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The Energy Market Nexus to Environment

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Abstract

With the decline of hydrocarbons, there will be a shift towards new dependencies on critical minerals and technology. Additional investment is necessary for minerals that power the energy transition, such as lithium, copper, cobalt, nickel, and rare earth elements. The geopolitics of resource policy will be affected by their supply sources and demand centers' new vulnerabilities and economic and geopolitical advantages. On the other hand, the diversification of supply chains and the sacrament of critical minerals and energy from domestic or friendly sources will be increasingly pursued by governments. Policy and the success of energy transition projects depend on the influence of wider environmental, social, and geopolitical considerations.

The 'first fuel' is often referred to as reducing energy consumption through more efficient usage because it effectively cuts demand, is quick to implement, and offers cost and climate benefits. To lessen the impact of higher prices on end users, many countries are opting for subsidies like tax breaks, price caps, or discounts.

Spain, for instance, has placed price restrictions on fuel and household energy use, while the UK has reduced taxes on road fuel and provided discounts on gas and electricity. Efficient measures will be negatively impacted by these policies without checks, as they will strengthen demand and exacerbate market shortfalls. To protect lower-income consumers and avoid encouraging more consumption, smart subsidies should be used.

Keywords: Challenges, Energy Market, Environment

Introduction

What is energy market?

The energy market refers to the trade and provision of energy resources, such as electrical energy, coal, oil, gas, hydrogen, and heat. It plays a significant role in global economies and is essential for power and gas supply. Energy markets have various dimensions and characteristics, and their development reduces the need for organizations to produce their own inputs. Governments also play a role in organizing these markets as both active players in the supply chain and regulators. The operation of energy markets involves models that determine their performance level and advantages/disadvantages. The restructuring of the energy market is influenced by factors such as energy pressure from Russia and the need for alternative energy sources. The regulation of the global energy market aims to ensure continuity of supplies, balance the interests of stakeholders, and promote rational, ecologically clean, and safe energy consumption (देवशाला शिवाजी नागदे , 2023; Mousavi et al., 2021; Mulder, 2020; Radulescu, 2014; Kohut-Ferens, 2022).

Papalexopoulos, (2013) provides an overview of energy markets and discusses different energy market models, transmission rights markets, and future energy market trends. However, it does not explicitly define what an energy market is.

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Helm et al., (1990) discusses various aspects of the energy market, including monopoly, efficiency, regulation, pricing, and the role of state intervention. Also helm et al., (1980) provides an up-to-date account of economic aspects of the energy markets, including electricity, gas, coal, and oil. It discusses recent advances in the economics of energy and their implications for regulation, privatization, and international competition. However, it does not explicitly define what an energy market is. Bressand, (2013) mentions that the energy industry differs from the rest of the economy in several ways, including its capital intensity, the endogenous nature of energy transportation infrastructures, the importance of rent and conflict over rent distribution, and the eminent role of the state in the ownership, control, and development of energy resources. These factors suggest that the energy market involves the buying and selling of energy resources, with significant involvement from the state and considerations of rent distribution.

What are the challenges facing the energy market?

The challenges facing the energy market include the need for greater flexibility to balance intermittent renewable power sources with demand and supply (Bilan et al., 2023). The energy crisis triggered by the Russo-Ukrainian conflict has had an unprecedented impact on investment in the energy market (Bhattacharyya, 2019). There is a fault line in the American political environment regarding when it is advisable for the state to intervene in the market, which affects energy market regulation and the management of externalities associated with energy production and delivery (Costa-Campi et al., 2018). The world is facing challenges in energy production due to the sharp increase in demand linked to population growth and new economies (Bose et al., 2019) The European electricity and gas markets have been deregulated and are continuously evolving to accommodate new challenges and improve integration, with paradigms of effective competition, subsidiarity, and sustainability driving their transformation (D'haeseleeret al., 2017).

