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China's Renewable Energy Innovation that Impact the World as Venture to Vanquish the Energy Crisis

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Abstract

The world is experiencing energy crisis today due to the Russian invasion in Ukraine that affect the global market as Russia cuts off its energy supply. Renewable energy is considered as a solution for the energy crisis since it's sustainable and can replace the old energy sources. China as the energy innovator, believed to influence the world with its renewable energy innovation since China has become the world's largest renewable energy producer that distributed its renewable energy. By following in China's footsteps in developing renewable energy, countries in the world have the potential to be independent and not depend on other countries for energy.

Key Words: Energy Crisis, Russian Invasion, Renewable Energy, China.

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INTRODUCTION

The IEA states that the world is experiencing a severe energy crisis as a result of the increasing global demand for energy. Energy is important to many different industries, including manufacturing, healthcare, education, agriculture, and other services. Energy is a vital component of human needs that has a significant impact on economic development and is now the primary cause of social advancement. Related to the global energy crisis, the Russian invasion of Ukraine has a broad impact on the global energy system, disrupting supply and demand patterns, and disrupting long-standing trade relations. Natural gas prices increased to record levels, this led to an increase in electricity prices as well. Oil prices reached their highest level in 2008. Higher energy costs have led to inflation that is sky-high, this has led to poverty, some factories are reducing their output or closing down, and economic growth has been slowed to the point that several countries were experiencing a deep recession. Europe's gas supply is particularly vulnerable due to its history of dependence on Russia, it could be rationed this winter, while the current crisis of energy resembles the oil crisis of the 70's, there are significant differences. Today's crises involve all of the fossil fuels, however, the price fluctuations of the 1970s were primarily limited to oil, while the global economy was more dependent on gas than it was on oil. The whole world economy is more connected than it was 50 years ago, this has increased its importance. That's why we can consider this the first true global energy crisis.

Some European gas manufacturing plants have limited production because they cannot afford to continue operating, however, in China, some have only experienced power outages. In countries that are developing or have recently developed, the majority of the household budget is devoted to energy and food. As a result, higher energy costs have led to extreme poverty and impede the achievement of universal and affordable energy access. Even in developed countries, increasing prices have an effect on vulnerable households and lead to significant economic, social and political consequences. Climate policy is being blamed for some of the recent increase in energy costs, but there is no direct evidence of this. In reality, a greater availability of clean energy sources and methods would shield consumers from the increasing price of oil. The financially detrimental effects of the Ukraine crisis have led to calls for a swift energy transition. The shift would see countries move away from highly polluting fuels, often supplied by a few large companies, to low-carbon sources of energy such as renewables and nuclear power. Especially in Europe, which has been deeply affected by the war, and Russian gas has historically accounted for the majority of imports. Natural gas reserves in the region have remained relatively stable during the harshest month of the year due to a mild

winter and weaker-than-expected demand. While this helps mitigate the impact of Russia's production cuts, the winter of 2023 is likely to be more difficult.

High conflict-related inflation and supply chain disruptions, exacerbated by the fallout from the COVID-19 pandemic, also highlight the risks of highly concentrated production and over-reliance on critical minerals. The combination of these factors has prompted widespread government intervention to protect consumers and shield the industry from rising energy and technology costs. At present, many countries and regions are considering how to use policies to realize the rapid transformation of clean energy while economic recovery, so as to avoid repeating the same mistakes.

China is the world's largest energy consumer and relies heavily on imported energy. The cost of China's energy imports affects the "turbulence" of the global energy market, which in turn affects inflationary pressures, domestic business operating costs, and China's energy and economic security. pose a potential hazard. Comprehensively assessing the impact of the Russia-Ukraine war on international energy trade, examining changes in the global energy landscape, and responding to key issues in a timely manner from a long-term strategic perspective, China must pay close attention to solving them. China can give full play to its leading advantages in the field of new energy power generation, actively participate in global new energy exchanges and cooperation, and promote the conversion and replacement of fossil energy to green energy. Natural gas is considered a reliable transitional energy source for the green energy transition. Increase efforts in natural gas exploration and development, develop extremely unconventional natural gas such as shale gas and tight gas, and open up natural gas import channels. Investigate the possibilities for new energy development in various locations, optimize the industrial layout, and constantly push for the advancement of technology and widespread use of new energy sources including wind, solar, nuclear, and hydrogen energy. It should be highlighted that transforming to green energy would take time, and if done too drastically, it can compromise energy security. At this point, coal plays a critical role in assuring the energy supply, and natural gas serves as a "stabilizer" in the process of transforming energy. Their clean utilization research has consistently supported energy transformation and replacement focused on ensuring energy security.

