ISSN: 2581-4311
DOI: doi.org/10.51219/IJCRSET/María-del-Carmen/130

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International Journal of Current Research in Science, Engineering & Technology

https://urfpublishers.com/journal/ijcrset

Vol: 7 & Iss: 1

Review

The Traditional Approaches to Energy Security

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Citation: Naranjo MD. The traditional approaches to energy security. *Int J Cur Res Sci Eng Tech* 2024; 7(1), 36-38. DOI: doi.org/10.51219/IJCRSET/María-del-Carmen/130

Received: 16 February, 2024; **Accepted:** 19 February, 2024; **Published:** 21 February, 2024

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ABSTRACT

If we examine the theoretical foundations of energy security, particularly in the aftermath of the initial oil crisis in 1973. The primary concern was to guarantee the uninterrupted supply of raw materials, specifically oil and natural gas (including Liquefied Natural Gas, LNG), and the integrity of energy infrastructures. For instance, pipelines for oil and gas, as well as power grids. Therefore, the conventional approach tends to establish a correlation between geopolitical vulnerabilities and risks, as well as disruptions in energy supply, and fossil fuels.

Keywords: Liquefied Natural Gas; Oil; Energy source; Energy Transition; Energy Diversity; Petroleum Security.

The renowned US think tank Council on Foreign Relations' publication, Foreign Affairs (2023), scrutinizes the notion of energy security. Energy security has become a fundamental principle for numerous governments in light of the recent energy crisis and the re-emergence of rivalries among major global powers. The issue of energy security has prompted Europe and the United States to adopt industrial policies aimed at facilitating the transition to a sustainable economy. However, paradoxically, these policies have undermined the international cooperation required to combat climate change by fostering fragmentation and protectionism.

By the year 2001, the International Energy Agency had already commenced its involvement in matters pertaining to energy security. The notion of energy security pertains to the uninterrupted availability of energy sources at affordable prices. Over the course of time, this notion has undergone a process of evolution and has evolved into an increasingly intricate concept, encompassing not only economic but also environmental, governance, and equity aspects. In a study that spans the years 1980 to 2016, the International Energy Agency examined the energy security in Canada, the United States, and Mexico[1].

Three distinct and distinct indices were devised to assess energy security in these nations:

1. **The Petroleum Security (ISP) assessment evaluates the dependence on oil as an energy source.**
2. **The Energy Diversity (IDE) measure measures the diversity of energy sources utilized.**
3. **The Energy Transition (ITE) encompasses the transition to more environmentally friendly energy sources.**

Subsequently, during the 1980s and 1990s, the International Energy Agency (IEA) defined energy security as "the availability of energy consistently, in various forms, in sufficient quantities, and at affordable prices". Nonetheless, in light of the increasing significance and necessity of safeguarding the environment and climate, the International Energy Agency (IEA) modified its definition to incorporate such criteria. In 2001, it stated that energy security entails uninterrupted physical availability at an affordable cost while preserving environmental concerns. The notions of "in sufficient quantities" and "at reasonable" or "affordable" prices are ambiguous, and as a result, there is a lack of consensus on a comprehensive definition of energy security. This is due to its multifaceted nature and the fact that it is contingent on factors unique to each nation, such as its geographical location, alliances, energy model, and geopolitical framework within which it is situated. It is evident that the status of a nation is contingent upon its status as a net producer (Russia), a net consumer (China, Japan, India, most ASEAN states, and others), or a transit country (Ukraine and Turkey). In general, net consumers are primarily concerned with the security of supply, while net producers are concerned with the "security of demand" of foreign markets. Transit states are often interested in both simultaneously, to reap the benefits of higher and more stable transit rates[2].

New Threats to Energy Security and Their Geopolitical Implications.

In the coming decades, the energy transition to a new era of non-fossil fuels will be determined by the interplay between the geopolitics of fossil fuels and renewables. It is a fast, complex, risky and vulnerable process. To this, we must also add a high degree of unpredictability due to "tsunamis of innovation" and potential unforeseen developments and disruptive implications.

The energy transition is heavily dependent on the modernization of energy infrastructures, particularly electricity grids, and the reorganization of regulatory frameworks to accommodate the evolving nature of energy supply. At a time when societies are increasingly dependent on the seamless functioning of essential energy infrastructures. However, regulators and policymakers tend to be fragile in adapting to disruptive technological innovations, which negatively impact the safety, accessibility, connectivity, productivity, efficiency, and sustainability of the energy transition[3].

Energy Transition and Geopolitics Are Intertwined

The conflict in Ukraine has demonstrated that the transition to a clean energy economy can be a chaotic process in practice, resulting in new conflicts and short-term risks that have prompted governments to adopt a new adage: energy security. The energy crisis has highlighted the different speeds and positions of governments and the lack of coordination in developing new sources of energy around the world.

The energy crisis has strengthened Europe's resolve to abandon oil, gas, and coal, as evidenced by the Green Industrial Act (2021) in Europe and the United States, as well as the Inflation Reduction Act (2022). In both regions, legislation is establishing incentives for domestic production, refining, and processing of minerals that are crucial for the transition to a green economy. These activities are now centralized in China, which is also a prominent player in the clean energy supply chain. In practice, both regions are encouraging domestic industries, thereby fostering protectionism and fragmentation, which may lead to less energy-secure economies. However, interconnected and functioning energy markets can enhance energy security by enabling supply and demand to respond to price signals, thereby allowing the system to improve in the face of unexpected shocks[4].