Table 1. Some study on challenges facing the energy market

Papers	Insights
Recent Advances in the Energy Market Development: Current Challenges and Perspectives of Energy Crises in Academia Yuriy Bilan +2 more- 2023	The challenges facing the energy market are primarily caused by the Russo-Ukrainian conflict, which has had a significant impact on investment in the energy market.
Overview of Challenges Facing the Energy Sector Subhes C. Bhattacharyya 01 Jan 2019	The paper provides a brief introduction to important issues facing the energy sector, but it does not specifically mention the challenges facing the energy market.
Economic analysis of recent energy challenges: Technologies, markets, and policies Maria Teresa Costa-Campi +2 more 01 Jul 2018	The paper discusses the challenges facing the energy sector, including the need for environmental sustainability measures and the impact of technological progress on market designs, regulatory frameworks, and policies.
Some Emerging Challenges in Electricity Markets Subhonmesh Bose +1 more 01 Jan 2019	The provided paper does not explicitly mention the challenges facing the energy market.
Flexibility Challenges for Energy Markets: Fragmented Policies and Regulations Lead to Significant Concerns William D'haeseleer +3 more- 06 Feb 2017	The challenges facing the energy market include the introduction of intermittent renewable electric sources and the need for greater flexibility in balancing demand and supply.
Journal Article•DOI Naive Energy Markets David B. Spence 22 Feb 2016	The challenges facing the energy market include ensuring well-functioning energy markets, fair energy prices, managing externalities, and attracting private investment for a reliable energy supply.
Achievements and Challenges in European Energy Markets Christoph Weber 01 Jan 2023	The challenges facing the energy market include the provision of locational signals for distributed renewable energy sources and the coordination issues at various levels in the European electricity markets.
Energy Market in Contemporary International Relations: Main Threats and Challenges Justyna Misiagiewicz- 25 Jan 2023	The paper discusses the challenges and threats to the international energy market in the context of transformations in international relations.
Naïve Energy Markets David B. Spence 06 Apr 2017	The paper discusses the challenges of ensuring well-functioning energy markets and managing the externalities associated with energy production and delivery.
The Energy Industry: Running at Full Speed Vincent Petit 01 Jan 2017	The challenges facing the energy market are the sharp increase in demand due to population growth and new economies, which leads to higher demands on resources and production means.
Economic Analysis of Energy Markets: An Introduction Machiel Mulder, 01 Jan 2021	The challenges facing the energy market include the need for an efficient supply of energy while mitigating negative environmental effects.
The Challenges of Climate for Energy Markets Timothy J. Brennan 01 Sep 2009	The challenges facing the energy market discussed in the paper include cap-and-trade vs. taxes, non-price regulations, energy efficiency policies, mitigation vs. adaptation, trade effects, and transmission planning.
The Challenges of Climate for Energy Markets Timothy J. Brennan 01 Sep 2009	The paper discusses six economic challenges facing the energy market, including cap-and-trade vs taxes, non-price

	regulations, energy efficiency policies, mitigation vs adaptation, trade effects, and transmission planning.
Energy Markets — Research Issues and Policy Needs Christoph Weber +1 more- 01 Jan 2005	The challenges facing the energy market are the internalization of externalities, efficient market operation, and investment adequacy in liberalized markets.
Electricity markets: challenges for economic research Richard Green 01 Jan 2003	The paper discusses challenges in studying electricity markets, including the need for fine-tuning market designs, accurate models of strategic firms, and unanswered questions about retail competition and security of supply.
Energy-Related Challenges Thomas Flüeler +3 more 01 Jan 2012	The paper discusses three main challenges facing the energy market: access and security, climate change and other environmental impacts, and economic and social development.
The Difficulty to Stabilize Energy Markets Oscar Mascarilla +2 more 01 Oct 2010	The paper discusses the difficulty of stabilizing the global energy market and the negative externalities caused by excessive market volatility. It also mentions the impact of globalization on energy markets and the role of cartels like OPEC in stabilizing prices. However, it does not explicitly mention the specific challenges facing the energy market.
Wholesale Electricity Markets in the United States: Identifying Future Challenges Facing Commercial Energy Emma Nicholson +1 more 09 Jan 2019	The challenges facing the energy market, as identified in the paper, are declining prices in wholesale electric energy markets, ensuring proper incentives for investment in flexible resources, and addressing the interdependence between the natural gas and electric industries.
Overview of Global Energy Challenges Subhes C. Bhattacharyya 01 Jan 2011	The paper provides a brief introduction to the various issues facing the energy sector, but does not specifically list the challenges facing the energy market.
The energy challenge Chris Llewellyn Smith 18 Aug 2012	The challenges facing the energy market include meeting future energy demand in an environmentally responsible manner and expanding the use of low carbon energy sources.
Global challenges in energy James P. Dorian +2 more 01 Oct 2006	The paper identifies four critical challenges facing the energy market, including growing pollution caused by fossil fuels and the need for a transition to a non-carbon-based global economy.
World Energy Prospects and Challenges Fatih Birol 13 Jul 2007	The paper discusses the challenges of energy security and environmental harm caused by energy use. It emphasizes the need for government action and public support to reconcile energy security and environmental protection.
The Three Challenges Facing the Electricity Sector Jean-Paul Bouttes +2 more 28 Nov 2011	The provided paper is about the challenges facing the electricity sector, not the energy market. Therefore, the paper does not provide information about the challenges facing the energy market.
Meeting the energy challenge. John P. Holdren 09 Feb 2001	The challenges facing the energy market include short-term supply-price crises, the need for adjustments in energy supply systems, and the need for increased investments in reliability and diversity of energy sources.
The global energy challenge: still fuel for progress? Erik Jarlsby- 30 Jun 2015	The challenges facing the energy market include the strain on oil and gas supplies, price shocks, and the impact of energy-related emissions on the global climate.

