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Some views on clean energy and enabling technologies for sustainable development

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Abstract: Sustainable development is a means of achieving balanced growth and development in terms of environmental, economic, and social aspects. The importance of energy efficiency and enabling technologies cannot be overstated. Progress in these fields requires the implementation of various policies, legal regulations and incentive mechanisms with the cooperation of both the public and private sectors. For many nations, high imports of energy resources affect economic stability due to foreign dependence on energy. Ensuring more effective use of domestic resources is therefore vital to enhance national energy security and mitigate risks associated with foreign reliance. Energy policies are to be designed to enhance energy supply security and diversify access to energy resources. The energy sector is also a major contributor to global greenhouse gas emissions, and many energy plans have failed to meet mandatory carbon reduction targets. Addressing climate change is imperative given its potential to disrupt energy supply systems and exacerbate environmental impacts globally. Revising climate-related policies and promoting investments towards the development of energy efficient and clean energy technologies is therefore imperative for nations to meet their intended carbon reduction targets and contribute to climate change mitigation and sustainable development. It should also stimulate economic growth and job creation, particularly in the green economy. These initiatives should play an important role in enabling to reduce energy poverty and increase social welfare, particularly in rural areas, through the access to clean and affordable energy sources.

Keywords: Energy efficiency, enabling technologies, clean energy, sustainable development, climate changes.

1. Introduction

Natural depletion of fossil fuel reserves, which make up approximately 81% of the total, is expected. It is predicted that the share of renewable energy in electricity production will increase from 28 percent in 2021 to 43 percent in 2030, and approximately 90% of the increase in electricity production by 2030 will be met by wind and solar energies alone. By 2050, renewable energy is predicted to account for about 30% of the world's energy total [1].

Low technologies cause uneconomic energy production and harm the environment. Alternative and renewable energies will play a significant role in creating new employment, developing future sectors, and promoting economic competition. Energy policies are created to support economic and social development as a result of high energy demand, economic growth, industrialization, and population growth. The goal is to utilize renewable energy instead of fossil fuels in a manner that is both environmentally secure and economically viable.

Economy can be improved, ecology can be supported and energy savings can be achieved by taking into consideration the possible effects on the environment during the planning and construction of all industrial facilities. While serving to protect the environment, the financial dimension of energy investments will increase and the success of a new technology will be measured by the cost-effectiveness parameter. In this case, clean and affordable energy will contribute to advancing sustainable development.

To achieve sustainable energy systems, it may be necessary to take into account certain parameters. These are [2]:

- Variety of energy and efficiency.
- Supply reliability,
- Public confidence,
- Market-responsive measures.
- Market-based solutions to climate change.
- The cost is reflected in prices.
- Technological innovation,
- The development of energy systems and regional integration.

The basic issues include diversifying primary energy sources and rationally using country resources for sustainability and low-cost energy supply. Investing in industry that utilizes environmentally friendly and clean technologies will contribute to sustainable development.

The literature suggests that the world's population will reach 8.5 billion by 2030 and 9.7 billion by 2050. The world's energy production is 77% consumed by industrialized countries, which account for approximately 28% of the world's population [3].

The national energy policy of many countries involves the use of domestic energy resources and energy saving, as is known. In order to meet the growing energy demand worldwide while improving the environment and conserving resources, clean energy production is necessary.

In order to enhance the environment, promote ecology, and boost the economy, it is essential to include the environment in the planning and construction of all industrial facilities. Clean energy production is necessary to meet the world's growing energy demand while also conserving resources and protecting the environment. Investing in energy requires significant financial resources, which are closely linked to environmental protection. Therefore, it is imperative to ensure that the environment is considered in a cost-effective manner when planning and building industrial facilities.

A country's energy culture relates to the national decision-making structure and can be selected as an interaction

between regular, stable, traditional and policy-related characteristics. Cultural actions such as elections, policies, and investments are strongly associated with the increase in national low-carbon achievements, as it is argued. Low carbon levels can be affected by various prospects and implications from the current and future roles of energy in each country [4].

