

ОБЩЕСТВЕНИ КОМУНИКАЦИИ И ИНФОРМАЦИОННИ НАУКИ
PUBLIC COMMUNICATIONS AND INFORMATION SCIENCES

**GLOBALIZATION, ENERGY AND INFORMATION PROCESSES:
GEOPOLITICAL POWER, INEQUALITY AND COOPERATION
IN THE GLOBAL ENERGY SYSTEM**

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Abstract: *Global energy supply is at the heart of current geopolitical, economic, and social transformation processes. Historically, energy has been a crucial foundation for industrial expansion and the development of state power; today, it is also a central prerequisite for economic development, social stability, and environmental sustainability. The publication assumes that, in the context of global interconnectedness, state action in the energy sector no longer functions primarily through traditional interventions. Instead, the focus is shifting to the collection, processing, and strategic use of information, making political control appear increasingly as a knowledge- and data-driven process. Based on a systematic literature analysis, the article examines the interactions between geopolitical power relations, global energy inequalities, and information processes. In addition to historical developments and established concepts of energy security, analytical tools for global energy flows are used. The focus is on the importance of exchange, information, and communication mechanisms for cooperation between countries in the energy sector – especially with regard to the emerging hydrogen market. The study concludes that shared knowledge, transparent decision-making processes, and firmly established communication channels are not mere side effects. Rather, they form the fundamental basis for international reliability, stable orders, and a balanced, fair transformation of energy systems.*

Keywords: *global energy governance; globalization and energy systems; hydrogen economy; power asymmetry in global energy policy; socio-technical energy systems*

INTRODUCTION

Energy is a fundamental prerequisite for modern societies and, at the same time, one of the key political resources for conflicts in the 21st century. It forms the material basis for economic production, military capabilities, and social development. However, with advancing globalization, its political significance has shifted: national energy systems are increasingly integrated into transnational supply and information networks, creating new dependencies, power asymmetries, and political risks.

Against this backdrop, this article examines the role of energy in the complex interplay of globalization, geopolitical power, and information processes. The central question is how global energy flows and information-based control mechanisms structure geopolitical power relations while simultaneously influencing the possibilities and limitations of international cooperation in the context of current energy crises.

This article takes a qualitative-theoretical approach and combines perspectives from energy policy, geopolitics, and information science. The aim is to analyze global energy systems as complex socio-technical orders that are shaped by both material infrastructures and knowledge, data, and communication processes. Methodologically, the dissertation is based on a theory-driven, analytically condensed synthesis of political science, interdisciplinary, and policy-related literature. The aim is not merely to compile existing research findings, but to systematically reconstruct and theoretically reconnect them. Different strands of debate are brought together in an integrative manner in order to reveal structural gaps at the interface of energy policy, global interdependence, and information governance.

The interdisciplinary bundling of fragmented research approaches creates a coherent analyt-

ical framework that reveals conceptual breaks and highlights previously under-theorized interactions between material energy infrastructure, geopolitical order formation, and information-related power structures.

This article explicitly does not aim to provide an empirical mapping of global energy systems, but rather a theoretical reconceptualization of the role of information processes within energy policy power and governance structures.

THEORETICAL FOUNDATIONS AND STATE OF RESEARCH

The increasing interconnectedness of the global economy and rising global energy demand mark a fundamental shift in the relationship between energy, the economy, and political power. With industrialization, energy evolved from a primarily locally used technical resource to a strategic prerequisite for state action. Today, the availability and control of energy decisively determine a state's ability to generate economic growth, develop industrial capacities, and ensure social stability (Smil 2004; Weissenbacher 2009). Energy has thus become a strategic resource whose significance extends far beyond economic aspects.

Researchers largely agree that energy has played a key role in global power structures since the 19th century. Access to energy resources influences not only industrial development but also foreign policy options and military capabilities (Yergin 2006). Energy is therefore closely linked to issues of state sovereignty, geopolitical stability, and international dependencies.

This article expands this perspective by adding a globalization-theoretical and information-science dimension. Energy is no longer understood merely as a physical resource used to exert political influence. Instead, it appears as deeply embedded in global value chains, trade networks, and digital information systems. The focus is on the movement of energy across borders, unequal structural starting conditions, and knowledge advantages and deficits that emerge as global interconnections intensify.

Unlike many theoretical approaches that consider either past energy regimes or specific raw materials in isolation, this study examines the current development phase of highly networked energy systems. In particular, it analyzes how these systems are shaped and controlled today by data, communication processes, and knowledge-based coordination mechanisms. Hydrogen serves not as an isolated object of study, but as an analytical example within a broader consideration of global energy governance.