What kind of energy market are exist?

There are various types of energy markets that exist. One type is the market equilibrium problems (MEPs) that involve players with both convex and nonconvex strategy spaces and objective functions (Grübel et al., 2021). Another type is the multi-carrier energy networks (MCENs) market, where MCENs participate in different markets such as the electricity market, ancillary markets, capacity market, and local balancing services (Kazemi-Razi et al., 2021). Additionally, there are energy markets specifically focused on electrical energy, which include challenges and dealings related to generation and transmission of electrical energy (Spence, 2016). Furthermore, with the emergence of distributed energy generation, new energy markets have been created where consumers and producers are no longer separated, giving rise to the concept of energy prosumers (Mousavi et al., 2021). These markets utilize block chain technology for secure and cost-effective energy trading (Boumaiza et al., 2022) Overall, the energy markets encompass a wide range of sectors and considerations, including power and gas supply, financial concerns, and environmental factors.

Table 2. Some study on kind of energy market

Papers	Insights
Existence of Energy Market Equilibria with Convex and Nonconvex Players Julia Grübel +5 more 31 May 2021	The paper does not explicitly mention the specific types of energy markets that exist. It focuses on market equilibrium problems involving players with both convex and nonconvex strategies and objective functions in the energy sector.
Energy Markets of Multi-carrier Energy Networks Seyed Mahdi Kazemi-Razi +1 more 01 Jan 2021	The paper mentions several energy markets that exist in multi-carrier energy networks, including the electricity market, ancillary markets, power balancing services market, capacity market, gas market, CO2 emissions market, energy efficiency market, and low-carbon incentives market.
Naive Energy Markets David B. Spence 22 Feb 2016	The paper does not explicitly mention the different types of energy markets that exist.
Energy market fundamentals and overview Fariba Mousavi +5 more 01 Jan 2021	The paper discusses various types of electrical energy markets, but it does not explicitly mention other types of energy markets.
AI for Energy: A Blockchain-based Trading Market 17 Oct 2022	The paper discusses the emergence of distributed energy generation and the concept of energy prosumers, where consumers and producers are no longer separated. It proposes a block chain-based energy trading market for Qatar's Education City Community Housing.
AI for Energy: A Blockchain-based Trading Market Ameni Boumaiza +1 more 17 Oct 2022	The paper discusses the emergence of distributed energy generation and the concept of energy prosumers, where consumers and producers are no longer separated. It proposes a block chain-based energy trading market for Qatar's Education City Community Housing.
AI for Energy: A Blockchain-based Trading Market 17 Oct 2022	The paper discusses the emergence of distributed energy generation and the concept of energy prosumers, where consumers and producers are no longer separated. It proposes a block chain-based energy trading market as a solution for this new energy market.

Reinforcement learning-driven local transactive energy market for distributed energy resources Steven Zhang +3 more 01 Mar 2022	The paper discusses the design of an autonomous local energy exchange (ALEX) market, which combines multi-agent learning and a double auction mechanism. It does not explicitly mention other types of energy markets.
Naïve Energy Markets David B. Spence 06 Apr 2017	The paper discusses two types of energy markets: well-functioning energy markets and fair energy prices, and the externalities associated with the production and delivery of energy.
Energy market trading systems in G6 countries Giuliano Andrea Pagani +1 more 01 Jan 2010	The paper discusses the transition from a static monopoly market to a dynamic energy-exchange-based market, with bundled and unbundled markets being the two main types mentioned.
A Decentralized Energy Trading System Based on Public Blockchain Md. Mainul Islam +3 more 21 Oct 2020	The paper mentions that existing electricity markets are based on centralized trading policy where electricity producers supply electricity to consumers and receive electricity bills via a trusted third party such as a bank.
AI for Energy: A Blockchain-based Trading Market Ameni Boumaiza +1 more	The paper discusses the emergence of distributed energy generation and the concept of energy prosumers, where consumers and producers are no longer separated. It proposes a block chain-based energy trading market for Qatar's Education City Community Housing.
E-Chain: Blockchain-Based Energy Market for Smart Cities Siwei Miao +5 more- 16 Oct 2020	The paper discusses the existence of peer-to-peer (P2P) energy markets where prosumers can trade their surplus energy.
Energy Trading as a Multiplayer Game Brandon R. Sutherland 21 Aug 2019	The paper does not explicitly mention the types of energy markets that exist. The paper focuses on a new approach based on game theory to model future energy markets.
Blockchain based smart energy trading platform using smart contract Seung Jae Pee +3 more- 01 Feb 2019	The paper mentions that various types of energy markets, such as solar energy, will be formed beyond oil and gas.
Simulation of trading strategies in the electricity market Kamil Charkiewicz +1 more 12 Jun 2011	The paper mentions that the energy market consists of several markets, including the Futures Contract Market and Next Day Market.
Energy trading in the distribution system using a non-model based game theoretic approach Bilal Ahmad Bhatti +1 more 01 Nov 2019	The paper proposes a comprehensive energy trading market at the distribution level using a non-cooperative, multiplayer game approach.
Nonconvex equilibrium models for energy markets: exploiting price information to determine the existence of an equilibrium Julia Grübel +5 more 11 Nov 2022	The paper does not explicitly mention the types of energy markets that exist. The paper focuses on solving market equilibrium problems involving players with nonconvex strategy spaces or objective functions.
Energy Market of the European Union: Common or Segmented? Bartlomiej Nowak 01 Dec 2010	The paper discusses the energy market in the European Union, highlighting issues such as unequal implementation of directives, lack of independent regulators, and discriminatory access to infrastructure. It does not explicitly mention the types of energy markets that exist.
Blockchain Based Transactive Energy Market Using Peer-To-Peer(P2P) Energy Trading Umare Sonali Vasant +3 more 20 May 2022	The paper discusses the implementation of a decentralized electricity market using a peer-to-peer (P2P) approach for trans active energy trading. It does not explicitly mention other types of energy markets.

