only mirror the will of the political players but also the institutional and infrastructural setting under which energy trading is predetermined.

The other dimension that is salient is the interaction between market liberalisation and geopolitical strategy. As mentioned earlier, the European gas market has developed out of the oil indexed long-term contracts to hub-based pricing systems. Although this shift has led to competition and transparency, it has also left European markets vulnerable to even greater price volatility in cases of supply shock. Therefore, a liberalised market structure can not only increase diversification, but also hasten the spread of external shocks through a system of integrated Europe.

Strategically, the use of energy as a geopolitical instrument does not necessarily mean that there is a conscious coercion in all cases. Instead, it represents the larger fact that the power to command essential resources may affect bargaining statuses in international relations. The governments can pursue infrastructure policies or contractual policies or market positioning which will strengthen their strategic flexibility in the future negotiations. In this connection, the energy policy is closely associated with the foreign-policy goals and national-security interests.

In the case of the European Union, the lesson of dependence on a powerful foreign supplier has highlighted the necessity of diversification and strength. The LNG terminals, cross-border interconnectors, and renewable energy sources have become the focus of the energy-security

strategy of the EU. However, the energy markets of the world are still interconnected, which means that the EU is still vulnerable to foreign shocks despite the reduced reliance on particular suppliers.

To sum up, energy is a geopolitical tool in cases of economic reliance, infrastructure limitation, and political goals intersecting. The example of EU-Russia relationship shows that the energy trade may be both a source of mutual economic gain and a source of strategic weakness. The change in this relationship after the 2022 events shows the dynamic nature of energy geopolitics, where market structures, policy choices, and geopolitical developments interrelate to influence how power is distributed within the international energy systems.

3. Sanctions, Conflicts and Strategic Interaction

3.1. The Political Context of EU–Russia Relations since 2014

Political relations between the European Union and Russia experienced a structural break in 2014, which significantly changed the strategic environment, within which bilateral economic relations take place. Before this point, the relationship between EU and Russia was characterized by a combination of economic dependence and political ambivalence; where commercial and energy relations went hand in hand with periodic geopolitical conflicts.

Economically, the relationship was based on interdependence. Russia has been one of the European Union's largest trading partners as the EU was the main export market of Russian products especially energy commodities like natural gas, crude oil and coal. This interdependence generated mutual gains from trade and created a cooperative equilibrium in which both actors had significant incentives to maintain stable economic relations despite underlying disagreements in political beliefs.

However, this equilibrium was inherently fragile. The stability of the relationship was occasionally tested by political tensions, which were caused by the incompatible models of governance, the expansion of NATO, and interests in the post-Soviet space. These tensions were still contained even though they did not essentially uproot economic cooperation until 2014.

The Ukrainian crisis of 2014 was a critical shift that radically changed the political and strategic environment in which bilateral economic relationships take place. In particular, the annexation of Crimea and the subsequent conflicts in Eastern Ukraine have sparked a significant decline in political relations, having a direct impact on economic cooperation, especially in the energy industry. As a result, the EU-Russia relationship has increasingly evolved into a strategically constrained economic relationship that has been characterized by strategic competition, sanctions, and open political confrontation.

Political crisis in Ukraine was a pivotal moment in EU-Russia relationships. In March 2014, after political upheaval in Ukraine and a change of government in Kyiv, the Crimean Peninsula was annexed by Russia. The EU and international community widely criticized this move as a violation

of international law and Ukrainian sovereignty. The EU responded by imposing a wave of political and economic sanctions against individuals, financial institutions, and major industries of Russian economy (European Commission, 2014). These sanctions marked the beginning of a new era in EU-Russia relations, which have become increasingly politically confrontational. The EU measures included closing European financial markets to large Russian banks, imposing export restrictions to dual-use technologies, and restricting the export of some technologies related to energy.

In the context of a game-theoretic model, the imposition of sanctions is a shift in the payoff structure of the game that defines bilateral interaction. In particular, the utility of mutually cooperative results is reduced, and the utility of retaliatory behaviour is increased. As a result, the Russian government enacted countersanctions, of which the importation of agricultural products in the European Union stood out among the key ones. This behavior is consistent with a standard retaliation strategy in repeated-game context, in which an actor responds to counterparty deviation, to impose costs, and to discourage future unilateral deviation.

Table 5: Payoff Matrix Shift (2014 – 2022)

	Russia: C	**Russia: D**
EU: C	(+10, +10)	(-5, +15)
EU: S	(-2, -5)	(-20, -30)

Source: Author's own construction based on Nash (1950), Baldwin (1985), and Dubey (1982).

Where:

- *C* = Cooperation (continuation of trade relations)
- *D* = Defection (trade disruption / retaliation by Russia)
- *S* = Sanctions imposed by the EU

As a result, the dynamic between the European Union and Russia shifted to a non-cooperative strategic environment that is defined by a combination of economic interdependence and political antagonism. The implementation of sanctions did not lead to the immediate disruption of economic

relations, especially in the energy sector. EU member countries continued with the same high degree of dependence on Russian natural gas supplies, and Russia was dependent on the earnings coming out of European markets. This interplay created an atmosphere of circumscribed cooperation as both players maintained economic interactions in key industries and were engaged in political confrontation simultaneously.

However, the political environment that defined the relations between the EU and Russia changed towards the direction of distrust and strategic rivalry. European policymakers redefined the long-term consequences of relying on Russian energy resources, fearing that relying on such resources would create vulnerabilities in the context of geopolitical tension. Such issues led to the European Energy Union strategy that aimed to strengthen the security of supply by diversification, building infrastructure, and increasing integration of the internal energy market (European Commission, 2015).

Diplomatic cooperation in a broader scope of international policy was also influenced by the impairment of a political relationship. The EU also halted various forms of political interaction with Russia such as frequent summits which had been a breathing platform in the economic and political concerted action. Additionally, the tensions between Russia and several individual EU Member States were further exacerbated especially those in Eastern Europe, where Russia has been considered as a security threat since historical times.

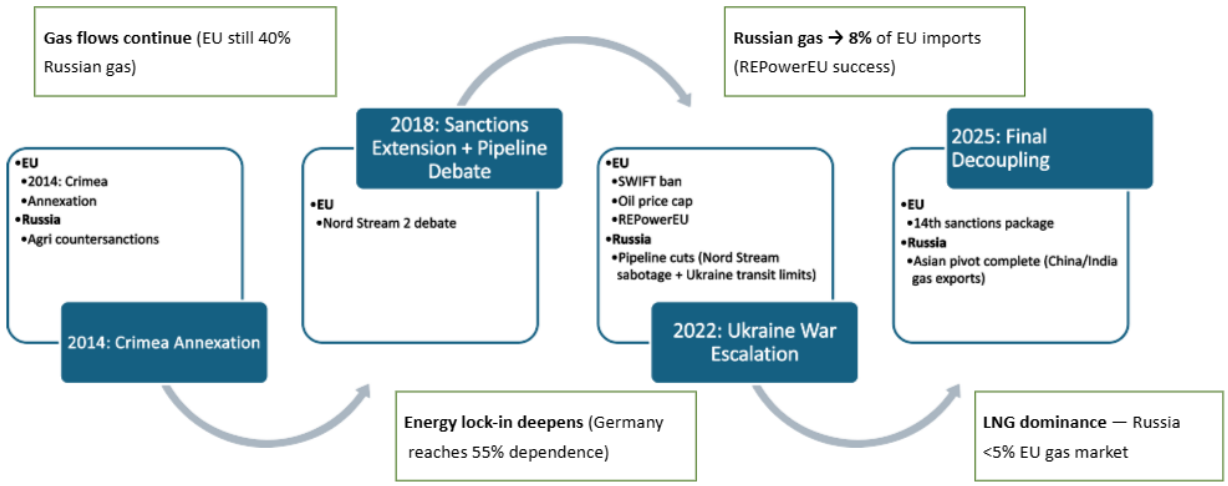
In the following years, the situation on the geopolitical scene was even more hazardous as the tension grew. The military presence in Eastern Ukraine continued in sporadic bursts and military interactions between Russia and Western nations were further disrupted by cyber security concerns, allegations of election interference and population wrangles over the international security setups. These events strengthened the impression that the EU-Russia relations were shifting towards a more antagonistic geopolitical model.

Although there was political tension, economic interdependence was high during the years between 2014 and 2021. European Union still imported significant amounts of Russian energy resources and Russian firms were still strong in the European energy markets. Such a combination of political rivalry and economic co-operation portrays the concept of complex interdependence as expressed in international political economy literature (Keohane & Nye, 1977). In

circumstances of complicated interdependence, states can maintain economic dependencies despite the decline of political connections between them.

Nevertheless, in 2022, the situation in Ukraine changes radically, and the geopolitical situation alters dramatically. Due to the large-scale military operation started by Russia in February 2022, a new, much broader wave of penalties by the European Union and its allies was triggered. These were measures that targeted a wide range of sectors such as finance, technology, transportation, and energy. The post-2022 sanctions were much more extensive in their scope compared to the sanctions that were imposed in 2014, and they were designed to limit the economic capacity of Russia to continue with the war.

Figure 10 – Evolution of EU–Russia Sanctions and Strategic Responses (2014–2025)



Source: EU Commission

The resulting political crisis only increased the change in EU energy policy. European organizations also implemented a package of measures that will decrease reliance on Russian fossil fuels, such as the REPowerEU agenda, increasing liquefied natural gas networks, and increased investments in renewable energy (European Commission, 2022). These policies were also aimed at contributing to the long-term restructuring of European energy relationships, as well as to deal with immediate risks of supply.

In this regard, the political aspect of the relationships between the EU and Russia became increasingly intertwined with economic and energy policy. All of the above, sanctions, counter

sanctions and energy market restructuring were all parts of a bigger strategic engagement between the two players. The relations between economies could not be considered only as commercial relations but became a part of a greater geopolitical environment where rivalry of power, security, and stability of the region took place.