METHOD

To be able to answer this phenomenon, the authors in this paper use qualitative methods. Where qualitative research is something that is used in a study that does not require the name of the data quantification process. Measuring data or calculating statistical data where this is not needed in terms of explaining the phenomena that occur As Happens in the Interests of China trying to innovate in its industrial sector as an effort to minimize the impact of the energy crisis from the Ukrainian war, but in qualitative methods it is necessary to describe descriptions happened to explain these phenomena in a study in his explanation by Alan Bryman. In addition, qualitative research is an attempt by researchers to collect data based on natural settings. Of course, because it is done naturally, the research results are also scientific and can be accounted for (David Williams, 1995).

RESULT AND DISCUSSION

Renewable Energy

Research on renewable energy has increased in both absolute and relative terms in recent years. Renewable energy can play a key role in addressing fossil fuel depletion and global warming. In recent years, renewable energy has also become an important topic of discussion in various countries. This started with a meeting of United Nations (UN) member states at the 21st Conference of the Parties (COP) in Paris in 2015, which culminated in the Paris Agreement. At the heart of the agreement is a joint effort to curb rising global temperatures.

Renewable energy is the energy that exists in nature and can be used continuously. This is in line with the statement of the International Energy Agency (IEA), which also states that renewable energy is energy that comes from natural processes and is constantly renewed. The term renewable energy was born as a solution to the potential limitations of non-renewable energy sources that are widely used today. In addition, the research results also show that the prolonged use of non-renewable energy or also known as fossil energy has a negative impact. Some of the negative impacts caused are triggered by the production of harmful gases from oxidation residues, such as CO_2, SO_2 and NO_2. The CO_2 gas produced is one of the greenhouse gases that triggers global warming. Whereas SO_2 and NO_2 are compounds that are sources of acid deposition which will return to the earth's surface with acid rain or as free particles. The impacts of acid deposition include disturbing the balance of soil nutrients, damaging water quality, extinction of several types of living things that cannot adapt to acidic conditions, causing health problems in humans, and many more. Starting from these thoughts and facts,

scientists in all parts of the world including Indonesia are trying to come up with new innovations as solutions to these various problems. Then, come to efforts to utilize renewable energy.

Renewable Energy Resources

a. Solar Energy

Solar energy is energy that comes from sunlight. In addition to helping plants carry out photosynthesis, it turns out that sunlight also has a function that is no less important for human life, namely as an alternative for electricity generation. The role of solar energy as a power plant has been developed massively by various countries such as Germany, the United States, India and Japan. To convert solar energy into electrical energy, a solar panel is needed which functions as an intermediary that absorbs sunlight, then converts it into electrical energy. Next, the electricity flows to the inverter which has the role of converting DC current into AC current before it can then be used to turn on various equipment that uses electricity as an energy source.

Energy use Solar power in the generation process is generally referred to as solar power plant (PLTS). PLTS is a generator of electricity that converts solar energy into electrical energy using photovoltaic (PV) modules or also known as photovoltaics. The use of PLTS in electric power systems is currently starting to be massive growth from year to year. This was prompted by several Triggering factors include the global target of reducing greenhouse gas emissions glass, energy transition, regulatory support from the government to encourage utilization of new and renewable energy (EBT) through national targets and regulatory products, the development of photovoltaic technology affect the increase in production, the potential for abundant solar energy and is available all year round in Indonesia, increasing demand renewable energy certificates, until there is a network parity phenomenon in the next few years in several countries. Through the initiation factor then Indonesia from now on until in the future will face the EBT era where the production of electrical energy will be a lot utilizing EBT power plants (PLT), especially those originating from solar energy. Penetration of PLTS into the electric power system the future will provide several opportunities as well as challenges in various elements, both to the community as a prosumer, the government as a regulator, to the manager of the electric power system.

b. Hydro Energy

The use of water as an energy source has been known for a long time. Of course, the abundant amount would be very unfortunate if it was only used to irrigate agricultural land, recreation areas, and for consumption. The process of converting water energy is quite easy, namely by making a water wheel which is then placed in a watershed that has a strong current. The goal is that the greater the energy produced. The waterwheel rotation generates kinetic energy which is then used to rotate the generator. Well, that's where the electrical energy is generated.