The Market for Energy Dieter Helm +2 more- 01 Jan 1989	The paper discusses the major energy markets, including electricity, gas, coal, and oil.
Equilibria in Network Constrained Energy Markets L. Massai +2 more 15 Jun 2022	The paper does not explicitly mention the types of energy markets that exist. The paper focuses on studying an energy market composed of producers competing to supply energy to different markets.
A Mixed Complementarity Model of European Energy Markets: Using equilibrium modeling to analyze the optimal price and trade volumes of energy commodities in Europe Lars Harald Gundersen +1 more- 01 Jan 2011	The paper does not explicitly mention the different types of energy markets that exist.
Equilibria in Network Constrained Energy Markets 15 Jun 2022	The paper does not explicitly mention the types of energy markets that exist. The paper focuses on studying an energy market composed of producers competing to supply energy to different markets.
Electricity markets [The Business Scene] L.S. Belyaev 29 May 2007	The paper mentions four main electricity market models, but it does not provide specific details about the types of energy markets that exist.

Method and Materials

Systematic analysis is a process of assessing and analyzing available evidence from scientific studies in a systematic and organized manner. It involves formulating research questions, designing and executing search strategies to find relevant studies, screening and extracting data from these studies, critically appraising each study for potential biases, analyzing the evidence, formulating a report to document findings, and disseminating the evidence to stakeholders (Khamidullaevna, 2022). Systematic analysis can be applied in various fields such as pedagogy, artificial intelligence, energy technological production lines, and complex precise mechanical product assembly. In pedagogy, systematic analysis is used to understand the basic principles of analysis in education (Aguilar-Ruiz, 2022). In artificial intelligence, it is used to make machines emulate human behavior (Schmid et al., 2020). In energy technological production lines, it is used to find optimal solutions for design, operation, and analysis (Bezzubceva et al., 2020). In complex precise mechanical product assembly, it is used to analyze assembling errors and predict assembling precision (Songhua et al., 2016).

The steps involved in a systematic analysis include formulating the research question and assembling the research team (Khan et al., 2022) A search strategy is then designed and executed to find all available evidence, both published and unpublished(Morgan et al., 2022). The evidence is screened for relevant studies, and relevant data is extracted from these studies (Schmid et al., 2020). Each study is critically appraised for potential biases (Oiwa et al., 2021). The evidence is then assessed and analyzed, and a report is formulated to document the findings (Zwanzig et al., 2020). Finally, the evidence is disseminated to different stakeholders.

Literature Review

How is the energy market in terms of its impact on the environment?