On the other hand, it is argued that many of the production units are inefficient, uneconomical and do not meet ecological standards, and therefore should be removed from use in the near future. Energy security, competitiveness, economic energy efficiency improvement, and addressing environmental impact factors are the key aspects of a country's energy policy [5].

The primary aim of this article is to emphasize the importance of sustainable development issues that may be related to clean energy and efficient technologies. All countries can rapidly expand the production of clean energy technology by pursuing their goals of advancing the transition to net zero, strengthening energy security, and competing in the new global energy economy. Therefore, recognizing that increasing international trade and supplier diversity is of great importance, rapid and cost-effective clean energy transitions can be achieved. If policymakers, energy companies, workers' representatives, educational and training institutions, and other key stakeholders work together to take the most appropriate measures, they can ensure the transition to cleaner energy sources and remain people-centered by preventing workforce transition risks. Key factors that emerging and developing economies can use to achieve national energy and climate goals include clean electrification, efficiency improvements, and a shift to lower- and zero-carbon fuels [1]. The key benefits of clean energy, which require significant financing in new and emerging industries, include growth and employment challenges. The role of both clean energy and enabling technologies that make it possible to tackle environmental challenges, reduce dependence on fossil fuels, and stimulate economic growth is crucial for sustainable development.

2. Sustainable Development and Environment

To promote sustainable development and protect the environment, all countries need to switch to renewable energy sources as much as possible due to the gradual decrease of fossil fuels and their increasing prices, as well as problems related to reducing their environmental impacts. The standards for local air pollution will be strengthened by protecting the climate system and effective and efficient application of relevant measures [6]. In order to meet the energy demands of a country, it is always important to consider issues such as energy production, transmission, distribution, and the use of standardized equipment and materials. It is important not to disrupt the functioning of systems that transfer energy according to the energy services needs of consumers. To achieve technological innovation and public confidence in the energy systems of the future, research should be conducted in various fields [1].

All countries aim to implement energy systems that are most suitable for improving their economic, social, and environmental conditions, in line with the goals of sustainable development. However, current demographic, social, economic, and technological changes pose significant challenges to the long-term sustainability of global energy systems. To achieve sustainable development goals, every government must provide renewable energy sources, as it can greatly reduce the difficulties associated with depleting fossil fuel reserves, increasing global fossil fuel prices, and minimizing environmental impacts. In order to protect the climate system and implement relevant actions, local air pollution regulations should be strengthened and effectively enforced.

The ecology, cultural heritage, and abundant natural resources should all be considered while addressing a country's energy needs. On the other hand, standardization of equipment and materials is essential in all fields of energy generation, transmission, distribution, and trade.

Energy systems in both developing and developed countries can have significant environmental impacts. Hence, a sustainable global energy system must prioritize efficiency while limiting emissions. During energy transitions, both systems must continue to function properly, providing energy services that consumers require, even if their contributions change over time. To ensure electrical security in tomorrow's power systems, new technologies, adaptable approaches, and procedures to ensure appropriate capacity are needed. Strong measures should be implemented in various areas for technological innovation and public confidence, including sustainable energy systems, energy diversity and efficiency, cost-reflective prices, market-sensitive interventions, supply reliability, regional integration of energy systems, and market [1].

Despite the high and dominant tendency to rely on fossil fuels, it is essential to take measures, particularly against global warming, in order to develop renewable energy sectors globally. The importance of switching from traditional fuels to environmentally friendly options is significant worldwide [7-8].

It is evident that the ecosystem is negatively impacted by the electricity produced from fossil fuels. It can be concluded that the utilization of more cutting-edge technologies in the utilization of fossil fuels will result in a decrease in greenhouse gas emissions [9-10]. Population growth, energy demand, intensive use of fossil fuels in energy production, and other human activities are some of the factors that threaten ecosystems [11]

In order to maintain sustainable development and use, every country must switch to renewable energy sources as soon as possible. Domestic resources can be converted into electricity or liquid fuels as they are the basis of renewable energy resources. Sustainable and clean energy production can be achieved through the use of renewable energy sources. Sustainable development goals can be achieved by utilizing clean and affordable energy. Renewable energy systems have been demonstrated to have the ability to affect the local and regional climate, which can have a long-term impact on both humans and wildlife [12].