In short, the post-2014 period suggests a paradigm shift in the political background of EU relations with Russia. What was once a form of relationship that was pragmatically- economical cooperation and an interdependence of energy has slowly transitioned into a form of relationship that is driven by geopolitical strife, sanctions and strategic competition. The processes that have begun in 2014 are the political background of the economic and strategic processes to be discussed in the further part of this chapter such as the justification of sanctions, reorganization of energy trade, and the dynamics of strategic interaction between the European Union and Russia in general.

3.2. Sanctions and Countersanctions: Economic and Strategic Logic

The use of sanctions and counteractions between the European Union and Russia represents a key mechanism through which political conflict is translated into measurable economic outcomes. Unlike purely diplomatic disputes, sanctions impose quantifiable economic costs and alter the payoff structure. Theoretically, the sanctions can be conceptualised as strategic instruments aimed at altering the payoff structure of interaction in order to influence the opponent's behaviour.

Sanctions in the EU–Russia context serve a dual purpose: they act both as punitive measures and as bargaining tools. On the one hand, they impose economic costs to deter undesirable actions; on the other hand, they signal willingness to sustain economic losses in pursuit of broader political objectives. In general terms, sanctions can be defined as restrictions imposed by one or more states to affect the political or economic behavior of another country. These actions can focus on finance, trade, technology, and energy sectors.

As discussed in Section 3.1, the political rupture of 2014 and its escalation in 2022 fundamentally altered the cooperative foundations of EU–Russia relations, transforming a previously interdependent relationship into a strategically constrained interaction. n the EU–Russia case, sanctions included financial restrictions, export controls, asset freezes and restrictions on energy-

related technologies (European Commission, 2022). The reaction of Russia, in terms of countersanctions especially to importing of agricultural products into Europe, established a reciprocal framework of economic restrictions.

From an economic perspective, sanctions generate costs for both the recipient and the sender. In the case of the European Union, sanctions imposed on Russia have caused some changes in the flow of trade, increased energy prices and hiked the costs of diversifying supply chains. To Russia, sanctions have been a limitation to access financial markets, technological imports, and reduced revenues of exports. This reciprocal cost construct shows that sanctions are not a zero-cost policy tool, but it is a trade-off strategic option between economic losses and geopolitical objectives.

Table 6: Types of EU Sanctions on Russia (2014-2026)

Year	Sector	Type of Restriction	Economic Impact	Strategic Objective
2014	Finance	Bank access ban	**-€50B liquidity**	Elite pressure
2014	Tech	Dual-use export ban	**Tech lag 5-10 years**; €50B investment block	Military limit
2022	Energy	Oil cap (€60/bbl); Coal ban	**Gas EU share 40%→8%**; RU €200B revenue loss	Weapon break
2022	Finance	SWIFT ban (7 banks)	**-€300B liquidity**; 20% bank funding loss	War funding
2023	Trade	Steel/chemicals ban	**Trade volume -86%** (€400B→€50B) [Eurostat]	Revenue starve
2025	Energy	14th pkg: Gazprom ban	**RU €200B loss**	Full decoupling

Sources: EC 17 packages; Eurostat

The transformation of the strategic environment can be formally linked to the shift in the payoff structure illustrated in Table 5 (Section 3.1). In particular, the transition from a cooperative

outcome (+10,+10) to a mutual defection outcome (−20,−30) reflects the deterioration of economic relations and the emergence of a non-cooperative equilibrium. While cooperation yields the highest joint benefits, both actors face incentives to deviate, especially under conditions of political conflict and declining trust.

Formally the logic of sanctions can be studied in a game-theoretic model. In a simplified static game, two players (the European Union and Russia) decide on cooperation or defection strategies. Cooperation involves the persistence of trade and stable relations and defection consists of sanctions, countersanctions, or disruption of supplies. The payoff table above shows the effect of sanctions in altering the strategic environment between a cooperative and non-cooperative strategy.

However, the EU–Russia interaction is more accurately represented as a repeated game rather than a one-shot game. In repeated interactions, actors consider not only immediate payoffs but also future consequences. Sanctions in this context serve as punishment strategies designed to enforce certain behavioural norms or deter undesirable actions. A standard representation of such a strategy is the trigger strategy, where cooperation continues until one player deviates, after which punishment is imposed.

$$\boldsymbol{U_i = \sum_{t=0}^{\infty} \delta^t \pi_i^t}$$

where $\delta \in (0,1)$ represents the discount factor and π_i^t represents payoffs over time t. A high discount factor implies that future payoffs are valued strongly, increasing the likelihood of sustained cooperation. However, when political conflict intensifies, the effective discount factor may decrease, making immediate strategic actions such as sanctions more likely.

The imposition of sanctions in 2014 can be viewed as the weakening of the cooperative equilibrium in a repeated game structure. EU responded to Russian activities in Ukraine by initiating economic sanctions, which pushed the relationship towards a retaliatory stage. Russian counter-sanctions are a retaliatory action which is in line with strategies of symmetric punishment. This is a dynamic that creates a cycle where the two players incur expenditures as they maintain their strategic positions.

The effectiveness of sanctions is based on several structural factors, such as economic asymmetry, the presence of alternatives, and the time frame of adjustment. Sanctions might not be effective when alternative markets or resources are available in the targeted country. In the example of Russia, the capacity to divert part of energy exports to Asian markets helped somewhat to overcome the impact of European restrictions. Meanwhile, the European Union could diversify its energy imports to buy more LNG and other suppliers but at a higher price.

Table 7: Economic Impact of Sanctions (2014-2025)

Indicator	EU Impact	Russia Impact
GDP Growth	-0.7% (2022); Recovered **+1.4% (2025)**	-2.1% (2022); + **1.8% (2025)**
Inflation	7.4% peak (2022) → 2.6% (2025)	17.8% peak (2022) → 9.5% (2025)
Trade Volume	-86% (€443B → €62B)	-68% (€309B → €98B)
Energy Prices	TTF €231/MWh (Aug 2022 peak)	Revenue €200B → €80B (-60%)
Investment	-€15B FDI	-€250B (capital flight)
Unemployment	+0.3% (temporary)	+1.8% (2023 peak)

Sources: IMF (2026); World Bank (2024); IEA (2025); Eurostat Q1 2026

Table 7 reveals critical asymmetries in sanctions impact that underpin the game-theoretic shift from cooperation to defection observed in Table 5. The European Union experienced manageable, temporary shocks — GDP contraction of only -0.7% in 2022 followed by +1.4% recovery by 2025, reflecting rapid LNG diversification and fiscal resilience. By contrast, Russia faced profound

structural damage: €250 billion investment collapse and 86% trade destruction represent permanent economic scarring beyond short-term war spending gains.

Inflation divergence further illustrates EU adaptability (7.4% peak vs Russia's 17.8%) while energy price shock (€231/MWh TTF peak) quantifies the credible threat Russia once wielded, now neutralized.

These quantitative outcomes validate the grim-trigger logic: EU sanctions have altered Russia's payoff structure, making cooperation unsustainable despite mutual economic costs, and thereby leading to a stable, decoupled equilibrium.

The trade volume collapse (-86% EU, -68% Russia) confirms complete decoupling equilibrium — validating the (-20,-30) mutual defection cell from Table 5. EU's lower adjustment costs enabled sustained pressure, while Russia's capital flight ensures long-term technological lag, transforming temporary geopolitical leverage into permanent economic disadvantage.

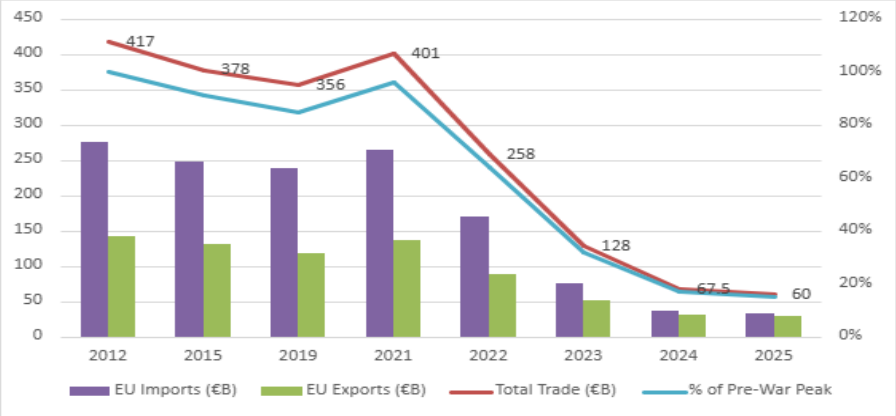
The second dimension is the difference between long-term and short-term effects. In the short run, sanctions tend to cause profound economic damage, such as a drop in trade and price fluctuations. But both actors can adjust themselves structurally in the long run. To illustrate, the European Union rushed in diversifying its energy policy, and Russia emphasized other non-oil export markets like China and India. Such modifications decrease vulnerability in the long run but they involve substantial transition costs and may lead to a permanent restructuring of economic relations.

Sanctions also play a signaling role in international relations. The European Union uses sanctions to express its politics and shows its readiness to pay an economic price to achieve some norms or strategic goals. This is a crucial signaling component especially in recurrent interactions where it shapes future behavior expectations. In the same light, Russian countersanctions demonstrate opposition and readiness to impose financial costs which strengthen its strategic stand.

The intensification of the sanctions since 2022 further contributed to the strategic aspect of the interaction. The European Union took more extensive and extensive measures, such as partial oil embargoes against Russia, financial transaction restrictions, and technology export restrictions. These actions were aimed at not only creating short-term economic costs but also undermining the

long-term economic and technological power of Russia. Russia retaliated by cutting gas supplies to Europe and increasing the shift to non-European markets.

Figure 11 – Deterioration in trade between EU and Russia (2012 – 2025).



Sources: Eurostat; World Bank Trade Data.