The impact of the energy market on the environment varies depending on different

factors. Stock market capitalization, energy transition, and natural resources have been found to reduce CO2 emissions, while international trade and economic growth are positively associated with CO2 emissions (Liang et al., 2023). Researchers The paper focuses on the effects of stock market capitalization and energy transition on the environment, but does not directly discuss the overall impact of the energy market.. Environmental pollution caused by the energy industry is a significant concern, and measures need to be taken to address it (Zakharov et al., 2022). They discusses the negative impact of the energy industry on the environment, including pollution and environmental disasters. It does not provide specific information about the overall impact of the energy market on the environment. The global consumption of fossil fuels and their extraction, production, and consumption contribute to environmental problems, but efforts have been made to reduce greenhouse gas emissions (Antokhina et al., 2021). They discusses the current situation of the energy market and its impact on the environment, including the negative environmental problems caused by the extraction, production, and consumption of fossil fuels. It also mentions the need to reduce the harmful impact on the environment and the use of alternative energy sources. Energy generation from various sources, both renewable and non-renewable, has potential environmental impacts, such as biodiversity loss, climate change, and emission generation, which need to be managed (Chang et al., 2021). Also, they discusses the impact of energy production on the environment, including its potential impacts on biodiversity, climate change, aquatic life, land use, and emission generation. It proposes environmental management strategies to address these challenges. The transition from a decentralized bilateral trading market to a centralized auction market in wholesale electricity markets can improve market efficiency but may also lead to increased pollution emissions (Brehm et al., 20221). They states that the transition to a centralized auction market in the Texas electricity market led to an unintended increase in pollution emissions, which offset the productive efficiency gain.

Table 3. Some study on relationship between energy market and environment

Papers	Insights
Energy and Economy: the Environmental Impact ofBenefits and Penalties Nuno Domingues 01 Aug 2018	The paper discusses the use of market-based instruments to mitigate the environmental impact of the energy market, focusing on achieving sustainable consumption and a decarbonized economy.
Economic Analysis of Energy Markets: An Introduction Machiel Mulder 01 Jan 2021	The paper states that using energy has significant negative environmental effects, as it is still mainly based on fossil energy.
How does the carbon market impact the economy-energy-environment system in resource-based regions of China? Empirical evidence from Shanxi Province Jianhui Cong 01 Nov 2022	The paper does not directly address the impact of the energy market on the environment. The paper focuses on the impact of the carbon market on the economy-energy-environment system in resource-based regions of China.

Environmental implications of market structure: Shale gas and electricity markets Christopher R. Knittel +2 more 01 Mar 2019	The paper examines the environmental implications of market structure using the price of natural gas paid by U.S. electric power producers. It finds that differences in market structure affect the response of power plant operators to fuel prices, which has material implications for carbon dioxide emissions.
Environmental impact of energy production and extraction of materials - a review Ahmad Shamoon +6 more 01 Mar 2022	The paper discusses the impact of various energy-producing infrastructures on the environment, highlighting the environmental concerns associated with fossil fuel extraction and the release of toxic chemicals during the mining of rare earth elements.
Modern Trends in Global Energy and Assessment of the Ever-Increasing Role of Digitalization I. A. Maksimtsev +2 more 21 Nov 2022	The paper discusses the importance of achieving a better environmental situation in the country by reducing CO2 emissions and strengthening the country's position in the global energy market. However, it does not provide a specific assessment of the impact of the energy market on the environment.
Impact of stock market, renewable energy consumption and urbanization on environmental degradation: new evidence from BRICS countries. Ijaz Younis +4 more 19 Feb 2021	The paper does not directly discuss the impact of the energy market on the environment. The paper focuses on the impact of stock market, renewable energy consumption, and urbanization on environmental degradation in BRICS countries.
Do technological innovation, natural resources and stock market development promote environmental sustainability? Novel evidence based on the load capacity factor Wen-Xuan Zhao +3 more 01 May 2023	The paper discusses the impact of renewable energy consumption on environmental quality, but it does not provide a comprehensive analysis of the overall impact of the energy market on the environment.
Trends in the development of the global energy market Irina A. Firsova +4 more 01 May 2019	The paper mentions that there have been negative impacts on the environment due to natural and human-made disasters in globally important energy regions. However, it does not provide specific details about the overall impact of the energy market on the environment.
A novel lens of stock market capitalization and environmental degradation Aamir Azeem +6 more 12 Sep 2022	The provided paper does not directly discuss the impact of the energy market on the environment.

What are the potential environmental impacts of the energy market?

The potential environmental impacts of the energy market include pollution, habitat destruction, water quality and quantity issues, soil erosion, and biodiversity preservation (Liang et al., 2023). The research focuses on the effects of stock market capitalization and energy transition on the environment, considering economic growth, natural resources, and international trade in Asian countries. The energy industry is a major contributor to environmental pollution, which has become a significant concern globally (Zakharov et al., 2022). The potential environmental impacts of the energy market include environmental pollution, greenhouse effect, and depletion of the ozone layer, photochemical smog, acid rain, soil degradation, deforestation, desertification, waste problems, and reduction of the gene pool of the biosphere.