Large financial resources are required for energy initiatives that include environmental protection. The benefits and development costs of suitable technologies should be addressed in the planning of power generation systems for sustainable development. During the development and building of all industrial facilities, all environmental aspects are considered, and the economics is enhanced, ecology is supported, and energy savings are supplied [13].

Biodiversity is also required for the sustainability of the natural environment in order for humans and the planet to survive. The main evaluation requirements are met by taxes, allowances, pollution subsidies, technological obligations, and research and development subsidies, all of which are regarded various environmental policy tools. Environmental policy instruments, on the other hand, are also relevant to agriculture, forestry, fisheries, transportation, substance use, and health [13-14].

It is important to examine the connections between the natural environment and economic and political systems, employing a strong analytical framework provided by economics. The implementation of severe environmental policies may result in higher costs and loss of market share for many countries. These factors should be taken into consideration while developing policies that aim to protect the environment [15, 16].

The world is facing serious environmental issues and it's imperative that we address them. As we continue to consume fossil fuels at an increasing rate, it's essential that both

developed and developing countries adopt energy systems that are sustainable in the long-term and that improve human, economic, social, and environmental conditions. However, as we face demographic, social, economic, and technical changes, it's becoming increasingly challenging to maintain the sustainability of global energy systems. To lead more sustainable lives, we need to address social and cultural patterns that are not conducive to sustainability. This requires us to promote sustainable alternatives in a positive light and offer incentives to encourage their adoption. Unfortunately, our current economic system, which assumes limitless natural resources and continuous economic growth, is a major obstacle to achieving this necessary change.

Obstacles relating to social and cultural difficulties must be removed. Belief in the current situation and the economic system continues to be an impediment to change. Some major concerns for future sustainable lifestyles may include: a- ensuring community accountability, b- supporting collaborative infrastructure through the sharing of goods and services, c- normalizing environmentally friendly solutions.

3. Energy Resources

One of today's most pressing challenges is responsible consumption, driven by global resource use, environmental impact, and social and economic principles [17]. At present, the primary source of energy supply and consumption is fossil fuels. However, the current need is to develop technologies that can improve human, economic, social, and environmental conditions to meet the present and future energy demands. Several factors influence the future of energy, including global politics, economic conditions, energy policies, technology, and market development. Aside from economic effectiveness, energy storage technology, and growing consumer demand, other considerations that should be taken into account when selecting an appropriate energy source for the energy mix include technological innovation and pricing.

Renewable resources can be used instead of fossil fuels due to their carbon-free energy potential. Making industrial investments in clean technology, diversity, and resource utilization will contribute to sustainability while also maintaining a low-cost energy supply. However, fossil fuels will continue to play an essential role in supplying the world's energy supply until 2040. Currently, the power system is mostly provided by coal, natural gas, and hydro sources; but, as demand grows, future systems will increasingly rely on batteries, bioenergy and other renewable sources, carbon-capturing fossil fuels, hydrogen, and ammonia.

4. Energy Efficiency

Energy conservation plays a vital role in promoting regional energy values that contribute to developing national modernization and security ideals. These values include stability, reliability, social reconciliation, and independence. Research in this area also focuses on energy transitions, low-carbon futures, and smart grids [18].

Efficiency and clean fuels are key to driving competitiveness. High energy prices have led to an increase in energy efficiency and some countries require both behavioral and technological improvements to reduce energy consumption. Adequate funding and a comprehensive energy research and development approach can help achieve these goals.

Energy intensity is a critical measure that demonstrates the direct relationship between energy efficiency and the sectors that comprise the national industrial structure. In this context, many industries may dramatically boost energy efficiency by replacing equipment and using innovative process technologies [1].