In the Forthcoming Decades, Climate Change Will Pose a Significant Threat to Energy Security, Posing Risks to Both Traditional and Emerging Infrastructure.

The occurrence of warmer waters and more severe droughts will exacerbate the challenge faced by power plants in cooling and relying on hydropower. The article in Foreign Affairs dated 2023 cites the fact that in the year 2022, California experienced a loss of half its hydroelectric production due to drought, and Brazil was compelled to ration electricity due to the loss of significant hydropower.

The Need to Safeguard Energy Infrastructure Is Imperative Due to The Increasing Number of Cyber Threats.

When discussing essential energy facilities, we refer to facilities and networks that are essential for the generation and distribution of electricity, as well as those that are essential for the extraction, storage, and transportation of gas and oil. These include refineries, liquefied gas terminals, nuclear power plants, or reservoirs. All of these crucial infrastructures are increasingly interconnected and interdependent due to the convergence of two networks, namely electricity and the Internet. Any prolonged disruption could result in significant consequences. Any prolonged interruption of electricity and internet connectivity would result in the deprivation of vital services such as water and energy supply to a nation. The greater the industrialization and technological advancement of a society that relies on the Internet, the greater its vulnerability and the potential hazards it would encounter in the event of a network collapse.

In recent times, the escalating global prevalence of sophisticated cyberattacks targeting industrial control centres has sparked concern among businesses, governments, and cybersecurity professionals. Numerous industrial computer systems that regulate power plants (SCADA/Supervisory Control and Data Acquisition systems) and other vital energy infrastructures have become outdated, even in developed nations, rendering them highly vulnerable to cyberattacks. The energy sector, particularly in highly industrialized nations, is widely regarded as the Achilles' heel of their political, social, and economic development. Particularly, crucial facilities in the electricity and gas industry are particularly susceptible to cyberattacks, owing to their particular dependence on both virtual and physical networks for distribution.

The aforementioned threats are anticipated to escalate with the upcoming digitalization of the energy sector, which will have a significant impact on the generation and distribution of electricity. Additionally, the global expansion of renewable energy sources, and the electrification of transportation, heating, and industrial sectors (Industry 4.0) are expected to augment the threats. With the digitization of the energy sector, the provision of reliable internet connectivity will become as crucial as the power grid itself. Smart meters, smart grids, Industry 4.0, the Internet of Things, cloud computing, and in the future, autonomous vehicles and Artificial Intelligence, will all contribute to a multitude of interconnected layers of continuously functioning infrastructures linked to the Internet. In this manner, the significance of resilience, specifically in the form of a stable electricity system, will increase as a result of the electrification of various sectors such as transportation, industry, and construction[5].

The Increasing Dependence on the Security of Supply of Essential Raw Materials.

One argument in favour of the expansion of renewable energy sources is that it will significantly reduce Europe's and the global dependence on fossil fuel imports, thereby enhancing energy security. It is probable that this approach will not only diminish the dependence on fossil fuel suppliers, who are often politically unstable, but also diminish their political and economic influence in international relations. Alternatively, the global expansion of renewable energy sources and the electrification of transportation and other industrial sectors will necessitate the creation of a novel generation of batteries for electricity storage. This will escalate the global demand for vital raw materials such as rare earths, lithium, cobalt, and others.

In this scenario, the global demand for Essential Raw Materials (EMPs) has the potential to surge significantly, resulting in new import dependences, bottlenecks, supply shortages, disruptions, and even greater geopolitical risks to supply at every stage of the process. The supply of essential raw materials is at every stage of the process, spanning from extraction and processing to refining and manufacturing. The challenge lies not in the physical scarcity of these materials but rather in the concentration of their production in a comparatively limited number of producing nations and companies. In contrast to conventional oil and gas resources, the extraction of MPE presents a more intricate and challenging geopolitical challenge, particularly in light of the anticipated rise in global demand in the future. At present, a significant proportion of essential raw materials, comprising 50%, are located in fragile states or regions that are politically unstable. Currently, China accounts for 98% of the supply of rare earth elements to the European Union and approximately 62% of the total 30 essential raw materials, as per the 2020 definition. The low substitutability and low recycling rates of numerous MSEs also contribute to the potential for future risks to their supply[6].

The availability and consistent availability of these fundamental raw materials, along with their associated supply chains, are essential prerequisites for any novel technology to enter the market and be effectively implemented. Furthermore, the strategic objectives of the European Green Deal and the further expansion of renewables can only be accomplished if a sufficient and stable supply of EMPs is achieved. This will necessitate the widespread implementation of a circular economy, a reduction in unreliable imports, and a heightened emphasis on the domestic extraction of PEMs within Europe itself.

Strategic Perspectives are a Valuable Resource.

The expansion of renewable energies will enable economies to reduce their dependence on fossil fuel imports, mitigate the geopolitical risks associated with this, diversify their energy mix, and enhance their supply security. Simultaneously, numerous nations are increasingly dependent on novel suppliers and global value chains, whether they are exporters of renewables and hydrogen, or nations that produce and refine the fundamental raw materials that the nation in question produces its renewables. In a medium- to long-term perspective, an electrified energy system comprising the transport sector and manufacturing industries can be solely based on a singular mode of transportation and a less diversified energy system. With multiple subsystems all dependent on a consistent supply of electricity, the internet, and a resilient cybersecurity environment. Furthermore, the European and global strategies for a hydrogen-based economy, with the strategic objectives of the European Green Deal, will have extensive geopolitical implications. They necessitate novel supply and value chains, exchange and supply routes, and will also generate novel rivalries and new geopolitical alliances.

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