Strategically, the imposition of sanctions is the core mechanism of a larger conflict game where both parties strive to achieve maximum relative advantage and minimum losses. Such a game can be Pareto-inefficient because there are economic expenses on either side. Rather, the balance of power is usually a trade-off between economic harm and strategic purposes.

Sanctions and countersanctions in this case change economic interdependence into vulnerability instead of a benefit to each other. Although interdependence initially introduced incentives to cooperate, it also offered channels in which economic coercion could be enforced. This two-sidedness of interdependence is one of the main themes of international political economy and is more pronounced in the case of the EU and Russia.

Finally, sanctions and countersanctions between the European Union and Russia are a complicated strategic game whereby economic tools are applied to achieve political goals. The introduction of sanctions changes the payoff of the relationship, turning it into a non-cooperative strategic environment. Though sanctions are costly for both sides, they also serve as instruments of deterrence, signaling, and long-term strategic adjustment. The success of these actions is determined by the economic structure, flexibility, and wider geopolitical background where it is applied.

3.3. Energy Trade Under Sanctions: Constraints and Strategic Choices

The establishment of sanctions and countersanctions caused a significant change in the organization of energy trade between the European Union and Russia, transforming what had previously been a relatively stable system of interdependence into a constrained and strategically manipulated relationship. Although the role of energy has been defined in the previous chapters as one of the central pillars of EU-Russia relations, the imposition of sanctions reshaped the range of available strategies to each player as well as the economic consequences of the adopted strategies. In this regard, energy trade ceases to be a mere market-based exchange and should be understood as a constrained optimization problem under geopolitical and institutional pressure.

Until 2022, the energy flow between the European Union and Russia was largely predictable, long-term agreements, and infrastructure-related dependence. The addition of sanctions against energy industries, financial flows, and the movement of technology, however, greatly curtailed the operating space within which this trade might be conducted. These limitations did not only influence the quantity of trade but also the prices, contractual structures, and energy flows.

From an analytical perspective, the effect of sanctions can be interpreted as a restriction of the feasible strategy set available to both actors. In the case of the European Union, the strategic objective is to minimize total energy procurement costs while simultaneously reducing excessive dependence on Russian supplies. This can be represented as:

$$\underset{Q_R,\, Q_A}{\text{Min}}\ C = P_R Q_R + P_A Q_A + C_D(Q_A)$$

subject to:

$$Q_R + Q_A \geq D$$

$$\frac{Q_R}{D} \leq \theta$$

where Q_R denotes imports from Russia, Q_A imports from alternative suppliers, D total energy demand, and θ the politically acceptable dependence threshold. This formulation captures the trade-off faced by the EU between short-term cost minimization and long-term strategic autonomy.

For Russia, the optimization problem differs substantially. Its objective is to maximize export revenues while reallocating supply away from restricted European markets toward alternative destinations, primarily in Asia:

$$\max_{Q_{EU},Q_{AS}} \quad R = P_{EU}Q_{EU} + P_{AS}Q_{AS} - C(Q_{AS})$$

subject to:

$$Q_{EU} \leq \overline{Q}_{EU}^{sanction}$$

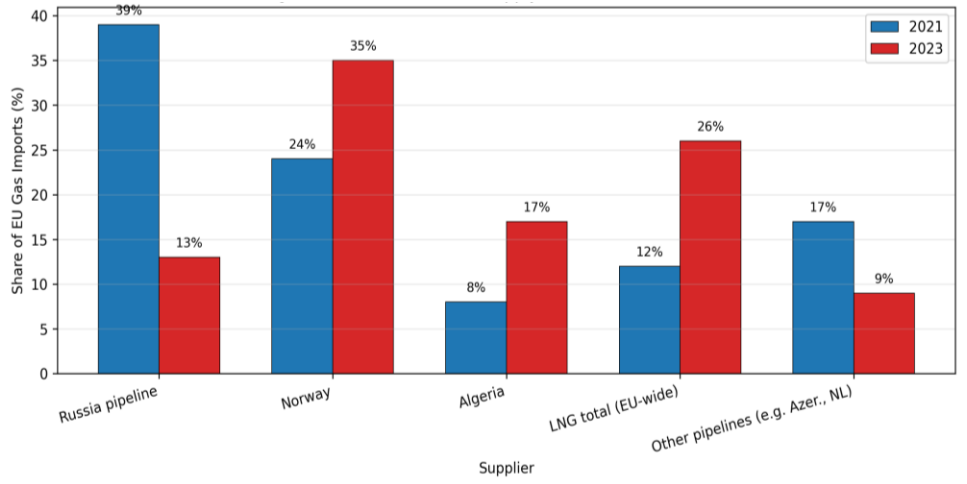
$$Q_{AS} \leq K$$

where K represents infrastructure capacity constraints, including pipeline throughput and LNG export capabilities. Sanctions therefore reduce access to the European market while forcing Russia to redirect exports toward Asian buyers, though such reallocation remains limited by transport bottlenecks and liquefaction capacity.

The implementation of these limitations essentially changes the strategic relationship between the two players. Rather than deciding to cooperate or defect in a free environment, the players are now constrained by small strategy spaces. The strategic decision that faces the European Union is whether to find a balance between energy security and economic price. The speed of diversification into LNG and other suppliers enhances resilience, but costs more in imports and makes the EU vulnerable to volatility in the global market. The strategically optimal response for Russia is to reallocate exports across destination markets while preserving revenue under infrastructure constraints.

Among the greatest limitations that sanctions have brought about concerns infrastructure. As argued in the other chapters, natural gas trade through pipeline establishes a high level of rigidity because it is fixed geographically. The cutting of Russian pipeline flows to Europe, whether due to sanctions, political decisions, or physical interference (e.g., Nord Stream incidents) led to a steep imposition on Russian capacity to service its traditional market. Meanwhile, the European Union was limited by its capacity to regasify LNG and domestic distribution networks, especially during the initial crisis phases.

Figure 12 – Shift in EU Gas Supply Structure (2021 vs 2023)



Source: Eurostat, 2024

A second major set of constraints concerns financial and technological restrictions. Sanctions against Russian financial institutions restricted access to the global capital markets, which impacted the capacity of energy companies to finance new projects. On the same note, the limits on technology exports, especially in the area of LNG and deep-sea mining, limited the long-term production of Russia. These restrictions demonstrate that sanctions may impact not only the existing trade movements but the future supply potential.

From a game-theoretic perspective, the introduction of constraints modifies the structure of the game itself. Instead of a standard strategic interaction, the situation can be described as a constrained game in which players optimize their strategies within restricted feasible sets. This can be represented as:

$$\max_{s_i \in S_i'} U_i(s_i, s_j)$$

where S'_i represents the constrained strategy set resulting from sanctions. The reduction of available strategies increases the likelihood of suboptimal outcomes, as players are unable to achieve previously attainable cooperative equilibria.

The empirical outcome of these constraints has been a significant restructuring of energy trade flows. The European Union rapidly reduced imports of Russian natural gas and substituted them

with LNG imports from the United States, Qatar, and other suppliers, as well as increased pipeline imports from Norway. Such diversification approach minimized reliance on Russian energy to a great extent at the expense of increased price and vulnerability to external market factors.

In the case of Russia, export strategy was reoriented due to decrease in the European demand. Export of energy was being shifted more to the Asian markets especially China and India. This transition has however been limited by the infrastructure constraints, such as the capacity of the existing pipelines like Power of Siberia, and the comparatively underdeveloped infrastructure in the LNG export, in comparison with the world leaders. This has made Russia struggle to compensate the loss of the European markets entirely in the short run.

Another strategic aspect is that of pricing power. The fact that Russia was a significant supplier to the European market before the sanctions gave it some power to influence the market conditions. Nevertheless, its market share has been declining, which has undermined this status, as pricing has been moving towards global LNG markets and diversified suppliers. This shift is indicative of a larger reallocation of market power in the world energy system.

The relationship between constraints and strategic decisions brings out the adaptive behaviour of both players. The European Union followed the policy of fast diversification and restructuring of its energy system, whereas Russia followed the policy of the reorientation of the market and partial disconnection with the European markets. These measures represent logical reactions to the limitations created by sanctions but also represent a long-term change in the organization of the global energy trade.

To sum up, energy trade under sanctions can be best viewed as a limited strategic game whereby both the European Union and Russia maximise their payoffs (or utility) under constrained and changing sets of available strategies. Sanctions do not merely decrease trade; they transform the pattern of economic engagement, change incentives and restructure strategic decisions. The resulting balance is not one of efficiency but of accommodation, with both players incurring expenses in the effort to make themselves less vulnerable and maintain their strategic freedom. This change is a paradigm shift from cooperation based on interdependence to constraint-based strategic competition in the European energy system.

3.4. Strategic Interdependence and Conflict of Interests

The development of EU–Russia relations since 2014 shows that political confrontation and economic dependence are not mutually exclusive but are combined in a system of strategic competition. The above discussions have indicated that the bilateral relationship was altered by political discontinuity, sanctions, and limited energy trade to a strategically competitive space. However, despite the progressive decoupling of trade flows and the increasing use of economic instruments as geopolitical tools, the interaction between the European Union and Russia remains fundamentally shaped by strategic interdependence. This interdependence no longer sustains stable cooperation but instead generates a long-term conflict of interests where both actors are economically and strategically interdependent despite having conflicting political goals.

Compared to mere economic interdependence, strategic interdependence is characterized by the fact that the actions of one actor systematically change the opportunity set, costs, and payoffs of the other. In the EU-Russia case, the choices on sanctions, supply reduction, diversification, infrastructure investment, and external alliances all have feedback effects. Any attempt by the European Union to decrease reliance on Russian energy has a direct impact on the Russian export earnings, fiscal stability, and accessibility to the market in the long term. On the other hand, the Russian supply choices still affect the price volatility in Europe, the use of infrastructure, and diversification cost even though the direct trade volumes are decreasing.