5. Policy and Strategy

Energy challenges have become a critical issue for emerging countries. Nevertheless, the restructuring of their energy sectors could lead to the introduction of advanced technologies which could be beneficial for many developing nations. It's worth noting that while sustainable energy methods are beneficial in the long run, they may require more investment than current technologies. The major components of strategic objectives and supply security are believed to be production and import, transmission, storage, and distribution infrastructure supply and demand management.

The ongoing Russia-Ukraine conflict has impacted energy markets and regulations, which may have long-lasting effects. In order to achieve the goal of net zero emissions by 2050, it is crucial to increase investments in energy while minimizing the risks of price fluctuations and volatility. This requires implementing effective incentives and leveraging various market resources.

Numerous countries prioritize the provision of affordable energy and meeting their national energy demands in their strategic plans. To achieve this goal, the government should offer energy subsidies to reduce consumer expenses and regulate production costs. However, implementing these subsidies can put a heavier burden on the state [9].

Many countries have adopted energy strategies to assist long-term economic, social, and industrial development. The main causes of the increase in environmental pollution are rapid industrialization and human work. The principles of sustainable development will be covered by energy-related aspects such as usage, safety, pricing, policy, practice, and technology. Standards must be strengthened and implemented properly and efficiently in order to combat all types of environmental changes.

A country should effectively utilize its environment, cultural heritage, and plentiful natural resources while meeting its energy requirements. Standard equipment and material support are utilized for energy generation, transmission, distribution, and trade. It is important not to delay the implementation of a policy promoting the use of renewable energy sources in the energy mix, in order to ensure sustainability [19-20].

Renewable energy generation is expected to bring about job opportunities in various sectors such as public transportation, construction, development, and production of energy-efficient technology. The shift towards a low-carbon economy will pave the way for the creation of new jobs, especially in underdeveloped countries, which will be more reliable and better compensated than the existing ones. This will help in building a sustainable and equitable future for everyone [21].

Renewable energy requires flexible transmission networks, energy storage innovations, and updated standards. Therefore, any subsidy program for renewable energy should incentivize the integration of large-scale interconnected networks [9].

Shifting to renewable energies is crucial, and the most effective strategy to achieve this is to promote energy competitiveness, guarantee supply security, and protect the environment. By providing public incentives, development will be guided, costs will be reduced, and profits will increase, making renewable energy more valuable. Additionally, reliability will be maintained, ensuring a sustainable and reliable source of energy for the future.

6. Environmental Pollution

Sustainable and eco-friendly energy sources are referred to as "green energy," also known as "renewable energy." Green energy sources have a far smaller environmental impact and

emit little to no greenhouse gases, in contrast to conventional fuels like coal, oil, and natural gas.

Environmental pollution is a significant issue caused by the usage of fossil fuels. Such fuels contain high concentrations of sulfur and ash, which contribute to air pollution. The primary causes of this pollution are outdated combustion technologies, obsolete industrial facilities, insufficient control systems, and inadequate insulation methods.

Burning coal results in the release of hazardous metals, radioactive elements, and carbon dioxide emissions that are harmful to the environment and human health. Although the use of lignite contributes to energy security, it also poses a risk in terms of causing local environmental damage and greenhouse gas emissions. Fossil fuels, particularly coal, are the primary source of CO_2 emissions globally. Renewable and nuclear energy sources have little to no direct impact on carbon dioxide emissions.

7. Climate Change and Its Effects

The use of cost-effective strategies to mitigate climate change would undoubtedly help enhance energy security and environmental performance. Climate-related threats, such as heat waves, droughts, extreme cold, and weather, put strain on electricity infrastructure and cause power outages. By improving the electrical mix, some climate impacts can be mitigated [1].

The Paris Agreement aims to achieve long-term climate goals, reduce air pollution, and ensure universal access to energy. The adoption of clean energy technology and other relevant inputs can significantly increase global production capacity if the transition to clean energy is accelerated. It is crucial to address industrial concerns to fulfill climate commitments. Therefore, job creation is secured in organizations and nations that can take advantage of market opportunities.