In summary, while energy has been extensively studied as a geopolitical power factor, the systematic link between energy, globalization, and information governance has so far only been addressed sporadically. This article focuses on this analytical intersection.

Energy as a geopolitical power factor

Numerous studies demonstrate that energy has been a key geopolitical resource since industrialization. Access to coal, oil, and industrial raw materials enabled states to build economic strength and project military power (Weissenbacher 2009, p. 19; Hobsbawm 1989, pp. 56–57). Energy functioned not only as a factor of production but also as a strategic instrument that structured imperialist expansion, industrial dominance, and political influence.

This dynamic became particularly evident in the 20th century. In both World Wars, industrial production capacity and a secure energy supply proved to be decisive factors (Hayward 1995, pp. 94–135; Scott 2019, pp. 136–161). Decisions regarding energy sources, transportation routes, and industrial infrastructure influenced both military strategies and political alliances. Energy thus became an integral component of national security concepts.

Even after 1945, energy remained a geopolitical focal point. The emergence of global oil markets, the development of transnational energy infrastructures, and the institutionalization of energy policy interests, for example through OPEC, led to lasting shifts in the international balance of power (Yergin, 2011, pp. 1–820, Yergin, 2009, pp. 1–982). Energy dependencies became political levers, while price fluctuations and supply shortages repeatedly triggered global economic and political instabilities.

Globalization, energy inequality and energy security

Globalization describes the intensification of cross-border economic, political, and social relations, which has led to a widespread international division of labor (Dreher, Gaston, Martens 2008, p. 1). In the energy sector, this process manifests itself in highly interconnected systems where energy production, transport, and consumption are spatially decoupled. Energy is often produced where resources are available, while the majority of consumption takes place in other regions of the world.

This structure is accompanied by significant inequalities in global energy consumption. Wealthy, highly industrialized states claim a disproportionately large share of the globally available energy and drive consumption to particularly high levels. At the same time, many regions of the Global South continue to lack reliable and sufficient access to energy, leaving millions of people there facing basic energy scarcity (Smil 2004, p. 557; Chen 2011). Energy-intensive production processes and environmental impacts are often outsourced to the Global South, exacerbating existing socioeconomic inequalities.

Against this backdrop, the understanding of energy security has also broadened. While earlier concepts focused primarily on the physical availability of energy, energy security today also encompasses aspects such as affordability, environmental sustainability, political stability, and social acceptance (Ang, Choong, Ng 2015, pp. 1081–1082; Sovacool, Brown 2010). Energy poverty remains a central global problem, closely linked to development issues and global justice. These inequalities are not solely attributable to market dynamics but are also shaped by the political and institutional frameworks of global energy policy. In this context, transparency, regulation, and data availability are of particular importance.

Information processes and global energy governance

Recent research increasingly underscores the importance of information processes for the functioning of global energy systems. Energy infrastructures are not merely physical networks, but complex socio-technical systems whose stability depends on data, knowledge, communication, and institutional coordination (Crossland 2017, p. 460). The planning, control, and monitoring of modern energy systems require the continuous processing and exchange of energy-related information.

Against this backdrop, a conceptual distinction between data, information, and knowledge is analytically useful. Data initially refers to raw, unordered measurements, for example, regarding energy production, transmission capacities, or consumption patterns. Information only emerges through the contextualization and interpretation of this data, while knowledge additionally encompasses the ability to use information politically, institutionally, or strategically. This distinction is of central importance for global energy systems, as political governance depends less on the mere availability of data than on its institutional processing and accessibility.

In the context of energy policy, therefore, it is not only the collection of data on production volumes or emissions that is crucial, but rather who controls this information, how it is interpreted, and in which decision-making processes it has an impact. Information processes are therefore not neutral, but always embedded in existing power and governance structures. This perspective allows us to understand energy policy not only as a matter of material control, but also as a knowledge-based negotiation of political agency.

Cross-border cooperation in the energy sector, especially in the development and networking of hydrogen infrastructures, can only function if reliable data are openly shared, technical and regulatory standards are aligned, and political and economic actors continuously and in a coordinated manner align their strategies (Chen et al. 2024, pp. 436–458; European Hydrogen Backbone 2025). Information processes build trust, increase investment security, and enable political coordination.