Hydrogen is an abundant element with a percentage of approximately 75% of the total mass elements of the universe. Hydrogen power is especially promising in the form of hydrogen fuel unlimited use without causing any pollution (Fahreza et al., 2018).

The use of hydrogen for energy can solve two problems at once, namely its shrinkage of fuel oil reserves and global warming (Huda, 2013). Hydrogen is also projected to be a friendlier alternative fuel for the future environmental and efficiency, where the resulting energy supply is very clean and does not have emissions, because it only produces water vapor during the process (P et al., 2016). Another widely used way to obtain hydrogen gas is the electrolysis of water, i.e. the use of electric current to decompose water (H2O) into its constituent elements such as hydrogen and oxygen gases.

c. Wind Energy

Utilization of wind energy can be done everywhere, both in sloping areas and highlands, and can even be applied at sea. Wind as a source available in nature can be used as a source of electrical energy. Wind is an endless source of energy so the use of a wind energy conversion system will have a positive impact on the environment. Wind is a form of energy available in nature which is obtained through the conversion of kinetic energy. The energy from the wind is converted into kinetic energy or electrical energy. Wind energy can make a significant contribution to reducing emissions because it does not produce CO2 emissions during the production of electrical energy by wind turbines. The workings of a wind power plant known as a Wind Power Plant is quite simple. Wind energy that rotates the windmill is forwarded to rotate the propellers on the generator at the back of the windmill, thus producing electrical energy.

d. Ocean Wave Energy

Ocean Wave Power Plant is the fluctuation of sea waves which can cause this system to not be optimal when the waves give a small thrust. When the thrust comes from big waves, the system can work optimally, but this process does not occur continuously. Ocean waves have potential and kinetic energy which can be calculated by Kim Neilsen's equations. By using these equations, it can be obtained how much energy is contained in the wave [3]. It is estimated that the potential of the sea can meet four times the world's electricity needs, so it is not surprising that various developed countries have competed to utilize this energy.

Energy Transition

The energy transition is a path towards transforming the global energy sector to zero-carbon. This refers to the shift in the global energy sector from a system of production and consumption of fossil-based energy (natural gas, oil and coal) towards renewable energy sources such as wind, solar and lithium-ion batteries. Continuing the notes of the International Renewable Agency, the energy transition is the transformation of energy that was previously based on fossil fuels into green energy that is more environmentally friendly. The energy transition is not new in world history. The same thing was done when changing the use of wood to coal in the 20th century. It's just that, nowadays the urgency of the energy transition has increased. This is none other than to protect the planet from the risk of climate change. The importance of today's energy transition is driven by various factors, including the high penetration of renewable energy into the global energy mix, improvements in technology and energy storage, and the start of electrification. In addition, this issue is growing because many investors are starting to prioritize environmental, social, and governance factors. On the other hand, the government's role is also needed to make the energy transition well realized. The urgency of the energy transition occurs because of three things, namely climate change, greenhouse gases, energy decentralization, and energy crisis. Climate Change: changes in long-term average weather patterns that determine the local to global climate of the earth.

Greenhouse Gases: These gases have the property of absorbing infrared radiation released by the earth's surface, then emitting it back to the earth's surface, thus making the earth hotter. Energy Decentralization: This is an effort to achieve a solution to access electricity to various regions in an area. That way, each region can produce and consume resources independently according to their respective needs. Why the Energy Transition Needs to be Done Acceleration of the energy transition needs to be done for various reasons, namely:

1. Climate Change This is the biggest reason behind the energy transition effort. The energy sector is the most dominant contributor to climate change, contributing nearly 90% of global CO2 emissions.