Lowering the levels of carbon dioxide in the atmosphere is crucial in delaying climate change and improving the living conditions on our planet for future generations. However, carbon taxes alone, have not been as effective in reducing carbon emissions as initially projected. Therefore, it is necessary to incorporate appropriate strategies for generating clean energy, which should include setting energy emission goals, implementing carbon fees, and minimizing transmission and distribution losses [22-24].

Efficient and effective climate change mitigation plans are crucial and require careful consideration and implementation. This approach can lead to the creation of social and economic co-benefits, which can help reduce poverty. In addition, it is essential to examine issues related to gender, health, and economic disparities when working on climate change solutions [21]. Climate change can also have an impact on social behavior, which is a significant issue. The portrayal of social norms, for instance, can have a positive impact on climate change [25-26].

During the 2015 Paris Climate Talks, experts discussed how implementing a carbon price could help tackle climate change by reducing greenhouse gas emissions. To achieve this, it's important to provide economic incentives to both producers and consumers, encouraging them to produce electricity using methods that are less harmful to the environment [27]. Decision-makers in developed countries often prioritize the improvement and evaluation of social welfare. As a result, they aim to implement more energy-efficient and environmentally friendly technologies to mitigate the impact of climate change and save energy in the long run. On the other hand, developing countries focus on increasing the overall production of goods and services by promoting social and environmental practices [28-29].

Sustainable energy development is necessary to support climate-friendly energy systems, due to the potential impacts of climate change factors such as average rainfall, rainfall distribution, seasonal rainfall patterns, and temperature increases.

There has been a global effort to raise awareness about the impact of climate change, through various international conventions, agreements, and similar initiatives. Different sites may prioritize different climate action measures based on their terrain, population, and socio-economic structure. However, the key areas where cities can make the most difference in reducing emissions are buildings, transportation, energy supply, and waste management.

As it is widely acknowledged, addressing climate change will require a coordinated international intervention strategy. Moreover, climate change is expected to cause more frequent and extended droughts, which will increase water demand and decrease availability. Appropriate measures can be taken to counteract unfavorable precipitation trends and safeguard people and ecosystems, provided that the right policies are put in place [16, 30].

The financial sustainability of energy infrastructure assets will be increasingly impacted by a rise in the frequency and intensity of climatic risks like droughts and floods. Through the destruction of assets like refineries and power plants as well as the interruption of regular business activities, climate hazards have the potential to depress asset values and have a detrimental effect on balance sheets of companies.

8. Enabled Technologies

Sustainable development relies heavily on enabling technologies. They have several advantages, ranging from lowering carbon emissions and preserving resources to fostering economic expansion and raising standard of living. Investing in these technologies is not merely a choice, but rather a requirement for a sustainable and prosperous future as the globe grapples with issues like resource shortages and climate change.

When it comes to achieving a net gain from economic expansion, it's important to consider the percentage of renewable energy used in total final net energy consumption and total greenhouse gas emissions. Experts agree that the amount of renewable energy used will be based on the credit and equity markets. Projections indicate that the renewable energy industry will grow globally as a result of regulatory and financial measures, and as the prices of renewable energy decrease. The increase in demand and decrease in prices will accelerate growth in the global renewable energy sector [28].

As expected, the global renewable energy market will grow as prices fall and regulatory and financial initiatives increase. As the decline in prices increases demand, the global renewable energy market will gradually accelerate its growth. Countries that implement low-carbon policies aim to create new markets for technological innovation. Standardized equipment and materials should support energy generation, transmission, distribution, and trading [6, 31].

Investments in electricity and electrification, along with updated infrastructure, can lead to reduced electricity costs. This, in turn, can result in a faster reduction in emissions, all at a lower cost. It's clear that if we continue at the current development rate, the widespread adoption of solar and wind energy, electric vehicles, and batteries will lead to a much faster revolution.