The linkages between energy and crop markets, particularly with the emergence of biomass as a biofuel feedstock, can have location-specific impacts on water quality, soil erosion, and habitat preservation (Domingues et al., 2018). Additionally, the use of renewable energy subsidies can lead to increased harvest of woody biomass, which can negatively affect forest health (Dodder et al., 2011). Discusses potential environmental impacts of the energy market, including effects on water quality and quantity, soil erosion, habitat and biodiversity preservation. To mitigate these impacts, market-based instruments such as taxes, fees, and subsidy reforms can be implemented to incentivize sustainable consumption and reduce environmental externalities (Boomhower, 2015). Governments play a crucial role in implementing and guaranteeing the success of international agreements and their own goals in addressing these environmental impacts.

Table 4. Some study on the potential environmental impacts of the energy market

Papers	Insights
Essays in energy and environmental markets Mar Reguant-Rido - 01 Jan 2011	The provided paper does not directly discuss the potential environmental impacts of the energy market.
Environmental implications of market structure: Shale gas and electricity markets Christopher R. Knittel +2 more 01 Mar 2019	The paper does not directly address the potential environmental impacts of the energy market. The paper focuses on the environmental implications of market structure using the example of shale gas and electricity markets.
Secular Trends, Environmental Regulation, and Electricity Markets Dallas Burtraw +3 more- 22 Mar 2012	The paper does not provide information about the potential environmental impacts of the energy market.
Secular Trends, Environmental Regulations, and Electricity Markets Dallas Burtraw +3 more- 01 Jul 2012	The paper does not provide information about the potential environmental impacts of the energy market.
Can the Energy Market Protect the Environment Ian Fells 01 Jul 2000	The potential environmental impacts of the energy market include the lack of consideration for environmental costs and the expansion of unchecked transportation, which is a significant energy user and environmental polluter.
Environmental Impacts of Emerging Biomass Feedstock Markets: Energy, Agriculture, and the Farmer Rebecca Dodder +6 more- 01 Dec 2011	The paper discusses potential environmental impacts of the energy market, including effects on water quality and quantity, soil erosion, habitat and biodiversity preservation.
Environmental impacts of bioenergy crop production and benefits of multifunctional bioenergy systems Srinivasulu Ale +3 more- 01 Jan 2019	The provided paper discusses the environmental impacts of bioenergy crop production, but it does not specifically address the potential environmental impacts of the energy market.
Environmental impact of energy production and extraction of materials - a review Ahmad Shamoon +6 more 01 Mar 2022	The paper discusses the environmental impacts of energy production and extraction of materials, including the release of toxic chemicals during the mining of rare earth elements.
Environmental Impacts of the Petroleum Industry, Protection Options, and Regulations Shahryar Jafarinejad 01 Jan 2017	The provided paper is about the environmental impacts of the petroleum industry, protection options, and regulations. It does not specifically mention the potential environmental impacts of the energy market.

Environmental challenges to the energy industries Lars J Nilsson +1 more 01 Jan 1994	The paper discusses environmental problems caused by emissions of air pollutants from the use of fossil fuels, including urban air pollution, acidification, regional air pollution, and climatic change.
Potential Environmental Impacts of Increased Reliance on Corn-Based Bioenergy Christian Langpap +1 more 01 Jun 2011	The provided paper discusses the potential environmental impacts of increased reliance on corn-based bioenergy, specifically in the US Midwest. It does not directly address the broader question of the potential environmental impacts of the energy market as a whole.
Impact of energy prices and cellulosic biomass supply on agriculture, energy, and the environment: An integrated modeling approach Rebecca Dodder +5 more 01 Sep 2015	The paper discusses the potential environmental impacts of the energy market, specifically in relation to CO2 emissions.
The energy, environmental and economic impacts of carbon tax rate and taxation industry: A CGE based study in China Boqiang Lin +1 more 15 Sep 2018	The paper does not specifically discuss the potential environmental impacts of the energy market. The paper focuses on the impact of carbon tax rates and taxation industry on energy, environment, and the economy in China.
Impact of stock market, renewable energy consumption and urbanization on environmental degradation: new evidence from BRICS countries. Ijaz Younis +4 more 19 Feb 2021	The paper does not specifically discuss the potential environmental impacts of the energy market. The paper focuses on the impact of stock market, renewable energy consumption, and urbanization on environmental degradation in BRICS countries.
Energy development and its effect on the environment Yu.A. Izrael 01 Oct 1987	The potential environmental impacts of the energy market include local thermal and chemical pollution, climate change, ocean pollution, acid precipitation, and ionization of the global atmosphere.
Do technological innovation, natural resources and stock market development promote environmental sustainability? Novel evidence based on the load capacity factor Wen-Xuan Zhao +3 more 01 May 2023	The paper discusses the impact of natural resources and stock market development on the load capacity factor (LCF), which indirectly relates to the environmental quality. However, it does not directly address the potential environmental impacts of the energy market.
Assess Environmental Damage Caused by Energy Activities Zatirostami Ahmad 01 Jan 2011	The paper discusses various environmental problems caused by energy activities, including water pollution, radiation, solid waste disposal, air pollution, acid deposition, ozone loss, and climate change.
Multi-environmental impacts of biofuel production in the U.S. Corn Belt: A coupled hydro-biogeochemical modeling approach Fubo Zhao +7 more 01 Apr 2020	The provided paper does not specifically discuss the potential environmental impacts of the energy market.
Relationship between green investments, energy markets, and stock markets in the aftermath of the global financial crisis Muhammad Shahbaz +6 more 01 Dec 2021	The potential environmental impacts of the energy market are not mentioned in the provided paper. The paper focuses on the causal relationship between energy markets, stock markets, and green stock returns in the aftermath of the global financial crisis.