Conversely, a lack of transparency and insufficient knowledge sharing can delay or undermine cooperation projects. Information asymmetries represent a key challenge in this context. Differences in access to data, technological knowledge, and institutional capacities, particularly between the Global North and South, exacerbate existing power imbalances and hinder a just energy transition. Energy crises can therefore increasingly be understood as information and governance crises in which the organization, availability, and political use of knowledge play a crucial role.

Information-based power, governance and resilience of global energy systems

Global energy systems are not defined solely by physical infrastructure, but increasingly by institutional frameworks that structure access to information, its interpretation, and its political use (Roehrkasten 2015; Crossland 2017).

In the context of globalized energy flows, information-based control mechanisms are therefore gaining increasing strategic importance. Actors who possess comprehensive and reliable data on energy production, transmission, and consumption, or who define technical standards, reporting systems, and classifications, can exert political influence and actively shape the framework for cooperation (Yergin 2011; Heffron, Sokołowski 2024). In this context, information functions not only as a reflection of existing power relations, but also as a resource with which these relations can be stabilized or altered.

In contrast, some energy policy and geopolitical publications argue that information-based control mechanisms are subordinate to physical factors such as physical infrastructure, territorial control, or the military security of supply routes. They maintain that energy supply remains based on physical foundations and cannot be guaranteed without functioning infrastructure.

However, reducing information-related aspects to mere technical support functions falls short. Particularly in globalized energy systems, where production, transport, and consumption structures are spatially decoupled, information processes acquire independent political significance. The ability to visualize energy flows, communicate risks early, and define standards significantly influences which actors are capable of action and which forms of cooperation are considered legitimate. Information-based governance thus does not replace material energy resources but rather complements and structures their political effectiveness.

At the same time, the literature on global energy policy makes it clear that the resilience of energy systems depends significantly on the quality of information-related governance. In crisis situations such as supply shortages, price shocks, or geopolitical conflicts, transparent information flows, robust early warning systems, and coordinated communication structures are crucial for maintaining collective capacity to act (International Energy Agency 2023; Sovacool, Martiskainen, Hook, Baker 2019). Conversely, missing, fragmented, or politically distorted information structures can increase uncertainty and promote escalation dynamics.

Furthermore, information-based governance is closely linked to issues of global justice. Unequal access to data, technical knowledge, and institutional resources contributes to the reproduction of existing power asymmetries between the Global North and South (Sadik-Zada 2021). Against this backdrop, it can be argued that a sustainable and equitable energy transition depends not only on technological innovations but also on the conscious design of inclusive, transparent, and accessible knowledge and information structures.

Overall, it becomes clear that information processes do not merely fulfill supporting functions but constitute an independent political dimension of global energy systems. They influence power relations, the capacity for cooperation, and crisis resilience and are thus an integral component of modern energy policy.

METHODOLOGY

This publication is based on a qualitative literature review. The analysis encompassed scholarly articles, monographs, reports from international organizations, and policy-oriented studies in the fields of energy policy, geopolitics, and information science. The evaluation was conducted using a theme-centered content analysis that systematically linked key concepts such as energy security, global energy flows, information asymmetries, and international cooperation. The aim was to identify recurring patterns of argumentation and to situate them theoretically.

RESULTS

The analysis shows that energy functions as a structural power factor that not only reflects historical and current geopolitical patterns but also actively shapes them. Access to, control over, and regulation of energy flows influence the political agency of states and international power

relations. Energy thus proves to be not merely an economic resource but a central element of geopolitical stability as well as potential conflict dynamics.

Globally organized energy flows reproduce and, in some cases, exacerbate existing inequalities. The energy-intensive consumption of industrialized regions is often based on production and environmental costs that are geographically displaced. This asymmetric distribution of benefits and burdens creates structural dependencies and reinforces global disparities between energy-producing and energy-consuming societies.

Affordability, sustainability, social acceptance, and institutional control are integral components of modern energy security concepts and require analytical approaches that go beyond purely technical or market-oriented perspectives. The independent influence of information-based governance mechanisms on the stability and resilience of global energy systems is particularly noteworthy. Not only material energy flows, but also control over energy-related data, knowledge, and technical standards shape geopolitical power relations. Fragmented or opaque information structures act as systemic risk factors, while transparent and coordinated governance structures foster trust and facilitate international cooperation.

DISCUSSION

The results show that energy policy in the context of globalized energy systems cannot be understood as a purely technical or economic sphere of control. Rather, it is a complex governance process in which material resources, political power, and information-based control mechanisms are inextricably linked. This article expands existing energy policy approaches by analyzing information not only as a supporting factor but also as an independent dimension of geopolitical power.