Clean energy technologies are becoming increasingly widespread, despite various opportunities and constraints. Global technological trends have a significant impact on industry competitiveness and future development. To reduce foreign

dependency on the industry, it is crucial to identify problems related to innovation and technology. Currently, the primary international trends to improve technology development include technology unions, information and communication technology, digitization, an emphasis on high-tech businesses, and a recognition of the importance of foreign enterprises [1].

The enabling technologies are created through large R&D intensity, rapid innovation cycles, large capital expenditures, and high-skilled employment. These technologies support various projects aimed at addressing global concerns, creating new products, encouraging economic growth, and providing employment. The current enabling technologies are connected to global developments such as new materials, manufacturing systems, electronics, nanotechnology, industrial biotechnology, and Photonics [6].

Technological advancements have led to the establishment of new markets, resulting in boosted growth and employment. Initiatives that encourage energy efficiency, renewable energy production, and energy storage address the need for improved materials, advanced process technologies, and industrial biotechnology. In conclusion, technology has become more effective in meeting the demands of various industries and has contributed to the development of a sustainable future.

Incorporating digital technologies into advanced processes is crucial for developing effective business models and creating new customer experiences. Similarly, developing technologies that can transform CO_2 into a valuable resource and using it in polymer manufacturing to reduce oil consumption is essential. The characteristics of process technologies change input raw materials into materials with various chemical compositions, structures, and qualities, making them useful for industries such as construction, automotive, medical, electronics, and energy. Advanced process technologies offer all types of solid, gaseous, and liquid materials to such industries.

Solar energy can be converted into both electrical and thermal energy, making use of a hybrid photovoltaic/thermal (PV/T) system, which can meet the energy needs of buildings. It is essential to develop the performance analysis of PV/T systems while considering operational conditions. Solar energy offers several advantages and is more cost-effective than traditional energy sources. The primary challenges of wind power are technical, social, and environmental. However, wind energy can still be a viable option for all countries, particularly in terms of environmental protection [32-33].

9. Discussion

There are numerous benefits associated with energy efficiency technology applications. For instance, it can lead to cost savings of up to 80%, energy savings of up to 30% and contribute to slowing global warming. Additionally, it helps to keep costs under control and achieve long-term progress. There is a need to explore various energy efficiency technologies in buildings, industrial facilities, transportation systems, and electrical infrastructure across the country to promote the use of cleaner energy and decrease energy consumption.

It is highly likely that new, efficient technologies will emerge in the future to cut environmental costs in a smarter way. This will lead to the development of energy systems that are both reliable and cost-effective, and that do not cause waste. Furthermore, the increased use of renewable energy will result in progress across all sectors, while also boosting employment. Given today's high energy demand, there is no doubt that there will be a substantial market for renewable energy. Therefore, investments in renewable technology will undoubtedly play a significant role in meeting the need for renewable energy.

Although achieving net zero emissions provides long-term security benefits, it also comes with significant risks. Energy systems with complex structures can introduce new security issues in addition to typical energy security hazards. The scope of climate change and its impact on the energy sector will depend on the level of decarbonization of each country's energy culture in the future.

Effective policies and the active involvement of policymakers play a crucial role in mitigating the impact of climate change, reducing energy costs, and promoting sustainable energy practices. Long-term growth in a country's revenue can be achieved through eco-innovation and the implementation of environmental taxation policies.

By assisting with energy infrastructure planning, significant adaptation investments are identified, and the value and normal operation of energy assets are ensured. Governments should provide incentives that can be used after adopting climate risk assessments.

Rising global temperatures may lead to a need for more cooling, which in turn could cause greater strain on electrical grids during times of peak energy demand. Similarly, extremely cold weather can also result in increased electrical demand. To counteract these effects, it is important to take measures that make electrical systems more resilient to the impacts of weather events. A key component of this is the public availability of reliable climate and weather data. To achieve greater system resilience, legislative and financial support for investment is necessary.