From a game-theoretic perspective, this interaction can be represented as a dynamic interdependence game in which each player's strategy enters the payoff function of the other:

$$U_{EU} = f(S, D, R)$$

$$U_{RU} = g\,(E, P, A)$$

where S denotes sanctions intensity, D diversification effort, R residual dependence, E export redirection, P pricing strategy, and A access to alternative markets. The central characteristic of this framework is that neither player can optimize independently: every strategic move generates second-round responses that reshape the strategic environment.

A fundamental conflict of interests emerges from the tension between European energy security and Russian revenue security. In the case of the European Union, the long-term goal is

predominantly to achieve maximum security of supply with minimum exposure to geopolitical leverage. This necessitates diversification, growth of infrastructure, coordination of regulations and the increased pace of switching to renewable energy. In the case of Russia, the strategic goal is to ensure the stable export revenues, geopolitical control via energy relations, and non-reliance on a limited circle of non-European consumers. These are structurally incompatible objectives, which form a state of persistent conflict equilibrium.

Table 8 – Conflict of Strategic Objectives: EU vs Russia

Strategic Dimension	**EU Objective**	**Russia Objective**	**Conflict Outcome**
Supply security	Maximize security of supply, reduce dependence on Russia	Maximize revenue and geopolitical leverage over Europe	Conflict over **decoupling vs remaining leverage**
Revenue stability	Not a core priority, but desire to avoid extreme price shocks	Secure stable export revenues	Conflict over **lower (EU-favored) vs higher (RU-favored) prices**
Infrastructure	Invest in LNG terminals, interconnectors, storage, and renewables	Invest in pipelines and LNG export projects toward Asia	**Lock-in in opposite directions**; EU reduces RU dependence, RU reduces EU access
Pricing	Shift to hub-based pricing, limit long-term contracts	Preserve pricing power where possible	Conflict over **contract terms** and **hub vs oil-index** pricing
Alliances/ Partnerships	Strengthen EU-US and EU-Asia energy cooperation	Closer ties with China and India	**Competition** for LNG routes, pipeline projects, and geopolitical influence

Source: BP (2023); IEA (2022); European Commission (2022); Gazprom (2021); World Bank (2023)

Infrastructure decisions are especially prone to conflict of interests. The European Union has taken more investments in LNG terminals, cross-border interconnectors, storage systems and renewable energy systems. Such investments decrease the residual dependence and dilute the strategic significance of Russian pipeline exports. Nevertheless, these measures are also associated with high transition costs to European consumers and industry. In parallel, Russia has shifted its strategic infrastructure to Asian markets, such as pipeline development and LNG export projects. However, this re-alignment generates new types of reliance on fewer buyers, which lowers bargaining power.

The strategic interaction can therefore be modeled as a repeated adaptation process:

$$s_i^{t+1} = BR_i\left(s_j^t\right)$$

where each actor chooses its next strategy as the best response to the previous action of the opponent. This recursive structure captures the continuous adaptation observed since 2014: EU sanctions induce Russian reorientation; Russian supply adjustments induce EU diversification; EU market redesign induces Russian infrastructure realignment.

One of the implications of this framework is the development of path dependence. The long-term structural consequences of strategic decisions undertaken post-2014 and particularly post-2022 are hard to undo. The sunk costs of LNG capacity and renewable transition by the EU predetermine diversification in the future. In the same manner, the transformation of infrastructure in Russia to the Asian direction forms long-term obligations which lower the chances of returning to the European markets on the same scale as before. Thus, strategic interdependence still exists, but the pathways of its functioning are more indirect.

The other significant conflict of interests relates to pricing mechanisms. As it was demonstrated in the preceding chapters, the European gas market shifted to hub-based pricing, which minimized bilateral leverage using oil-indexed contracts. This system under sanctions shifted market power off bilateral long-term dependence and onto global LNG competition. Although this undermined the direct pricing power of Russia against Europe, it also exposed Europe to the effects of price

shocks globally. Consequently, the two actors are indirectly connected by being exposed to volatility in the global gas market.

The fact that strategic interdependence has been maintained even after bilateral trade has declined, lends credence to the more general theoretical point that interdependence may persist in modified form even after decoupling. Strategic connections are maintained even in cases where direct trade flows are weaker because of infrastructure legacies, market expectations, pricing spillovers, and geopolitical signaling. In this regard, conflict in itself is imbued in interdependence, rather than being its replacement.

The outcome of this interaction is a stable conflict equilibrium rather than a renewed cooperative equilibrium. Formally, the strategic environment can be likened to a repeated non-cooperative game where both parties opt to play best actions that reduce vulnerability instead of maximizing joint welfare. This can be interpreted as a second-best equilibrium:

$$U_{EU}^{*} < U_{EU}^{coop}, \quad U_{RU}^{*} < U_{RU}^{coop}$$

where both actors achieve lower payoffs than under pre-2014 cooperation, yet neither has incentives to unilaterally return to the previous equilibrium due to credibility constraints and structural realignment.

This is of particular interest in the international political economy. The case of EU-Russia shows that economic interdependence does not exclude conflict but reshapes the avenues of conflict pursuit. Energy markets, sanctions, infrastructure, and market design are all arenas where strategic rivalry is reproduced continuously.

To sum it up, the European Union and Russian relationship is currently defined by strategic interdependence in the conditions of conflict. The mutual influence of strategic decisions was not erased by sanction and diversification, although they decreased the direct trade dependence. Rather, both actors are stuck in a dynamic feedback loop where each policy decision redefines the opportunity set of the other. The resultant balance is that of a long-term strategic competition, where conflict of interests and long-term economic and geopolitical interdependency coexist.

This section therefore provides a natural transition to the next analytical phase of the thesis, where the long-term implications for European market resilience and geopolitical bargaining are examined in greater depth

4. The Game Theoretic Model of EU–Russia Energy Interaction

4.1. The Structure of the Model: Players, Strategies and Payoffs

The EU-Russia strategic interaction in energy trade may be formally modeled as a non-cooperative game of two players under political and infrastructural restrictions (Nash, 1950). The model is based on the advancements covered in the earlier chapters and it describes how the energy interdependence has evolved into a strategic environment that is influenced by sanctions, diversification policies, supply restrictions, and long-term geopolitical realignment.

The game includes two rational players:

- Player 1: the European Union (EU)
- Player 2: Russia (RU)

Both the actors are supposed to maximize their respective utility functions under economic, political and infrastructure related constraints.

The European Union's utility depends on three main objectives:

1. security of energy supply
2. minimization of procurement costs
3. reduction of geopolitical vulnerability

The utility of Russia depends on:

1. export revenue maximization
2. preservation of geopolitical leverage
3. maintenance of long-term market access

The utility functions can therefore be represented as:

$$U_{EU} = \alpha S - \beta C - \gamma D$$

$$U_{RU} = \theta R + \lambda L - \mu M$$

where:

- S = supply security
- C = procurement cost
- D = dependence vulnerability
- R = export revenue
- L = geopolitical leverage
- M = market loss

The parameters $\alpha,\beta,\gamma,\theta,\lambda,\mu > 0$ capture the relative strategic importance assigned by each player to the respective components of utility.

This reflects the asymmetry of strategic priorities between the two actors. Resilience and strategic autonomy are the two main priorities of the European Union, and the sum of revenue stability and political influence is comparatively more significant to Russia.

The strategic set of the European Union is defined as:

$$S_{EU} = \{C, D\}$$

where:

- C = continue trade cooperation
- D = diversify imports and impose sanctions

Russia's strategic set is:

$$S_{RU} = \{C, R\}$$

where:

- C = maintain stable supply
- R = restrict supply or retaliate

The interaction between these strategies generates four possible outcomes. Unlike Table 5, which illustrates the historical payoff deterioration between 2014 and 2022, Table 9 presents the simplified baseline strategic structure used for formal modeling

Table 9 – Basic Strategy Matrix

	Russia: Maintain Supply (C)	**Russia: Restrict Supply (R)**
EU: Cooperate (C)	(10,10)	(-5,15)
EU: Diversify/Sanction (D)	(5,-5)	(-15,-20)

Source: Author's own construction based on Nash (1950) and Axelrod (1984).

The payoff matrix summarizes the main strategic dilemma of the thesis. Mutual cooperation (C, C) produces the maximum joint welfare and is associated with the time before 2014 when interdependence and mutual economic benefits were rather stable.

But when political confrontation arises, both parties have an incentive to implement defensive measures to minimize future vulnerability.

The cooperative outcome reflects:

- low prices
- stable energy supply
- strong export revenues
- limited market volatility

By contrast, the conflictual outcomes reflect:

- sanctions and countersanctions
- diversification costs
- supply disruptions
- revenue losses
- long-term infrastructure reallocation

Structurally, the game resembles a modified prisoner's dilemma, although the asymmetry of retaliation payoffs also introduces elements of a punishment and deterrence game, consistent with the strategic logic of repeated cooperation and reciprocal retaliation discussed by Axelrod (1984)

The payoff ordering implies that both players face incentives to deviate from mutual cooperation when political distrust increases, thereby making the cooperative outcome fragile in a one-shot setting.

A crucial feature of the model is the presence of exogenous infrastructural constraints:

$$Q_{RU} \leq K_{pipeline}$$

$$Q_{LNG} \leq K_{termnal}$$

These restrictions are a reflection of the short-run flexibility of both players which is limited. The amount of exports that Russia can make is limited by the pipeline capacity, and the diversity choices of Europe are limited by the LNG regasification and the infrastructure of terminals.

This assumption links directly to Chapter 3, whereby strategic flexibility was found to be constrained by sanctions and infrastructure bottlenecks.

From the perspective of aggregate welfare, the ranking of outcomes is:

$$(10,10) > (-5,15) > (5,-5) > (-15,-20)$$

However, from the viewpoint of individual strategic incentives, both players may rationally prefer self-protective strategies even when these generate lower collective welfare.

The model also presupposes the lack of complete trust, political uncertainty, and dynamic expectations which are necessary to explain why rational actors can adopt inefficient results.