Environmental impact of energy production D. Lidgate 01 Jan 1992	The provided paper does not directly discuss the potential environmental impacts of the energy market. It focuses on analyzing the atmospheric pollution generated by the combustion of fossil fuels in the United Kingdom in 1990.

How can the energy market be made more environmentally sustainable?

The energy market can be made more environmentally sustainable by developing market designs that integrate remedies for market conduct with regard to environmental externalities (Ahmad et al., 2021).This can be achieved through incentive-based market clearing mechanisms that consider incomplete information regarding generation costs (Rangel-Martinez et al., 2021; Kamalinia, 2014). They discusses the use of machine learning (ML) techniques in the energy sector, including renewable energies and smart grids. It suggests that ML algorithms can be used to promote the development of ambitious energy management projects, but it does not specifically mention how the energy market can be made more environmentally sustainable. Also, they discusses the role of sustainable energy volatility in a market participant's expansion planning problem, considering sustainable generation incentives and carbon emission penalties. However, it does not provide specific strategies for making the energy market more environmentally sustainable. Investment in renewable energy industries should be supported by consistent policies and procedures that address institutional obstacles (Hogan, 2015) Power plant building should be compatible with existing transmission and distribution networks to minimize risks for investors (Keppler et al., 2022). They discusses the need for an evolution of market design towards hybrid regimes to achieve deep decarburization targets with reduced uncertainty and lower costs. Energy companies can contribute to sustainable and environmental development by implementing marketing strategies that promote renewable energy, sustainable growth, and environmental protection. Additionally, market designs should integrate environmental externalities and market power mitigation to efficiently address sustainability challenges. By considering these factors, the energy market can transition towards a more environmentally sustainable system.

Table 5. Some study on the energy market be made more environmentally sustainable

Papers	Insights
Corporate Social Responsibility in the Energy Sector: Towards Sustainability Florence Mus 01 Jan 2022	The paper discusses the importance of integrating sustainability into the business strategies of energy companies to make the energy market more environmentally sustainable.
Energy Security, Sustainable Development and the Green Bond Market Arkadiusz Orzechowski +1 more 26 Aug 2022	The paper does not provide a direct answer to the question. The word "sustainable" is mentioned in the paper in the context of sustainable development goals and sustainable development indicators. However, the paper does not specifically discuss how the energy market can be made more environmentally sustainable. The paper focuses on exploring the dependences between the green bond market, sustainable development indicators, and energy security.
Deep Neural Network for Predicting Changing Market Demands in the Energy Sector for a Sustainable Economy Mingming Wen +2 more 02 Mar 2023	The paper does not provide specific information on how to make the energy market more environmentally sustainable.
Modern Trends in Global Energy and Assessment of the Ever-Increasing Role of Digitalization I. A. Maksimtsev +2 more 21 Nov 2022	The paper discusses the importance of improving environmental safety in the energy market and reducing CO2 emissions. It suggests that digitalization can play a role in improving the environmental sustainability of the energy market.
Role of machine learning in attaining environmental sustainability P. Asha +8 more 01 Nov 2022	The paper does not provide a direct answer to the query. The word "sustainability" is mentioned in the paper, but it focuses on the use of renewable energy and artificial intelligence to achieve sustainable development goals, rather than specifically addressing how to make the energy market more environmentally sustainable.
Green policy under the competitive electricity market: An agent-based model simulation in Shanghai. Yang Zhou +2 more 01 Dec 2021	The paper suggests that to make the energy market more environmentally sustainable, green policies should focus on replacing coal-fired energy with renewable or gas energy.
Harnessing the Power of Artificial Intelligence for Collaborative Energy Optimization Platforms Adam Stecyk +1 more 06 Jul 2023	The provided paper discusses the transformative potential of Artificial Intelligence (AI) tools in shaping the future of energy systems. It highlights the importance of energy in sustainable development and explores how AI can optimize energy generation, distribution, and consumption. However, it does not specifically address how the energy market can be made more environmentally sustainable.
Shaping the future of sustainable energy through AI-enabled circular economy policies Mir Sayed Shah Danish +1 more 01 May 2023	The paper proposes an AI-driven policy framework aligned with circular economy practices to shape the future of energy and make it more sustainable.
AI and ML Toward Sustainable Solar Energy 01 Jan 2023-Power systems	The paper discusses how AI and ML can help make the energy market more environmentally sustainable by improving predictions, increasing efficiency, and overcoming setbacks in renewable energy sources like solar power.

