

## The Chinese experience in relying on renewable energies to enhance its energy security

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**Abstract:** China has prioritized energy security as a central component of its national strategy, recognizing its critical role in political stability and economic growth. This paper explores the factors contributing to China's success in developing renewable energy sources, including hydropower, solar, and wind energy, positioning the country as a global leader in clean energy production. It addresses the challenges China faces, such as environmental pollution and reliance on fossil fuels, while highlighting key strategies for enhancing energy independence and technological innovation. The study utilizes descriptive and analytical methodologies to assess China's energy security strategy, examining the pillars that support its renewable energy initiatives. Additionally, it draws lessons from China's experience, offering insights for other countries, particularly Algeria, seeking to advance their renewable energy sectors. The findings highlight that the cornerstone of China's achievements in renewable energy lies in the government's strong commitment to implementing supportive laws and initiatives. This study provides insights into the effectiveness of policy frameworks and governance in advancing renewable energy goals, offering lessons for other countries seeking to enhance their energy sustainability.

**Keywords:** Renewable energies; energy security; energy sources.

**JEL codes:** Q28 ; Q42

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### I-Introduction:

China has made energy security a key priority on its agenda, and it is one of the most significant and well-known problems related to its overall policies. In China's political and economic strategy for the twenty-first century, it has evolved into a key objective linked to national security. China has focused its attention on renewable and environmentally friendly energies by encouraging investment in them, in addition to relying on the assurance and enhancement of fossil energy supplies, given that energy security is the key to achieving political and social stability as well as continued economic growth. China is now the world's top producer of hydroelectric, solar, and wind energy, producing cleaner, renewable energy each year than any other nation.

Given the significance of the Chinese experience in the field of renewable energies, we will endeavour to address the problem statement represented by the following question: What are the factors contributing to the success of the Chinese experiment in developing renewable energies? And what are the lessons learned from it for Algeria?

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Renewable energies are considered the optimal alternative to traditional non-renewable energy sources, contributing to energy security both for China and the world as a whole. Therefore, first, it aims to highlight the importance of renewable energies in achieving and enhancing energy security in China. This includes an exploration of how renewable resources contribute to environmental balance and support sustainable growth within the country. Second, the paper seeks to understand the strategies pursued by China in the field of renewable energy. This involves examining the initiatives that encourage investment in renewable technologies and the transformations necessary to address the energy challenges China faces, thereby enhancing its overall energy security. Lastly, the research will address the current status of renewable energies in China by examining various achievements and the challenges that continue to confront their development. This comprehensive analysis will provide insights into the progress made and the obstacles that remain in the pursuit of a sustainable energy future.

The study holds significant importance due to the crucial role of renewable energies as a strategic option for sustainable development. Considering China's leadership in this field, adopting its experience as a successful model is imperative for leveraging its benefits.

## **II – Background about Chinese reasons for the developing renewable energies:**

China's urgent need to develop renewable energy sources is driven primarily by its status as a leading global producer of carbon emissions and a significant contributor to climate change and environmental pollution. The country faces severe air quality issues, particularly in urban areas, which have led to public health crises and economic costs related to health care and lost productivity. As a result, transitioning to sustainable and clean energy sources has become essential for mitigating these impacts and fostering a healthier environment. According to the International Energy Agency (IEA, 2020), the urgency of addressing climate change has prompted China to invest heavily in renewable energy technologies. The World Bank (2021) also emphasizes that the shift toward renewables is critical for reducing pollution levels and achieving sustainable development goals. Furthermore, research by Zhang et al. (2019) highlights that adopting renewable energy can significantly reduce greenhouse gas emissions, thereby contributing to global climate stabilization efforts.

Another crucial factor influencing China's renewable energy development is the need for energy security. The country's heavy reliance on coal and oil poses significant challenges in ensuring a stable and secure energy supply. Fluctuations in global oil prices, geopolitical tensions, and domestic resource constraints have underscored the necessity for diversification of energy sources. By investing in renewable energy, China aims to increase its energy independence and reduce its vulnerability to external shocks. A study by the China National Energy Administration (2018) indicates that diversifying energy sources is a key strategy for enhancing national energy security. Additionally, the Council on Foreign Relations (2021) points out that a shift toward renewables can help mitigate risks associated with fossil fuel dependency. Research by Li and Chen (2020) reinforces this perspective by showing that renewable energy investments can effectively buffer against supply disruptions and price volatility.