A realistic extension of the framework concerns the endogenous evolution of market power over time. Russia's leverage declines as the EU's diversification strategy becomes more effective, whereas the EU bears substantial short-run adjustment costs during the early stages of sanctions and import substitution.

Therefore, the payoff structure should be interpreted as dynamic rather than permanently fixed, which naturally motivates the repeated-game analysis developed in the next section and reflects the broader logic of evolving cooperation under repeated strategic interaction (Axelrod, 1984).

This formal structure provides an analytical basis for the remainder of the chapter. The one-shot game identifies short-run equilibrium outcomes, while the repeated-game framework describes how cooperation may persist, collapse, or transform under retaliation, reputation and credible commitments.

4.2. The One-Shot Game: Strategic Outcomes and Equilibria

The one-shot form of the game with the payoff as shown in Table 14 characterizes the strategic interaction between the European Union and Russia in the short run when there is a political shock, partial trust, and scarce institutional coordination. In this framework, both actors choose their strategies simultaneously, taking the opponent's action as given and maximizing their immediate payoff in a standard non-cooperative normal-form setting (Osborne and Rubinstein, 1994).

Formally, the strategic interaction may be represented as

$$G = \{N, (S_i)_{i \in N}, (U_i)_{i \in N}\}$$

where $N = \{EU, RU\}$, the strategy sets are defined in the previous section, and the payoff functions reflect the political and economic objectives associated with supply security, revenue preservation, and geopolitical leverage.

The equilibrium can be calculated through reviewing the best-response incentives entrenched in Table 9. For the European Union, cooperation remains the optimal short-run strategy under both possible Russian actions. Assuming that Russia continues with stable supply, the EU gets a payoff of 10 of cooperation against 5 of immediate diversification and sanctions. In the case where Russia chooses to limit supply instead, the EU would still prefer to cooperate, receiving -5 instead of -15. This implies that cooperation is the best-response of the EU to both possible Russian actions, and in this specific payoff configuration it is a dominant strategy for the EU within the one-shot framework (Gibbons, 1992).

This result is economically intuitive. The EU has significant adjustment costs related to diversification in the short-run: infrastructure bottlenecks, pipeline-based industry dependence,

and LNG regasification capacity. Therefore, in situations of political tension, preserving partial cooperation is still less expensive than instantaneous strategic decoupling.

Russia's incentives differ. When the EU cooperates, Russia has a strictly higher payoff from restricting supply (15) than from maintaining steady exports (10). The logic reflects the short-run exploitation of market power and the strategic use of energy as a bargaining instrument, consistent with one-period opportunistic behavior in strategic market games (Dubey, 1982).

However, when the EU imposes sanctions and diversifies, Russia's payoff is higher from supplying (−5) than from further retaliation (−20), as the latter only deepens mutual losses. Thus, the best-response mapping leads to the strategy pair (C, R).

This forms the unique Nash equilibrium of the one-shot game

(C, R)

At equilibrium, the European Union sustains short-run cooperation, and Russia is engaged in strategic supply restraint to obtain as much short-run geopolitical leverage and short-term rents as possible through asymmetric dependence.

Although individually rational, this outcome is strategically inefficient. Mutual cooperation (C, C) would yield higher joint welfare, generating total payoffs of 20, whereas the equilibrium outcome yields only 10. The difference highlights the welfare loss generated by political mistrust, incomplete commitment, and opportunistic incentives (Fudenberg and Tirole, 1991).

The one-shot equilibrium can thus be viewed as a kind of strategic hold-up, where one party takes advantage of the interim inflexibility of the other. The short-run reliance of the EU on Russian energy imports exactly provides the asymmetry that opportunistic restriction is profitable in a single-period model.

This logic closely reflects the empirical dynamics observed during the early phases of political confrontation. During the times when the diversification potential of the EU was still insufficient, Russia could reasonably use supply pressure as a coercive tool even though it might result in reputational loss in the long term. Simultaneously, the fact that the EU continued partial

cooperation was an economic reality of very inelastic short-term energy demand and lack of replacements that could be readily scaled.

Nevertheless, this is the very short-term character of the one-shot game that is the primary analytical restriction of the game. The equilibrium fails to consider the retaliation in the future, reputation, sunk cost in diversification and the fact that in the present, the coercive gain will lead to permanent structural destruction of demand tomorrow. When the interaction is prolonged over several periods, the incentive to defect is conditional, depending on the future anticipated losses (Mailath and Samuelson, 2006).

For this reason, the repeated-game version developed in the next section provides a more realistic framework for understanding how cooperation may persist, collapse, or transform through retaliation, punishment, and long-term strategic adaptation.

4.3. The Repeated Game: Cooperation, Retaliation and Long-Term Strategies

While the one-shot game explains the logic of short-run opportunistic behavior, the strategic interaction between the European Union and Russia is more realistically understood as a repeated game, in which both players interact over multiple periods and condition their present choices on expected future responses. This extension is especially applicable to the situation of long-term gas contracts, pipeline-specific investment, and recurring political bargaining on the subject of energy reliance. Let the stage game described in the previous section be repeated infinitely over periods *t=0,1,2,.,* and both players discount the future payoffs by a common factor:

$$0 < \delta < 1$$

where δ captures the importance assigned to future gains relative to immediate benefits. A higher value of δ reflects a stronger long-term orientation, greater concern for reputation, and a larger shadow of the future (Mailath and Samuelson, 2006).

Under repeated interaction, mutual cooperation (C,C) may be sustained as a subgame-perfect equilibrium if both actors adopt contingent strategies based on future punishment. A natural representation in this context is the grim-trigger strategy: each player cooperates as long as the

other has never deviated but permanently switches to the non-cooperative response after any deviation.

For the European Union, this corresponds to continued trade cooperation as long as Russia maintains stable supply. In the case of Russia, collaboration will continue as long as the EU will not diversify and implement sanctions that will exceed the cooperative point. Any unilateral deviation triggers an irreversible shift to the punishment path, characterized by retaliatory sanctions, supply reductions, and accelerated strategic decoupling.

Sustainability of cooperation is determined by whether the short-term profit of deviation is higher than the discounted value of future cooperative rents. In the case of Russia, the payoff of deviating cooperation is the difference between the opportunistic payoff and the cooperative payoff:

$$15 - 10 = 5$$

However, deviation causes the loss of future cooperative payoffs and moves the interaction toward the conflict equilibrium. Cooperation is sustainable when:

$$\frac{10}{1-\delta} \geq 15 + \delta\frac{-5}{1-\delta}$$

Solving the incentive constraint yields:

$$10 \geq 15(1-\delta) - 5\delta$$

$$10 \geq 15 - 20\delta$$

$$20\delta \geq 5$$

$$\delta \geq \frac{1}{4}$$

This threshold suggests that in case Russia attaches a high level of importance to the future, the long-run cost of losing the European market would be greater than the short-term geopolitical gain of supply restriction.

The same reasoning applies symmetrically to the European Union. Although immediate diversification may reduce vulnerability, premature sanctions in the absence of direct provocation

impose large short-run costs through higher spot prices, industrial disruption, and infrastructure adjustment expenses. Thus, the EU also has reasons to maintain cooperation in case the stability of future supply is credible.

The strategic structure of the model is thus changed using the repeated-game framework. In contrast to the one-shot environment where opportunistic restriction is the only Nash equilibrium, repeated interaction makes the cooperative solution self-enforcing via the threat of punishment in the future (Fudenberg and Tirole, 1991).

The outcome is highly empirically applicable to the EU-Russia energy relations prior to 2022. The continuation value of both actors was sufficiently high through long-term contracts, sunk investments in pipeline infrastructure, and bargaining over pricing and transit that was repeated. The anticipated future flow of reciprocated benefits perpetuated collaboration even in the face of unrelenting political strains.

Nevertheless, the logic of repeated-games also provides the explanation of why it is that cooperation often fails abruptly in the wake of significant geopolitical shocks. When political conflict reduces the expected duration of the relationship, lowers trust, or makes future trade appear structurally unsustainable, the effective discount factor δ declines. Once δ falls below the cooperation threshold, opportunistic deviation becomes individually rational.

The post-2022 strategic rupture is especially well explained through this mechanism. The intensification of sanctions, the loss of trust, and the hasty restructuring of EU energy acquisition to LNG imports and other pipeline paths diminished the continuation value of cooperation to a considerable extent. Simultaneously, the shift of Russia towards the Asian markets partly offset the anticipated losses on the European markets, which further undermined the disciplining effect of future punishment.

Retaliatory path dependence is also reflected in the repeated-game. When one of the actors defects, the later choices of strategies do not exist in the cooperative space but rather in a path of punishment that is determined by sunk infrastructure, political signalling, and strategic credibility. This is one of the reasons why short-term shocks can form persistent institutional and business realignment.

In this respect, the repeated game can be considered a more realistic explanation of long-term EU-Russia strategic behaviour as compared to the one-shot model. It proves that cooperation is not simply a by-product of common interests, but it is an outcome of a sufficiently valuable future interaction, the credibility of punishment, and the expectation of future interdependence on the market.

The following section is based on this dynamical reasoning, but it narrows down to the issue of credible threats and commitments, which decide whether strategies of punishment and incentives of long-term cooperation are plausible in practice.

4.4. The Role of Credible Threats and Commitments

The sustainability of cooperation in the repeated-game framework depends not only on the value of future interaction, but also on the credibility of punishment strategies and strategic commitments. A threat can only affect the behavior of the opponent when it is rational to execute it when deviation has taken place. Only credible threats are sufficient to support a subgame-perfect equilibrium in a dynamic game theory, but non-credible punishments are ineffective since they would not be optimal once the punishment phase is really achieved (Fudenberg and Tirole, 1991).

This distinction is central to EU–Russia energy relations. The repeated-game logic developed in the previous section assumes that deviation from cooperation triggers retaliatory responses such as sanctions, supply restrictions, accelerated diversification, or permanent contractual withdrawal. Nevertheless, the responses will only have strategic consequences where both parties are convinced that the retaliatory measure to be taken will actually be taken despite its costs.