From this perspective, further implications arise for the analysis of global energy governance. If information processes are understood as an independent power resource, questions of data accessibility, standard-setting, and institutional transparency move more sharply into focus for energy policy research. Governance structures can then no longer be grasped solely through formal institutions or material resources but must be analyzed as knowledge-based orders in which political authority and legitimacy are increasingly mediated through information control.

For international cooperation, this means that successful energy cooperation depends less on technical compatibility alone than on the ability to establish shared information and communication structures. Particularly in conflict-ridden or asymmetric contexts, access to reliable information determines whether trust can develop or whether existing power imbalances are further entrenched.

The perspective developed here also differs from approaches that primarily view energy policy as a problem of technical efficiency or economic optimization. While such approaches make an important contribution to the analysis of cost structures, innovation pathways, and infrastructure issues, they often neglect the power- and knowledge-related prerequisites for political governance. In contrast, an information-centered perspective shows that political action does not result solely from technological performance or market design, but depends significantly on the organization, accessibility, and political use of knowledge. This contribution thus opens up an analytical perspective that does not replace technological and economic approaches, but rather complements them with a power- and governance-oriented dimension.

Actors with privileged access to data, knowledge, and institutional decision-making processes have greater opportunities to determine the energy policy agenda and shape the framework for cooperation. Without transparent and inclusive information structures, there is therefore a risk that future energy systems will reproduce existing power structures.

CONCLUSION

This article demonstrates that the global energy crisis cannot be understood solely as a technological or economic challenge, but rather has profound political, social, and informational dimensions. Energy simultaneously functions as a material resource, a geopolitical power factor, and a subject of communicative negotiations. A successful energy transition therefore requires not only

technological innovations, but also robust information processes, institutional transparency, and resilient forms of international cooperation.

Information-based governance mechanisms play a central, yet hitherto underestimated, role in global energy systems. Issues of data access, the definition of standards, and knowledge organization significantly influence power relations, the capacity for cooperation, and crisis resilience. Without the conscious design of inclusive information and governance structures, there is a risk that future energy systems will reproduce existing global inequalities.

In light of increasing geopolitical fragmentation, the question of how information-based energy policy can be sustainably implemented even under conflict-ridden conditions is gaining particular importance.

Since this article is based exclusively on an evaluation of existing literature and does not conduct any original data collection, it also serves as a starting point for further research. In particular, empirically based case studies, for example on cross-border hydrogen projects or on unequally distributed knowledge in regional energy markets, could help to further develop, refine and substantiate the theses formulated here with concrete examples.

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ГЛОБАЛИЗАЦИЯ, ЕНЕРГЕТИКА И ИНФОРМАЦИОННИ ПРОЦЕСИ: ГЕОПОЛИТИЧЕСКА ВЛАСТ, НЕРАВЕНСТВО И СЪТРУДНИЧЕСТВО В ГЛОБАЛНАТА ЕНЕРГИЙНА СИСТЕМА

Резюме: Глобалното енергоснабдяване е в центъра на настоящите геополитически, икономически и социални трансформационни процеси. Исторически, енергията е била решаваща основа за индустриалната експанзия и развитието на държавната власт; днес тя е и централна предпоставка за икономическото развитие, социалната стабилност и екологичната устойчивост. Публикацията изхожда от предпоставката, че в контекста на глобалната взаимосвързаност държавните действия в енергийния сектор вече не функционират предимно чрез традиционни интервенции. Вместо това фокусът се измества към събирането, обработката и стратегическото използване на информация, което прави политическия контрол все повече процес, ръководен от знания и данни. Въз основа на систематичен анализ на литературата статията разглежда взаимодействията между геополитическите властови отношения, глобалните енергийни неравенства и информационните процеси. В допълнение към историческото развитие и утвърдените концепции за енергийна сигурност се използват аналитични инструменти за глобалните енергийни потоци. Акцентът е върху значението на механизмите за обмен, информация и комуникация за сътрудничеството между държавите в енергийния сектор – особено по отношение на възникващия пазар на водород. Проучването заключава, че споделяното знание, прозрачните процеси на вземане на решения и твърдо установените канали за комуникация не са просто странични ефекти. По-скоро те формират фундаменталната основа за международна надеждност, стабилни порядки и балансирана, справедлива трансформация на енергийните системи.

Ключови думи: глобално енергийно управление; глобализация и енергийни системи; водородна икономика; асиметрия на силите в глобалната енергийна политика; социално-технически енергийни системи

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