Numerous energy-efficient technologies and green chemistry methods are being embraced to achieve the long-term objectives of green chemistry. The ultimate goals of green chemistry will be accomplished by reducing costs, conserving energy, making a substantial contribution to energy requirements, eliminating pollution at its source, and assisting in the mitigation of global warming.

The design of enabling energy technologies and the maintenance of a safe environment requires some rare and critical elements. Key components include critical minerals such as lithium, cobalt, copper, nickel, germanium, and neodymium. Further research and development are necessary for the recycling, and reuse of electric vehicle batteries, and measures to increase end-user energy efficiency. Additionally, it is essential to reduce mineral density and replace minerals in critical applications.

In the future, we can expect more efficient technologies to emerge, reducing environmental costs in smarter ways. This will lead to the development of reliable and cost-effective energy systems. The use of renewable energy will benefit all sectors, including employment opportunities. The current demand for energy highlights the need to promote a large market for renewable energy. Therefore, investing in renewable technology will be a significant step towards fulfilling the need for renewable energy.

While achieving net zero emissions gives long-term security benefits, it also carries significant hazards. Energy systems with complex structures can introduce new security issues in addition to typical energy security hazards. The breadth of climate change and its impact on energy will be defined by the state of countries' energy cultures in terms of future decarbonization paths.

Policymakers' participation and support are critical components of successful practices that can help lessen the consequences of climate change, cut energy expenditures, and improve energy behaviors. Long-term increases in country’s budget income will be connected to environmental taxation and eco-innovation.

By assisting with energy infrastructure planning, significant adaptation investments are identified, and the value and normal operation of energy assets are ensured. Governments should provide incentives that can be used after adopting climate risk assessments.

As rising global temperatures require cooling, periods of peak energy demand may place a greater strain on electricity networks. A similar issue can be seen in the rise in electrical demand as a result of the extreme cold. As a result, measures are required to make electrical systems resilient to the harmful effects of weather occurrences. Reliable climate and weather are inextricably linked to making their data public. Thus, investments in system resilience can be done through legislation and financial support.

Certain rare and critical elements are indispensable in developing energy technologies that enable us to maintain a safe environment. Key components such as lithium, cobalt, copper, nickel, germanium, and neodymium, are vital. To fully utilize these resources, further research, and development are necessary for recycling, electric vehicle battery reuse, and implementing measures to enhance end-user energy efficiency. Additionally, it is crucial to reduce mineral density and replace minerals in critical applications.

10. Conclusion

While achieving net zero emissions will provide long-term security benefits, it will also entail significant risks. Potential risks that may arise in the transition to net zero emissions are issues such as transition costs, dependence on renewable energy sources, supply of rare and critical elements, policy and regulatory uncertainty, geopolitical conflicts, new infrastructure integration, and resistance to renewable energy sources.

Clean energy sources contribute to reducing air and water pollution, climate change, and carbon emissions associated with power production, as compared to traditional fossil fuels. However, clean energy technologies will contribute to the preservation of biodiversity and ecological balance because they have less of an impact on ecosystems. The move to sustainable energy creates new job prospects in the fields of research, production, sustainable development, international cooperation, and the installation of renewable energy technologies. These programs, therefore, have the ability to accelerate the adoption of renewable energy solutions worldwide. Through research and the development of innovative technologies, emerging countries will be able to offer substantial solutions to a wide range of possible crises. However, for countries that cannot do this, inequality and differences will increase. Ultimately, the effects of climate change will threaten food supplies and livelihoods in climate-vulnerable economies, exacerbate the effects of natural disasters, and limit progress.

There is no denying that enabling technologies have a crucial role in coming up with creative solutions for a range of social, economic, and environmental issues. To ensure sustainable development, as briefly stated, there is a need for some important and effective technologies such as renewable energy technologies, climate technologies, clean transportation technologies, waste management technologies, precision agriculture technologies, health technologies, smart grid technologies, energy storage systems, circular economy technologies, biotechnology, financial technologies, satellite technologies, robotics and social innovation platforms, artificial intelligence, and data analytics nanotechnology.

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