In the case of the European Union, the threat of rapid diversification can only be real when institutions and infrastructures required to facilitate substitution are already established. Threats of this nature were only partially believable prior to 2022. The presence of pipeline-specific dependence, a low level of LNG regasification capacity, and the high level of industrial dependence on unvarying pipeline flows meant that the possibility of immediate diversification was less realistic, despite the fact that the EU could declare future de-diversification of Russian

gas. As a result, Russia could rationally discount part of the EU's diversification threat, weakening its deterrent effect.

The threat structure of the EU gained credibility to a large extent when irreversible investments began to be made. The growth of LNG terminals, the construction of reverse-flow pipeline capacity, the long-term agreements with other suppliers, and the regulatory engagement within the framework of the REPowerEU transformed diversification from a political signal into an economically binding strategy. Such sunk investments are commitment devices, in that once invested the capital has been committed, it becomes more expensive to go back to the former level of dependence. Game-theoretically, irreversible investment alters continuation payoffs of subgames in the future and enhances the credibility of punishment.

A similar logic applies to Russia. Supply interruption threats are only credible when the short term geopolitical benefits and long term strategic repositioning benefits outweigh the loss of revenue of decreased access to the European market. Prior to the large-scale reorientation of exports, such threats were constrained by strong fiscal dependence on European energy demand. Nevertheless, the expense of implementing supply restrictions reduced as Russia continued to diversify its export routes to Asian markets. This heightened the plausibility of the coercive supply threats and changed the equilibrium structure of the repeated interaction.

The aspect of commitments is thus tightly associated with the aspect of irreversibility and sunk cost. Structural commitment mechanisms include the construction of the pipeline, LNG infrastructure, interconnection networks, and long-term contractual requirements. When these kinds of assets are present, they reduce the set of strategies that are feasible at later points in the game and consequently remake the beliefs regarding future action. Strategic commitments are therefore not merely political pronouncements, but material constraints that are entrenched in the infrastructure and in institutions.

Such an outlook can be used to understand why the 2022 rupture resulted in a more severe strategic disorientation than previous political crises. As soon as both actors made such large irreversible investments in alternative market structures the EU in the direction of diversified LNG and non-Russian suppliers and Russia in the direction of redirection to the Asian market, the past cooperative equilibrium grew less and less credible. Although short-run economic interests might

have had a temporary influence on partial reinstatement of trade, the political and infrastructural investments, once sunk, made a reversion to the former balance a strategy highly vulnerable to dislocation.

Theoretically, the force of credible threats and commitments supports the dynamic logic of subgame perfection. The cooperation can only last when the punishments are imposed when they deviate and the punishments are individually rational in all continuation subgames. When commitments are entrenched in infrastructure and policy-making, the believability of those punishments increases, and long-run strategic behavior is more predictable.

This means that long-term strategic payoffs in the EURussia scenario are not only a matter of preference and payoff but also the degree to which each party can commit itself using irrevocable economic decisions. The persistence of cooperation or conflict hence relies on whether or not institutions, contracts, and physical infrastructure convert announced strategies into credible future actions.

The next section will compare these theoretical forecasts with the empirical development of the EU-Russia energy relations, which will enable the analysis of the equilibrium logic of the model against the events that occurred in post-2014 and post-2022.

4.5. Comparison of Theoretical Results and Real-World Dynamics

The theoretical framework constructed in the foregoing sections can offer a coherent approach to the interpretation of the empirical evolution of the EU-Russia relations in the field of energy. One-shot game predicts opportunistic behavior in the context of short-term dependence, the repeated-game model elucidates the sustainability of cooperation with continuation value, and the credible-threat model elucidates the refocusing of future equilibria by irreversible commitments. In comparison with the changes that can be observed since 2014 and, in particular, since 2022, the model shows high alignment between the theoretical anticipations and the actual strategic behavior.

The logic of the repeated-game equilibrium is well-mirrored in the period between 2014 and 2021. Regardless of the political break after the crisis in Crimea and the sanctions, the cooperation in the field of energy on a massive scale did not stop. This continues to be in line with the prediction of

the model which states that cooperation is self-enforcing when the discounted value of future trade is greater than the short-run benefits of opportunistic deviation (Fudenberg and Tirole, 1991; Mailath and Samuelson, 2006). The long-term nature of gas contracts, high rates of infrastructure specificity, and repetitive negotiation of transit and pricing allowed the continuation value to be large enough that both actors continued to partially cooperate even during geopolitical tension.

This interpretation is well-founded and supported by the empirical record. Prior to the invasion of Ukraine on a large scale, Russian gas already consumed around 45% of EU gas imports, which is indicative of the extent of mutual dependence and the strategic importance of further trading. The benefits of future cooperation, expected due to continued trade, even with the rise in political distrust since 2014, maintained the cooperative equilibrium of the repeated-game model due to sunk costs in pipeline infrastructure.

The shift in theory towards cooperation to defection is especially prominent in the post-2022 era. The large geopolitical shock sharply reduced the expected duration of the relationship, undermined trust, and significantly lowered the effective discount factor δ. Regarding the repeated-game model, this shock lowered the continuation value of cooperation below the threshold necessary to maintain the cooperative equilibrium. Once the expected future benefits of trade no longer compensated for the immediate incentives to defect, strategic decoupling became individually rational for both sides.

The current trends in the market are in strong agreement with this forecast. Since the introduction of REPowerEU, the EU has decreased the share of Russian gas in overall imports from about 40% in 2021 to 19% 2024, and further to 13% in 2025 (European Commission, 2022; Eurostat, 2025; Bruegel, 2025). This sharp decline indicates that the prospects for future cooperation have lost credibility, and the diversification and punishment strategies have become self-reinforcing — exactly as predicted by the model.

The role of credible threats and commitments is also confirmed by the empirical evidence. The fast growth of LNG regasification capacity, reverse flow infrastructure and long term contracts with other suppliers changed diversification as political message into a concrete promise. These irreversible investments changed the continuation payoffs of the future strategic interaction, and precisely as in the predictions of Section 4.4. In that regard, the REPowerEU plan served as a

massive institutional commitment mechanism, making the decoupling course of the EU at the long-run more credible.

The prediction of the model on the possibility of other outside options is also quite consistent with the developments observed, on the Russian side. The cost of limiting European supply was partially lowered by the gradual reorientation of export flows towards Asian markets. As the availability of alternative buyers increased, the deterrent force of lost EU market access weakened. This is directly related to the logic of the model that variations in outside options change the credibility of threats and the equilibrium course of the repeated interaction (Fudenberg and Tirole, 1991; Gibbons, 1992).

Meanwhile, there is also an important nuance that is identified by the empirical record and enriches the theoretical model. Despite a steep decline in dependence on the pipeline, Russian LNG still retained a residual position in the European energy imports in the transition period. This implies that strategic decoupling is not necessarily rapid or total, but can occur through partial equilibrium adjustment, where some channels of interdependence remain active even as the hegemonic cooperative structure breaks down. This remaining dependence does not nullify the model but instead confirms the significance of sunk infrastructure and contract rigidity discussed in the earlier sections.

Another advantage of the model is the fact that it explains path dependence. Once the cooperative equilibrium collapsed, subsequent choices became conditioned by the new punishment path: sanctions, LNG terminal investments, rerouted trade flows, and regulatory redesign all reinforced the strategic irreversibility of the new equilibrium. This reflects the theoretical forecast that after the players transition to the punishment subgame, the future strategy decisions are constrained by sunk costs and new expectations.

Overall, the comparison between theoretical results and empirical developments suggests that the model captures the core strategic dynamics of EU–Russia energy relations with considerable explanatory power. The development of one-shot opportunism to repeated cooperation, and then the breakdown of cooperation following a big geopolitical shock, is very similar to the observed change in relationship.

The core usefulness of the model is not then in forecasting the precise past occurrences but in outlining the strategic processes by which dependence, trust, punishment, and irreversible commitments influence the long-run relationship of energy. In this regard, the framework provides a solid theoretical prism for explaining the continuation of pre-2022 interdependence and the subsequent structural decoupling.

5. Discussion: Interpreting Real-World Events Through the Model

5.1. How the Model Explains EU and Russian Strategic Behavior

The game-theoretic model formulated in the last chapter gives a systematic explanation of how the European Union and Russia acted in a situation of asymmetric interdependence, political uncertainty, and the changing outside options. Rather than interpreting the deterioration of energy relations as a purely exogenous consequence of geopolitical events, the model demonstrates that much of the observed behavior can be understood as the rational outcome of strategic incentives embedded in the structure of dependence itself.

The asymmetry of short-run vulnerability and long-run adaptability is the central theme of the model (Keohane and Nye, 1977). In the case of the European Union, the first strategic priority was the maintenance of supply security in the circumstances of high levels of pipeline dependence and industrial exposure to imported gas. That is why despite the political break of 2014, the EU did not instantly shift to the path of complete diversification. The immediate expenses of quick decoupling, such as price volatility, shortages in infrastructure, and industrial adjustment strains, caused partial cooperation to be the individual rational choice even as political mistrust increased.

The model also provides an excellent explanation of the behavior of Russia in terms of the incentive structure. On one-shot setting, the concept of temporary supply restriction is an effective tool of market power exploitation in the cases when the importing party does not have immediate substitutes (Stern, 2017). This argument explains why the strategic benefits of coercive application of energy might be short-term even when the risks are long term. The short-term gains did not only extend to the increased spot-market rents, but also to the geopolitical leverage, signifying power, and the possibility of influencing the bargaining environment by creating controlled uncertainty.

The repeated-game extension supports this interpretation by demonstrating that cooperation prior to 2022 was not always an indicator of political alignment, but was the outcome of a sufficiently high continuation value placed on future trade. There were powerful motives on both sides to maintain the flow of long-term benefits being generated by stable contracts, incurred infrastructure and foreseeable demand. In this sense, the continuance of cooperation with political conflict was

no more paradoxical than it might otherwise seem descriptively: it was the solution to recurrence strategic interaction with a high discount factor.