Technological innovation and economic competitiveness also play significant roles in China's renewable energy strategy. The government views investments in renewable technologies not only as a means to address environmental and energy security challenges but also as a pathway to boost domestic innovation and create job opportunities. China has positioned itself as a leader in the global renewable energy market, particularly in solar and wind technologies. The National Development and Reform Commission (2019) reports that the renewable energy sector has become a key driver of economic growth, contributing to job creation and technological advancement. Furthermore, research by Wang et al. (2021) highlights that fostering innovation in renewable energy technologies can enhance China's competitive edge in the global market. The International Renewable Energy Agency (IRENA, 2020) supports this by noting that investments in renewables can lead to significant economic benefits, including job creation and increased industrial competitiveness.

The rapid growth of China's population and economy has resulted in an escalating demand for energy, necessitating the provision of affordable and sustainable energy solutions. As urbanization continues and the middle class expands, energy consumption patterns are changing, placing additional pressure on existing energy infrastructure. The Chinese government recognizes that meeting this growing demand with sustainable energy sources is essential for long-term economic stability and social well-being. According to the Chinese Academy of Sciences (2020), sustainable energy development is critical for supporting economic growth while minimizing environmental impacts. The World Economic Forum (2021) echoes this sentiment, emphasizing that transitioning to renewable energy is vital for meeting the needs of a burgeoning population. Moreover, a report by the Asian Development Bank (2020) points out that integrating renewable energy into the national grid is crucial for ensuring reliable access to energy for all citizens.

International commitments, particularly in relation to the Paris Agreement on climate change, further motivate China's renewable energy initiatives. As an active participant in global climate agreements, China is focused on reducing its carbon emissions and increasing the share of renewables in its energy mix. The Chinese government has set ambitious targets for carbon neutrality and renewable energy development, aligning its domestic policies with international climate goals. Research by the United Nations Environment Programme (2021) underscores that China's efforts to enhance its renewable energy capacity are essential for fulfilling its international commitments. Additionally, the Global Carbon Project (2020) reports that the transition to renewables is critical for China to meet its climate targets and contribute to global emission reduction efforts. Furthermore, studies by Chen and Li (2021) show that advancing renewable energy initiatives can enhance China's reputation on the international stage as a responsible leader in climate action.

In conclusion, China's motivation to develop renewable energy is multifaceted, driven by environmental concerns, energy security needs, technological aspirations, rising domestic demand, and international commitments. These factors collectively shape China's strategy for a sustainable energy future, reinforcing its position as a global leader in the renewable energy sector.

### III- China's experience in renewable energy:

The Eleventh, Twelfth, and Thirteenth Five-Year Development Plans demonstrate the willingness and desire of Chinese officials to shift towards renewable energy. The usage of fossil fuels, particularly coal, has resulted in environmental contamination and an intensification of the greenhouse effect, which is the cause of this shift. To accomplish this energy transition and improve China's energy security, the Chinese government has enacted a number of policies.

#### 1- Reducing the proportion of coal in the energy mix:

A major energy economics strategy was part of China's Eleventh Five-Year Strategy for Development, which sought to progressively transition the nation away from coal as a major source of energy and towards clean, renewable energy. China made the use of clean energy a priority in the Twelfth Five-Year Plan for Chinese Energy Development, which was announced in January 2013. As a result, the country reduced its carbon emissions by 17% and its pollutant emissions by 10% from 2005 to 2013. By 2060, China wants to be carbon neutral (Qinhua & William, 2016, p. 13).

#### 2- Investment in renewable energy:

Due to the Chinese government's efforts to promote investment in renewable energy, this industry has seen a particularly rapid inflow of capital. Investment in renewable energy grew at an average annual rate of 42% between 2004 and 2013. The global investment rate fell in 2012, but in China it increased by 22%; in 2013, however, it fell by 6% (Bridle & Kitson, 2014, p. 2).

Beijing underlined the need to encourage investment in renewable energies in its Twelfth Five-Year Plan (2011–2015). China's dedication to this cause drove the country to achieve notable advancements in this area, making it the world's leader in the majority of renewable energy sources, as the table 1 illustrates.

Table 1: Ranking of the top five countries globally in renewable energy investment / annual additional energy / production for the year 2016.

| Energy \ Rank              | 1            | 2      | 3         | 4        | 5         |
|----------------------------|--------------|--------|-----------|----------|-----------|
| Hydropower                 | China        | Brazil | Ecuador   | Ethiopia | Vietnam   |
| Solar energy               | China        | USA    | Japan     | India    | Britain   |
| Concentrated solar power   | South Africa | China  | -         | -        | -         |
| Wind energy                | China        | USA    | Germany   | India    | Brazil    |
| Solar water heating energy | China        | Turkey | Brazil    | India    | USA       |
| Production of biodiesel    | China        | Brazil | Argentina | Germany  | Indonesia |
| Production of ethanol fuel | USA          | Brazil | China     | Canada   | Thailand  |

Source: (REN21, 2018, p. 25)

From the table, it can be deduced that China leads the world in the usage of renewable energy sources, outpacing major industrialised nations like the US, Japan, and Germany. It is important to note that China was the main beneficiary of the United Nations' "Clean Development Mechanism" scheme, which was established under the Kyoto Protocol. China was able to quickly upgrade its energy output and cut emissions of carbon dioxide as a result. China stands to gain three from this (Taib, 2019, p. 30):

- Attracting foreign investment for the development of renewable energies:
- Identifying new sectors that mitigate greenhouse gas emissions.
- Gaining international experience.

