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Editorial

Advancements in the Energy Sector and the Socioeconomic Development Nexus

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Contemporary societies, in conjunction with economies from around the world, show an increasing demand for energy. Energy, the driving force behind development, plays a crucial role in running the modern global system. As a result, the future challenge will be not only to meet the rising demand, but also implement less reliance on depleting fossil fuels, which can degrade the environment. Synergies between fossil fuels and different types of pollution can equate to a widening inequality gap [1], higher economic costs [2], and regulatory oversight into (new) sectors such as "dumping in outer space, renewable energies, environmental information disclosure, and green production technologies" [2]. These constructs can create noticeable differences, from traditional regulatory domains to a new normal where green policy dictates citizenry [3,4]. In consequence, several technologies and interventions have been presented in this Special Issue entitled "Energy Security as a Key Driving Factor for Socioeconomic Development: From Mitigation to Solution." Viable means of reducing and preventing such drivers with significant economic benefits have been documented and predicted. As such, the sustainability of supplied energy requires a reduction in emissions to control the absorption capacity vis à vis the environment. Globally, policymakers have largely recognized the significance of the relationship between energy and economic progress. According to Indriyanto et al. [5], policymakers usually consider the social and economic aspects of energy security in terms of its affordability and accessibility of service. One of the primary concerns of policymakers should be to ensure energy security for its users [6]. The condition of socioeconomic development depends on safe, secure, and sustainable energy at affordable prices. These factors have resulted in an increasing interest to undertake activities that develop renewable energy sources and expand energy alternatives society wide. Energy efficiency is treated as the most cost-effective way to reduce energy demand while maintaining stable economic activity. Some researchers have called this a "fifth fuel", even though it does not have much in common with the traditional sources of energy science [7]. Increasing energy efficiency is an important supportive aspect to solving issues in relation to climate change, energy security, and energy competitiveness. Accordingly, no country can afford to waste energy and must prioritize it if it is to continue to modernize.

Another pressing challenge is rapid economic development in the developing world. This change is highly dependent on energy consumption primarily sourced from fossil fuels [8,9]. This influx mostly considers energy conservation as a perceived additional cost and a lowering of living standards. This standpoint has been considered an approach that denies communities in developing regions the opportunity to improve their living condition and technological progress. Energy poverty represents the situation often observed in developing regions and plays an important part in examining the effect of financial inclusion (i.e., by identifying principal channels) between available funds and available energy [10]. The lack of or limited access to modern energy services, such as electrical power, and the negative effects on well-being associated with energy poverty (e.g., slow economic growth, a low human development index, and high environmental impact) are the effects of such poverty that requisite a mitigation of a solution type of progression.

In line with these goals, this Special Issue collated research from the international scientific community and provided a picture of the global problem of energy security via case studies and technological know-how. Important leading-edge topics include energy efficiency modelling and simulation tools, energy security and development nexus technology, transformative research into renewables, impact of energy poverty on human development and the environment, energy resource studies and exploitation barriers, fossil fuel subsidies and fuel switching, and techno-economic assessment of energy supply solutions and the potential role of carbon-neutral technologies. All these topics have an underlying policy element that require initiatives and recommendations to reduce and limit energy poverty, so as to highlight the energy security socioeconomic nexus of developing solution-based outcomes.

Hoody et al. [11] investigated American-based reduction programs that have overseen utility-sponsored residential energy over the last decade. The programs disclosed important investments in energy efficient appliances and developments. They noted that co-investment by residents of varying socioeconomic backgrounds supported the utility initiatives directed toward behaviour-based energy reduction via “technologies, such as smart meters and smart Wi-Fi thermostats linked to phone apps” [11]. The research sought to explore these programs specifically at low-income residences using peer-to-peer energy education and support. This study correlated previous findings in which qualitative data, obtained from program implementers is a viable starting point for the development of an improved energy design. The design highlighted “grassroots community co-design of the program and community engagement through program implementation to transform energy consumption and behaviours and find energy justice for vulnerable communities” [11].

Janikowska and Kulczycka [12] examined the transitional use of a tool for preventing energy poverty among women in the mining areas of Silesia Region, Poland. The study utilized the Silesia Region as a representative example of an archetypal European mining territory whose economy is primarily based on coal. With job losses on the rise from the mining sector, the study showed demographic and social data of different groups of people, i.e., mainly households inhabited by single women affected by energy poverty. The Just Transition strategy was applied to the situation of women to transition to other (i.e., future) labour markets outside of the mining industry. The process of restructuring the inhabitants was found to be a profound cultural change, which affected “the ethos of conscientious work, reliability, and love of family that is so important to the inhabitants of the region and which is the ethical code of the Silesian population” [12]. Conclusive findings suggested that the process of closing the mining sector should entail “fairness, solidarity, and sustainable development,” [12] and be interlinked with assisting such communities with compensation for “incurred costs and losses (including environmental) [as well as to] receive post-industrial infrastructure to be used for scientific, educational, social, cultural, and commercial purposes” [12]. It can be said that, at length, replacing coal should (by default) augment the advancement of renewable energy, energy storage technology, and other operative energy-based technologies that can stabilize the power system.