The loss of this balance since 2022 can also be explained with the help of the model as the change of expectations and not the mere response to one event. When the future value of cooperation became negative, then the strategic reason to limit oneself was destroyed. The reorientation of Russia towards Asian purchasers and the hastened diversification of the EU changed the outside choices of both actors and weakened the viability of the restoration of the previous cooperative equilibrium (IEA, 2023; Eurostat, 2025).

One of the most significant contributions of the model is that it explains the reasons why rational agents can rationally decide to accept jointly worse results than Pareto-efficient outcomes but individually rational in discounted payoffs (Fudenberg and Tirole, 1991). The continuation of sanctions, countersanctions, and expensive infrastructure redundancy might appear inefficient in the context of static welfare. Nevertheless, when future vulnerability and strategic exposure are added to the payoff structure, these decisions become individually rational efforts to decrease reliance and enhance bargaining autonomy.

The model also describes the significance of beliefs and expectations in the process of strategic behavior. Policy declarations are not sufficient to adjust the equilibrium unless they modify the beliefs of the opponent regarding future actions that are possible. That is why the development of infrastructure, redesign of regulations, and the long-term contracts with other suppliers were more strategically significant than rhetorical statements that could be made unilaterally. They transformed the thinking system of the game by rendering future punishment and other possible pathways of diversification believable.

More generally, the model implies that the EU-Russia energy relations cannot be interpreted as a one-way shift between cooperation and conflict, but rather as an active strategic process where the value of cooperation is determined by expectations, the rigidity of infrastructure, and the credibility of alternative options. Strategic behavior was thus an internal product to the changing institutional and physical form of the energy market.

In this regard, the theoretical framework offers more than an account of what has happened in the past. It provides a broad political economy rationale of the manner in which interdependent actors

act when economic efficiency, geopolitical advantage and long-term strategic autonomy collide. The model shows that what can seem externally as political escalation can actually be the internally rational outcome of changed continuation values, changed threat credibility and made irreversible commitment choices.

It is this interpretative viewpoint which grounds the second section, in which the limits of cooperation and the economic cost of conflict are considered when individually rational strategies take the players off the welfare maximizing equilibrium.

5.2. Limits of Cooperation and the Cost of Conflict

One of the general implications of the game-theoretic model is that the individually rational strategies do not always produce collectively efficient results. The experience in the strategic game between the European Union and Russia shows that cooperation can fail even in an instance where both players will be better off materially in the case of sustained exchange. The incompatibility of individual motives and collective good is the inherent boundary of collaboration under the circumstances of political distrust, non-retractable commitments, and evolving external alternatives.

The model constructed in Chapter 4 demonstrates that cooperation can only be maintained as long as the continuation value of future trade, credible punishment mechanisms and perceived sustainability of mutual dependence is high enough. When these conditions become weak, the individual rational incentives change to defection, sanctions, diversification and strategic decoupling. Even though such options could raise independence and minimize vulnerability, they also come with heavy financial burdens on both parties.

For the European Union, the limits of cooperation became visible through the high short-run cost of replacing pipeline gas with alternative sources. The intensive growth of LNG regasification facilities, reverse-flow infrastructure, emergency storage demands, and long-term contracts with non-Russian suppliers created great fiscal and industrial adjustment costs. Moreover, the transition period subjected the firms and households to price spillover, supply volatility and inflation pressure and this depicts that the action to move out of the cooperative equilibrium entailed

significant welfare losses. The sudden rise in European gas prices in 2022 – 2023 is the evidence of the price of shifting the efficient yet vulnerable equilibrium to a more safe, yet structurally expensive one (IEA, 2023; European Commission, 2024).

In the case of Russia, economic costs manifested themselves in the form of the loss of access to the market, the loss of export revenue, and the need to allocate infrastructure to other destinations. Although the shift to Asian markets partially replaced the lost European demand, the reorientation was associated with price discounts, transportation bottlenecks, and further investment needs (IEA, 2023; Stern, 2024). From the perspective of the model, these costs represent the economic burden of moving from a high-value repeated equilibrium into a punishment path in which future rents are permanently lower.

Another constraint of cooperation is the strategic distrust role. Even when short-term material incentives would appear to support partial restoration of exchange, the belief structure established after major geopolitical shocks may prevent a return to the former equilibrium. When future commitments are no longer credible, the cooperative course is no longer self-enforcing. This develops a hysteresis of strategic interaction: conflict produces institutions, infrastructure, and expectations that continue to generate conflict even after the original shock is no longer there.

The model thus implies that the economic cost of conflict does not just refer to the trade losses that can be seen. It also involves the cost of redundancy, including the duplication of infrastructure, precautionary overinvestment, storage capacity, and the loss of scale efficiencies previously obtained because of interdependence over long term. These are logical expenses in the view of strategic autonomy, but they are social expensive compared to the former synergistic system.

One of the most important implications relates to the efficiency/resilience trade-off. Before 2022, the energy relationship between the EU and Russia was able to yield a considerable degree of efficiency due to consistent pipeline flows, long-term deals, and low transportation expenses. Nevertheless, the very structure was more susceptible to coercive disruption. The diversification strategy that followed in 2022 mitigated this weakness but with the cost of a less efficient equilibrium of infrastructure redundancy and increased marginal procurement costs (Keohane and Nye, 1977; European Commission, 2025). The model thus shows that resilience may demand the conscious trade-off of short-run efficiency.

From a political economy perspective, this trade-off highlights the structural limit of cooperation in highly strategic sectors. In situations where the commodity in question, like natural gas, has direct national security, industrial stability, and geopolitical bargaining power implications, pure efficiency-based equilibria can prove to be insecure. Strategic actors can make rational decisions to use options that are more expensive as long as they minimize the chances of being coerced in the future.

This discussion also streamlines the meaning of sanctions and countersanctions. Although they are commonly considered in the context of the immediate destruction of trade, the model posits that their more general meaning is that they permanently alter the continuation value of future interaction. Sanctions do not simply lower the current welfare, but they redefine the viable equilibrium configuration of the whole strategic association by lowering the plausibility of ongoing cooperation.

Finally, the boundaries of cooperation in EU-Russia energy relations can be seen as a result of the collision of rational incentives and strategic insecurity. The reason why conflict is economically costly is that the individually rational motive of autonomy, deterrence and lower vulnerability will shift the two players out of the welfare-maximizing equilibrium. By this long-run cost of conflict is not accidental, but an endogenous result of the strategic behavior in the conditions of mistrust and irreversible commitments.

This view gives grounds to the last part of the thesis, which looks at the large-scale consequences of the model on future EU energy policy and the politics of strategic interdependence.

5.3. Strategic Mistakes, Political Constraints and Economic Losses

The game-theoretic framework also helps explain how strategic mistakes and political constraints amplified the economic losses associated with the breakdown of cooperation. Although the conflict equilibrium in the section above is individually rational under the changed payoff structure, the movement to that equilibrium was not always efficient in terms of timing, expectations, and action. The European Union and Russia seem to have underestimated the pace, plausibility, and the long-term implications of the other party in a number of aspects, their strategic adaptation.

One of the strategic errors made by Russia was the overestimation of the long-term market power of pipeline gas vis-à-vis Europe, particularly in the short term. In the one-shot model, supply restriction created immediate geopolitical advantage and short-term rents. Nonetheless, the repeated-game extension proves that these benefits can be maintained only in the case the continuation value of future cooperation is maintained. By using supply pressure at a scale that undermined expectations of future reliability, Russia accelerated the reduction of the very dependence from which its bargaining power had historically emerged (Yafimava, 2020; Bruegel, 2024).

Game-theoretically, this can be viewed as a miscalculation of the rate at which the opponent will change. The Russian strategy implicitly assumed that the European Union's diversification constraints—limited LNG regasification, infrastructure bottlenecks, and industrial rigidity—would persist long enough to preserve coercive leverage. However, the rapid growth of LNG terminals, reverse-flow capacity, and long-term agreements with other suppliers changed the EU's outside options more quickly than the original coercive strategy appears to have anticipated.

The strategic error on the European side was of a different kind: the risk of vulnerability was underestimated over many years because of the efficiency gains associated with low-cost pipeline imports The cooperative equilibrium before 2022 generated strong material benefits, but the model suggests that these benefits were sustained under an implicit assumption of continued supplier reliability. The dependence was concentrated in a strategically sensitive industry, which exposed the EU to exactly the kind of hold-up problem described in the one-shot model (Strange, 1996; Fudenberg and Tirole, 1991).

This error was not necessarily irrational during that time because the repeated-game continuation value was high during the majority of the pre-2022 years. However, in a long-term strategic view, the underinvestment in the infrastructures and institutions of diversification raised the cost of adjusting in the future after the failure of the cooperative equilibrium.

The limitations on politics also supported such strategic errors. Both players do not play in an entirely abstract payoff-maximizing environment. The set of strategies which are possible is influenced by domestic political pressures, fiscal needs, regulatory frameworks and commitments of alliances. In the case of the European Union, a collective decision-making framework among

the member states created frictions in the coordination process and varied threat perceptions and exposure levels. These institutional lags retarded diversification during earlier periods and raised the prices of quick collective adaptation during later periods.

In the case of Russia, political limitations were connected to the fiscal reliance on hydrocarbon rents, strategic signaling requirements, and internal legitimacy of geopolitical posture. These could have increased the political payoff associated with short-run coercive action beyond its economic restriction, and so misaligned the long-run rationality of optimization suggested by the repeated game.

The interaction of strategic mistakes and political constraints therefore produced economic losses larger than those predicted by a frictionless equilibrium transition. It was not only the cost in terms of inevitable loss in transitioning the cooperation to conflict, but also the added cost of delayed adaptation, duplication of infrastructure under the emergency conditions and the shattering of the trust capital that had been built over decades.