2. The Paris Agreement International Climate Negotiations (the agreement of the participants of the 21st COP in Paris in 2015 to restrain the increase in the earth's temperature) requires each member country to take a role in climate change commitments, which is manifested by the determination of their respective Nationally Determined Contribution (NDC).

3. Technology and Use of New Energy With the growing use of renewable energy at the global level, research and development of available technologies is increasing. Thus, renewable energy technologies are increasingly diverse, quality and efficient.

In addition to the three things above, geopolitical and economic conditions are also reasons for the importance of energy transitions, such as the decentralization of power plants, renewable investment trends, procurement of renewable energy generator installations, freedom from fossil dependency, and changes in electricity consumer behavior. Energy Transition Technology Continuing the Energy Transition record, there are three technologies that can support the smooth running of the energy transition program, namely: Carbon Capture and Storage (CCS) This is a process in which carbon dioxide originating from combustion of power plants and other industrial sources is compressed and injected into underground geological formations.

China's Energy Transition

Achieving carbon neutrality will require a profound transformation of China's energy system. Here, we combine Monte Carlo analysis with a bottom-up energy-environment-economic model to generate 3,000 cases with different carbon peak times, technology development paths, and cumulative carbon budgets. The results suggest that if emissions peak by 2025, carbon neutrality targets 45-62% electrification, 47-78% renewables in primary energy supply, 5.2-7.9 TW of solar and wind, and energy storage Use to reach 1.5-2.7 PWh etc. would require negative emissions of 64-1,649 Mt CO 2 and synergistically reduce local air pollutants by about 80% by 2050 compared to current levels. The timing of peak emissions and the cumulative carbon budget have major implications for decarbonization pathways, technology choices and transition costs. Early peaking reduces deadweight loss and prevents over-reliance on carbon removal technologies. Technological breakthroughs, changes in production and consumption patterns, and policy improvements are urgently needed to achieve carbon neutrality.

China's extraordinary economic growth over the past four decades has lifted hundreds of millions of people out of poverty, made the country a leader in many industries, and is the world's largest carbon emitter, accounting for one-third of the world's carbon dioxide (CO2) emissions 1. China supplies more than half of the world's steel and cement, but China's CO2 emissions from these two industries alone are higher than the EU's total CO2 emissions. China aims to peak its carbon emissions by 2030 and achieve carbon neutrality by 2060. The energy sector is the source of nearly 90% of China's greenhouse gas emissions, making energy policy central to China's transition to carbon neutrality. An IEA report, China's Energy Sector Roadmap to Carbon Neutrality, examines how China can achieve its goals while ensuring energy security and affordability for citizens. This suggests that the required investment is well within China's capabilities, given the size and dynamism of its economy. The report responds to the Chinese government's invitation to the IEA to cooperate on a long-term strategy.

"China is a clean energy powerhouse that has played a leading role in many global success stories, from solar energy to electric vehicles," said Fatih Birol, executive director of the International Energy Agency. "China's pursuit of carbon neutrality will lead to future Decades of significant development of low-carbon technologies and a significant reduction in fossil fuel use."

"The really encouraging news, however, is that our new roadmap demonstrates that China has the capabilities and means to accelerate a clean energy transition that will deliver greater social and economic benefits to the Chinese people and transformative opportunities for the world ."climate change. "The rise of clean energy . . . with global temperatures up to 1.5 °C," Birol added. "This accelerated transition will lead to a sharp drop in China's carbon emissions after 2025, opening up the possibility for China to achieve carbon neutrality by 2060. This is good for China and good for the world."

China has made important progress in its clean energy transition, but still faces some major challenges. Coal accounts for more than 60 percent of electricity generation, and China continues to build new coal-fired power plants domestically. At the same time, China is adding more solar capacity every year. It is the world's second-largest oil consumer, but also has 70% of the world's electric vehicle battery capacity.

At the same time, achieving China's climate goals cannot rely solely on the introduction of renewable energy and electric vehicles. It must include solutions to reduce emissions from large fossil fuel power plants, steel mills, cement kilns and other industrial plants. If China's existing high-emissions energy infrastructure

continues to operate as it does now, CO2 emissions could account for a third of the global carbon budget by 2060, limiting global temperature rise to 1.5°C. This is apart from new factories that may be built to meet the growing demand.