Cherepovitsyna, A. (2023). Artificial intelligence in the energy sector.	The paper discusses how artificial intelligence (AI) can make the energy industry more sustainable, but it does not specifically mention how the energy market can be made more environmentally sustainable.
Machine Learning for Sustainable Energy Systems Priya L. Donti +2 more 18 Oct 2021	The answer to the query is not present in the provided paper. The paper is about the use of machine learning in sustainable energy systems, but it does not specifically discuss how the energy market can be made more environmentally sustainable.
Sustainability, Globalization, and the Energy Sector Europe in a Global Perspective Henri Waisman +3 more 23 Mar 2014	The paper discusses the need for policies and measures that provide correct incentives for long-term investments, incorporate sectoral measures, and foster globalization patterns consistent with energy sustainability objectives.
Models and methods for electricity and gas markets in a low-carbon economy Luigi Boffino 01 Jan 2021	The paper discusses increasing renewable energy penetration and using storage capacity as possible solutions to make the energy market more environmentally friendly.
Carbon-Oriented Operational Planning in Coupled Electricity and Emission Trading Markets Yunqi Wang +3 more 14 Jan 2020	The paper proposes a two-stage scheduling model that investigates the environmental benefits of consumers participating in both electricity and carbon emission trading markets through active demand side management (DSM). This model can effectively achieve carbon emission mitigation and provide consumers extra environmental benefits.
The interaction of wholesale electricity market structures under futures with decarbonization policy goals: A complexity conundrum Bethany Frew +3 more 01 Jun 2023	The paper does not provide a direct answer to the query. The word "environmentally" is mentioned in the paper in the context of "environmentally sustainable" energy system decarburization goals. However, the paper focuses on exploring the impacts of different market structures on generator operations and deployment, rather than providing specific strategies for making the energy market more environmentally sustainable.
Decarbonisation and wholesale electricity market design Tim Nelson +2 more 01 Oct 2018	The paper does not provide a direct answer to the question of how the energy market can be made more environmentally sustainable. The paper focuses on the challenges and considerations of implementing an "energy-only" market in a decarbonized energy system.
The role of renewable energy and artificial intelligence towards environmental sustainability and net zero 25 May 2023	The paper discusses that the energy market can be made more environmentally sustainable by leveraging renewable energy sources and utilizing artificial intelligence to optimize energy systems and enhance energy efficiency.
Can liberalized electricity markets support decarbonized portfolios in line with the Paris Agreement? : A case study of Central Western Europe William Zappa +2 more- 01 Feb 2021	The paper does not provide specific recommendations on how to make the energy market more environmentally sustainable.
Integrated grey relational analysis and multi objective grey linear programming for sustainable electricity generation planning Hanif Malekpoor +5 more 01 Oct 2018	The provided paper discusses the use of grey relational analysis and multi-objective grey linear programming for sustainable electricity generation planning. It does not directly address how the energy market can be made more environmentally sustainable.

Energetics Systems and artificial intelligence: Applications of industry 4.0 Tanveer Ahmad +7 more 01 Nov 2022	The paper does not provide a direct answer to the question. The paper discusses the applications of artificial intelligence in the energy market, but it does not specifically address how to make the energy market more environmentally sustainable.

Conclusion

To reduce the risks of future price spikes and volatility, stronger policies will be necessary to drive a huge increase in energy investment. The energy sector was much more vulnerable to the disruptions we saw in 2022 due to the subdued investment due to lower prices in the 2015-2020 period. The States Policy Scenario predicts that clean energy investment will surpass USD 2 trillion by 2030. The need to attract new investors to the energy sector is highlighted by the need for it to exceed USD 4 trillion in the net zero emissions scenario by 2050. The worrying gap in clean energy investment levels between advanced emerging and developing economies requires major international efforts to be urgently reduced.

There is no need for any reinforcement to support the environmental case for clean energy. The case for energy security and cost-competitive and affordable clean technologies has become stronger based on economic arguments. The alignment of economic, climate, and security priorities today has already begun to result in a better outcome for both individuals and the planet.

Bringing everyone together is crucial, particularly during this time when geopolitical fractures on energy and climate are more apparent. The new energy economy requires a broad coalition of countries to have a stake, so we must redouble our efforts. The process of transitioning to a more secure and sustainable energy system may not be easy. But today's crisis makes it crystal clear why we need to press ahead.

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