Another consequence of the model is that path dependence can reinforce strategic errors. When the actors have taken costly adjustment trajectories, even the sunk investments themselves diminish the possibility of returning to a more efficient equilibrium. In this regard, mistakes in the initial evaluation of dependence, credibility, and outside options have a long-term effect that goes beyond the initial political shock.

The general point is that in industries where strategic interdependence is intense, the cost of misestimating the adaptive capability of the opponent can be equivalent to the initial war itself. Economic losses come not only through the rational deterrence and diversification decisions, but also through the wrong expectation regarding the speed at which the decisions can change the strategic environment.

This discussion logically culminates in the last analytical part, which takes into account alternative strategic possibilities of what might have happened and discusses how alternative expectations, commitments, or timing decisions might have resulted in different equilibrium paths.

5.4. Possible Alternative Strategic Scenario

The explanatory power of the game-theoretic model lies not only in its ability to describe observed developments in EU–Russia energy relations, but also in its capacity to generate counterfactual strategic scenarios. The model enables exploration of alternative equilibrium paths that may have arisen under different political and economic circumstances by adjusting the continuation value of cooperation or the credibility of threats, or the timing of irreversible commitments.

Another potential alternative scenario is about the pre-2022 European diversification preceding the massive geopolitical breakup. Had the European Union been able to increase LNG regasification capacity, reverse-flow interconnectors, and long-term supply contracts to other exporters already in the period just after the year 2014, the short-run asymmetry of dependence would have been significantly decreased. Regarding the model, this would have reduced the one-shot benefit of opportunistic restriction to Russia and raised the believability of the punishment policy of the EU in the repeated-game context. In this case, the cooperative equilibrium could have been maintained, though on a more equal and less coercion-prone level.

The second option is the Russian strategic decision to maintain the credibility of suppliers in the long run instead of taking advantage of the short-run strength. The repeated-game model shows that as long as the continuation value of future trade is high enough, the temptation of cooperation can overrule short-term coercive profits (Fudenberg and Tirole, 1991). The cooperative repeated equilibrium, had Russia been less concerned with sending geopolitical signals in the short run and more concerned with maintaining access to the European markets in the long run, might have persisted even following extreme political shocks. The efficiency gains of the current infrastructure would be maintained by both parties in this situation, and the relationship would be adapted over time by limited diversification as opposed to total decoupling.

The third situation is the development of a hybrid balance between partial cooperation and strategic hedging. Instead of evolving between high levels of interdependence to speedy structural decoupling, both actors might have shifted to a mixed equilibrium where pipeline gas flows would not have been fully shut off and the EU would have at the same time increased the level of diversification as an insurance policy. This type of equilibrium would represent a strategic balance

between the efficiency and resilience: reliance would decrease without completely eradicating the economic benefit of old infrastructure (Keohane and Nye, 1977; Pérez-Osorio, 2022).

This situation is especially applicable since some of its aspects are still evident in remnant LNG imports and transitional contractual provisions. This is a middle ground equilibrium in which punishment is not absolute but selective, and where external alternatives are better without necessarily destroying mutual exchange benefits.

A second possible counterfactual is the importance of institutional guarantees and third party commitment mechanisms. Had more robust multilateral monitoring bodies, legally binding transit assurances or collaborative crisis-management frameworks been established in 2014, the threat of punishment in case of unilateral deviation would have been more credible without necessarily separating the markets completely. External enforcement institutions in game-theoretic language increase the deviation cost, and may stabilize cooperation even in the case of weakening bilateral trust.

This reveals a significant theoretical implication: the collapse of cooperation was not predetermined by political shocks alone, but also depended on the absence of sufficiently strong commitment devices capable of sustaining beliefs in future cooperation.

Another option that the model can offer is that the timing of adjustment can vary, but the ultimate equilibrium can be a similar one. An example would be that the European Union might still have ultimately managed to diversify out of Russian supply, but by adopting a slower, pre-emptive course of action taken over a longer horizon (IEA, 2023; Eurostat, 2025). A course like this would probably have minimized short-run welfare losses that were extreme in nature, due to emergency infrastructure buildups, price spikes and industrial volatility. It is also possible that the long-run conflict equilibrium may still be attained but at significantly reduced transition costs.

The deeper implication of these alternative scenarios is that the equilibrium outcomes are extremely sensitive to expectations, timing, and credibility and not just determined by exogenous events alone. The same geopolitical shock can have extremely different strategic consequences based on the infrastructure that was in place, the strength of the outside options, and the perception of how long trade will continue.

This supports the main finding of the thesis: strategic interdependence is not creating one deterministic path, but a collection of potential equilibria, the achievement of which relies on the dynamics of beliefs and resource commitment as rational actors update their beliefs through time.

From a policy perspective, this section suggests that a significant number of the extreme costs that were experienced post 2022 were not inevitable in a technical way. They came as a result of a certain chain of strategic decisions, failure to adapt in good time, and crashing credibility. More consistent and less expensive results might have been produced by diversifying earlier, or by making more institutional commitments, or by exercising more restraint in exercising coercive leverage.

This concluding debate reinforces the general contribution of thesis because it demonstrates that the model proposed is not just retrospective but also analytically applicable in the assessment of future strategic directions under other circumstances of asymmetric energy interdependence.\this is draft for this chapter could you pls check and give me feedback as my prof

Conclusions

This thesis aimed to analyze how game theory can be used to understand the dynamics of strategic interaction between the European Union and Russia in the energy trade under the circumstances of asymmetric interdependence, political uncertainty and the emergence of major geopolitical shocks. Integrating theoretical assumptions based on non-cooperative and repeated games with the empirical processes of EU-Russia gas relations, the thesis establishes a formalized analytical framework that could explain the maintenance of cooperation prior to 2022 and the structural collapse of the latter after the fact.

The main theoretical contribution of the thesis is the building of a dynamic game-theoretic model of energy interdependence. The model shows that the EU-Russia relationship cannot be sufficiently explained by the purely static concept of trade dependency. Instead, the interaction is better interpreted as a strategic environment in which rational actors continuously evaluate short-run gains, long-run continuation values, punishment credibility, and irreversible commitments. The thesis combines one-shot opportunism, repeated-game cooperation, and credible threat mechanisms in a single framework to demonstrate how the same interdependent structure can facilitate both stable cooperation and fast decoupling under varying expectations.

One of the key results of the analysis is that the continuance of cooperation prior to 2022 was not always an indicator of political alignment, but an equilibrium supported by a high continuation value assigned to future trade. The cooperation became self-enforcing due to long-term contracts, sunk costs in pipeline infrastructure, recurrent bargaining, and lack of outside alternatives even after 2014, when political mistrust had increased. In this regard, the repeated-game structure offers a compelling account of the reasons why economic interdependence was resilient even under the circumstances of sanctions and geopolitical strain.

At the same time, the thesis demonstrates that the collapse of cooperation after 2022 can be explained as an endogenous shift in equilibrium conditions. The sharp decline in trust, the expectation of a shorter future horizon of trade and the emergence of more credible outside options for both actors reduced the continuation value of cooperation below the threshold required to sustain the previous equilibrium. Long-run strategic decoupling was underpinned by the rapid

growth of LNG regasification infrastructure in Europe, the introduction of REPowerEU, and the progressive shift of Russia on the side of Asian markets.

The other significant finding involves the significance of credible threats and irreversible commitments. As in the analysis carried out, policy announcements alone cannot change strategic behavior in the absence of material investments and institutional mechanisms that shift the strategy space that is feasible in the future. The expansion of infrastructure, long-lasting alternative supply agreements, and rerouted export paths in the EU-Russia example turned political cues into plausible promises, and thus redefined beliefs and turned the new equilibrium situation into a self-reinforcing loop.

The discussion chapter also pointed out that strategies that are individually rational can produce worse overall results. The shift between a highly efficient but fragile cooperative equilibrium to a more robust yet costly to the economy conflict equilibrium describes the inherent political economy trade-off between efficiency and strategic autonomy. In this respect, the thesis adds to a more general insight into how rational agents in very strategic industries can deliberately forego short-run welfare to minimize long-run vulnerability to coercive dependency.

Another value added by the thesis is its counterfactual approach. The analysis of alternative strategic outcomes, including earlier diversification, more robust institutional insurance, or slower pre-emptive transition routes, indicates that the costs of 2022 were not predetermined. Instead, they were a result of a particular series of strategic decisions, a lack of timely adjustment, and a crumbling credibility. This reinforces the broader conclusion that strategic interdependence does not generate a single deterministic outcome, but rather a set of possible equilibria shaped by expectations, timing, and irreversible resource commitments.

From a policy perspective the results indicate that the management of strategic energy dependence must be balanced between efficiency and resilience prior to the political shocks becoming reality. The EU experience demonstrates that dependence on one dominant supplier can help to maximize short-run welfare and create strategic vulnerability in the long-run at the same time. Diversification and redundancy, on the other hand, might seem to be expensive during normal times, but are the critical commitment devices that smooth out future bargaining. In a more general sense, the thesis makes a contribution to the literature at the interfaces of game theory, political economy, and

international energy relations by providing a systematic account of the process of cooperation, punishment, and path dependence development in strategic commodity markets. The framework can also be generalized to other instances of asymmetric dependence with critical raw material, interconnections of electricity, or global supply chains.

As with any stylized model, the analysis is limited. The payoff forms are ordinal forms as opposed to econometric approximations and the strategic interaction is reduced to two major players. Further studies may generalize the model by including a number of EU member states, endogenous domestic political restrictions, or stochastic shocks of global LNG markets and energy prices. In general, the thesis has shown that the process of the EU-Russia energy relationship changing to the deep cooperation to the structural decoupling could be unified in the context of dynamic strategic interaction.

The central conclusion is that interdependence can never be understood as purely economic: it is a strategic relationship whose stability depends on trust, expectations, credible punishment, and irreversible material commitments that shape future choices.

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