The path laid out by the China Roadmap is in line with the country's more ambitious goals announced last year to peak carbon emissions by 2030 and achieve carbon neutrality by 2060. The main drivers for reducing emissions along this path to 2030 are improving energy efficiency, scaling up energy from renewables, and reducing the use of coal. From 2020 to 2060, renewable energy generation, especially wind and solar power, will increase sevenfold, accounting for nearly 80% of China's electricity mix by then. Industrial CO2 emissions will drop by almost 95% by 2060, and the role of new innovations such as hydrogen and carbon capture will increase dramatically after 2030. The changes will boost China's job market, as new jobs created in low-energy, technical carbon farming will outweigh losses from a decline in the fossil fuel sector.

The roadmap also examines how China can keep up with and benefit from an accelerated clean energy transition that would reduce China's carbon emissions by almost 20% by 2030 from current levels. In addition to the main benefits of reducing the impacts of climate change, there are social and economic benefits, including greater prosperity in regions that have not yet fully benefited from China's economic development, and the net benefit of creating more jobs nationwide. The need for investment is not an obstacle to a faster transformation, because cumulative investment is like slower investment. This roadmap shows what is possible: China has a clear path to a more sustainable, secure and inclusive energy future. "As China makes some important decisions in the coming weeks and months, the IEA is pleased to share our global analysis and expertise with Chinese policymakers so that together we can help build a better future. I also welcome President Xi Jinping's announcement last week that China will stop building coal-fired power plants overseas as a further positive step to limit global emissions.

Industrial Innovation in China

Over the past 20 years, China has cemented its position as an energy innovator on the global stage, as evidenced by the history of solar energy and more recently electric vehicles. This is the result of decades of increased policy focus on technological innovation, supporting China's ambition to become a knowledge creator and fostering innovation-driven socioeconomic development. Looking ahead, clean energy innovation will play a key role in achieving China's goal of maximizing carbon emissions by 2030 and achieving neutrality by 2060, and is one of the government's core priorities during the 14th Five-Year Plan period (2021-2025). This report provides new and complementary analysis and information

based on the "Carbon Neutral Innovation" chapter of the IEA Energy Sector China Carbon Neutral Roadmap. It maps the institutional and policy landscape of clean energy innovation in China, showing trends in indicators chosen to track and explain the technological development process.

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Looking ahead, China's focus on technological innovation and development is likely to increase, especially to achieve the long-term goal of carbon neutrality and position China in the global clean energy technology value chain. This has important implications for global policy discussions, as China's ability to innovate effectively will shape the global energy transition.

This report is an extension of the "Innovating for Carbon Neutrality" chapter of the IEA Energy Sector China Carbon Neutrality Roadmap and provides complementary analysis and information. It aims to map China's clean energy innovation landscape, similar to the technology innovation section of the energy country reports of IEA member countries. .The aim is to identify important developments in recent years, especially since the IEA last published on this topic in 2015, and to show trends in selected indicators that can be used to track innovation progress. This report is part of the IEA's broader work to support the vision China on a carbon neutral future and aspires to summarize insights from China's energy innovation story in recent years and important announcements to date for the coming period to illustrate the foundation on which the 14th Five Country 14-Year Plan (FYP) (2021-2025) may be built.

China and the Global Leadership of Renewable Energy

When it comes to renewable energy production figures, China leads the way. According to the organization for Economic Co-operation and Development, China is the world's largest producer of wind and solar energy and the largest domestic and foreign investor in renewable energy. In 2016, Chinese companies signed four of the world's top five renewable energy deals. As of early 2017, five of the world's top six solar panel makers were in China, and it was the world's largest wind turbine maker. China's future leadership in renewable energy, by examining the Chinese government's domestic incentives to reduce carbon emissions and pollution, China's ambitious renewable energy investment targets, the international community's consensus on climate change, and the geography of the transition to renewable energy Political implications are analyzed, among other things, is the current government policy on 'inbound investment' in the sector. Unlike the U.S. government's regressive engagement with the industry under President Donald Trump, China has the political incentives, economic capacity, and moral consensus necessary to lead the renewable energy industry globally.