Rausch and Suchanek [13] identified socioeconomic factors influencing the investment decision in solar power of the prosumer in Germany. They pieced together socioeconomic factors that impact on the investment decision of private households towards investments in small scale solar units throughout the country. With Germany’s last nuclear power plant being phased out in 2022 and its coal-fired power plants being turned off in 2038, legislators have mandated renewable energy alternatives to close the gap that fossil fuels and nuclear power will leave behind. As such, a portion or share of the prescribed “renewable energies could be [sourced] from private households that mainly invest in small scale solar” [13]. This study examined Germany’s energy transition to stimulate investment decisions of private households. Secondary socioeconomic data from 2009 to 2018 found, via a factor analysis of identified latent variables, that five factors have an impact on the investment decisions of prosumers: socioeconomics, urbanization, education, scale of industrialization, and the birth-to-death rate variance. They concluded that investments from prosumers are mostly found in the southern parts of the country "where the quality of life is high and many inhabitants live [on] their own properties in rural areas" [13]. In contrast, inhabitants living in urban areas with a "low level of freestanding houses and a lower level of property ownership" [13] did not invest in (alternative) home-based solar—instead opting for traditional energy means. A pivotal, transitory phase for legislators will be when municipal authorities, in conjunction with the participation of the inhabitants, deindustrialize the country's energy from coal-fired power plants in a post-2038 Germany.

Czermański et al. [14] proclaimed that container shipping is the largest producer of emissions within the maritime shipping industry. They formulated an energy consumption approach to estimate air emission reductions in container shipping as a means of measuring ship emission levels. This research is linked to the International Maritime Organization's MARPOL Annex VI application of Tier III requirements, the Energy Efficiency Design Index for new ships, and the Ship Energy Efficiency Management Plan for all ships. It amalgamated findings that can assist policy formulation germane to energy consumption by estimating the volume of sulfur oxide, nitrous oxide, particulate matter, and carbon dioxide emitted from container ships (i.e., via logged data and average vessel speed records generated by the automatic identification system). The research was mapped using geographic information systems and framed empirical findings "to estimate ongoing emission reductions on a continuous basis [...] to fill data gaps where needed, as the latest worldwide container shipping emissions records date back to 2015" [14]. The study reinforces early stage detection of environmental impacts and helps to adopt the greatest potential for emission reductions in terms of location.

Fu et al. [15] examined the effects of regional innovation capability on green technology efficiency of China's manufacturing industry between 2011 and 2017 in A-share listed enterprises. This study highlighted the innovation capabilities of the local manufacturing industry to achieve green technology and sustainable development initiatives. The research took an explicit look at whether "regional innovation capabilities can promote the improvement of green technology manufacturing efficiency [and found] a significant spatial correlation between [the two as] prevalent within spatial heterogeneous bounds" [15]. In a geographical context, it was illustrated that regional innovation capability was strongest in eastern China, in which human capital and government revenue aided in advancing the green technology sector. Green technology can be seen as an alternative practice of facilitating cleaner energy and part of the transitory solution to energy security.

Cirella et al. [16] presented an expository essay that looked at the rural-to-urban transition and correlated it with urban energy demands. The essay examined three distinct themes to developing awareness for urbanization: internal urban design and innovation, technical transition, and geopolitical change. Over the last 30 years, the authors argued that "the urban population boom continues to pressure the energy dimension with heavily weighted impacts on less developed regions; [moreover, unsustainable] urban energy will need to reduce resource inputs and environmental impacts" [16]. It was noted that a decoupling of economic growth from energy consumption will also need to be facilitated regardless of fossil fuel usage (i.e., the preferred method of energy for cities). They stated an "increased understanding is emerging that sustainable energy forms can be implemented as alternatives" [16]. The key to this future transition will be the will to invest in renewables (i.e., solar, wind, hydro, tidal, geothermal, and biomass), efficient infrastructure, and smart eco-city designs. The essay clarified how the technical transition of energy-friendly technology can be implemented into the overall energy mix and how smart electricity-based storage grids—with artificial intelligence—can aid at the international level as well as enforce an energy re-shift to a better human-energy-oriented relationship.

The contributions to this Special Issue presented a broad view to the advancement of the energy sector in correlation to the socioeconomic development nexus. Focusing solely on savings or increasing the efficiency of energy use will not be sufficient [17,18]. In the near future, it will be necessary to work towards a planet-friendly energy mix approach. Improvements to the production process, modernization of equipment and buildings, and the introduction of new technologies will all be vital activities aimed at improving the energy efficiency of the economy. This idea is centred on providing the same number of products or services using less energy and less raw materials to produce it. The effect should reduce polluting emissions and increase the energy security of the state. The fundamentals of energy efficiency policy spurs from this design (i.e., concept)—to the betterment of assessing and improving energy efficacy—so as not to impede on economic growth or economic competitiveness. Energy efficiency targets may be achieved by applying market measures that ensure economic benefits by optimizing technological-economic processes, while considering the complexity of the energy efficiency issue inclusive of the environment. This, however, cannot be attained without combining the efforts of all sectors of the economy and individual users. As such, changing final user behaviour is an essential part of the energy transition process. Synergy, obtained in this way, should allow for the achievement of ambitious energy goals, the reduction of environmental degradation, and the assurance of energy security—sector-wide.

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