The Chinese government is prioritizing investment in renewable energy sources as they enable the country to overcome air and water pollution problems and reduce the risk of socio-economic instability. Reducing air pollution is a direct reason why the Chinese government is promoting renewable energy. The Environmental Committee of the National People's Congress found in 2005 that the production and consumption of fossil fuels accounted for 90 percent of sulfur dioxide emissions. In 2013, Tsinghua University and the Asian Development Bank reported that seven of the world's ten most polluted cities were in China. Research also shows that climate change is fueling the smog crisis plaguing China. Dissatisfaction breeds fear. Environmental issues are the main reason for mass demonstrations (Chen Jinping, 2013). Since maintaining internal stability is the Communist Party's top priority, Premier Li Keqiang has emphasized the need to develop clean energy to combat air pollution in numerous reports to the State Council and the National People's Congress over the years.

China's commitment to investing in renewable energy is backed by a huge potential to increase production and consumption. The 13th Five-Year Power Plan (2016-2020) envisages increasing the share of non-fossil fuels in total electricity generation from 35% to 39% by 2020. By 2030, one-fifth of the country's electricity consumption will come from renewable non-fossil fuels. According to the International Energy Agency, China will account for 36% and 40% of global solar and wind growth, respectively, over the next five years. The spread of renewable energy is also part of China's larger efforts to develop an "ecological civilization", a

cross-industry approach to reducing pollution and fossil fuel use, curbing climate change and improving energy efficiency. China has also spearheaded investment in many international renewable energy projects and increased its contributions to multilateral organizations. For example, in April 2016, the BRICS New Development Bank, in which China has a stake, provided its first $811 million long-term loan to finance clean energy projects in its member countries.

China's environmental goals for developing renewable energy are relatively uncontroversial and widely supported because of the positive externalities of investing in the technology and its application. This is driven by a global consensus to reduce greenhouse gas emissions to reduce the impact of climate change. A 2015 poll of 40 countries identified climate change as the greatest global threat. Seventy-nine percent of survey participants believe their countries should limit greenhouse gas emissions as part of an international agreement. The unanimous decision to sign the 2015 Paris Agreement is the official sign of the international community's commitment to address the challenge of climate change. As the world's largest emitter of greenhouse gases, China's shift to producing and consuming renewable electricity is critical to its international commitment to reduce carbon emissions by 2030. The next goal is strategic; by increasing the share of renewable energy in its electricity consumption energy mix, China can reduce its reliance on regions with unstable energy security, thereby easing geopolitical tensions. The fossil fuel energy market depends on the security of oil and gas transportation routes in and out of fossil fuel rich countries, which in turn requires enhanced military protection. Protecting oil wells is one of the reasons why China established its first naval base in Djibouti. In contrast, the availability of renewable energy sources such as wind and sunlight far exceeds that of fossil fuels and is more evenly distributed across countries.

China's leadership in renewable energy growth will benefit global geopolitics in two ways. First, China would lose the justification for expanding its regional military presence on the grounds of energy security by increasing the share of domestic renewable energy in its energy mix.

Second, as the use of renewable energy spreads globally as an externality of the development of China's renewable energy sector, more countries will potentially become energy producers and thus less dependent on unstable regions such as MENA (Middle East and North Africa) and Russia (threat of supply cutoff). energy) for conventional fossil fuels.

CONCLUSION

The current article concludes that since non-renewable energy is widely used it has a negative impact on the world and furthermore the energy crisis is happening globally now, the renewable energy sources are seeming promising and can be the solution for the world. The energy crisis mentioned above is the energy crisis caused by Russian war that affected the costs of heating, cooling, lighting, mobility and the embargo sanctions imposed on Russia which made Russia cuts off it energy supply to Europe and it has massive impact for European countries and one of the ways to address this issue is by look at China which utilize the use of renewable energy to replace non-renewable energy. China's renewable energy innovation plays a crucial role in influencing the world especially Europe as European countries are experiencing an energy crisis due to the Russian invasion. The world can follow China in developing its renewable energy to make each country self-sufficient in terms of energy. Renewable energy makes a country less dependent on non-renewable energy supplies from other countries such as Russia. For example, China. China has reduced the use of coal as fuel and is transitioning towards the use of renewable energy even today China is the largest producer of renewable energy.

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