China has released a number of documents encouraging investment in renewable energy sources, including wind, solar, and hydroelectric power, in an effort to encourage the shift to renewable energy. Investments in renewable energy increased by 70% between 2006 and 2016, while China's production of fossil fuels fell during that time, as table 2 illustrate.

Table 02: Investment Volume in Renewable Energies in China during the Period 2006 – 2016 (Unit: Billion US Dollars)

| year       | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015  | 2016  |
|------------|------|------|------|------|------|------|------|------|------|-------|-------|
| Investment | 11.1 | 16.6 | 25.3 | 38.1 | 41.4 | 46.0 | 58.3 | 63.3 | 87.3 | 115.4 | 132.6 |

**Source:** (Boufach, 2018, p. 107)

The table shows how investments in renewable energy have been rising steadily. China is making an effort to take advantage of global investment opportunities while increasing its local investments in renewable energy. This is clear from the fact that 46% of invested funds go towards solar energy, 43% towards wind energy, and 11% towards other sources.

### 3- Renewable Energy Sources in China:

It consists of:

#### 3.1- Hydroelectric Energy:

Representing the greatest share of renewable energy in the nation, it supplies around 18% of China's total electricity. With 229 gigawatts of installed hydroelectric power, or about 25% of the world's total, China is currently the world's greatest hydroelectric power generator. China is the world's largest user of small-scale hydroelectric energy, with a capacity of 290 gigawatts in 2015, in addition to large-scale hydroelectric plants. (Monjel, 2020, p. 190)

#### 3.2- Wind Energy:

In China, wind power ranks as the second most important renewable energy source, with an installed capacity of 89 gigawatts in 2013. With wind power capacity growing more than a hundredfold, the Chinese wind energy sector is expanding at the fastest rate in the world right now. China's goal under the Twelfth Five-Year Plan was to attain approximately 100 gigawatts by 2015. Producers of wind energy are eligible for a 50% tax discount from the Chinese government.(Abdel Moneim Ahmed, 2015, p. 110)

### **3.3-Solar Energy:**

In 2012, China's solar energy output supplied about 30% of the world's photovoltaic energy supply. With an average production of about 19 gigawatts, or 50% of global production in 2013, China is thought to be the world's largest provider of solar cells (Abdel-Moneim Ahmed, 2015, p. 113). Compared to its interest in wind energy, China's interest in solar energy came later. As solar energy has grown to dominate the global market for solar panels, it has emerged as one of China's new strategic pillars for the development of renewable energies.(Schwoob, 2012, p. 4)

### **3.4- Biomass:**

Wood and energy crops are examples of biomass, which typically has a minor overall impact. It is helpful, nevertheless, in certain situations when biomass is burned to produce heat, some of which is transformed into biogas for different applications and some of which is transformed into liquid fuel. Plans from the government call for using biomass more often. China possesses around 10 gigawatts of biomass energy and is the world's third-largest producer of fuel ethanol. China wants 50 million rural households to be powered by biogas.(FAQs, 2014, p. 2)

## **V- Success factors of renewable energy development policies in China and the lessons learned from them.**

Due to a number of variables that have made it possible for it to advance despite the regional obstacles that it faces, China has emerged as a global leader in the field of renewable energy.

### **1-The success factors of the Chinese experience in developing renewable energies :**

The success factors of the Chinese experience in developing renewable energies are as follows: (Boufach, 2018, p. 108)

- The Chinese government's commitment to putting policies and procedures pertaining to the development of renewable energies into practice, as well as its ability to adjust to changes and developments regarding the future evolution of sources, discoveries, and technologies, while also addressing a variety of roadblocks and challenges.
- Utilising a variety of tools and methods to support and transform renewable energy projects, such as finding appropriate ways to price renewable energy, giving loans, and enacting preferential taxes, all of which have been crucial to the growth and success of the renewable energy industry.
- Allocating significant funds for development and innovation, as well as working to mobilise the required local resources for renewable energy technologies in national contexts, will support research centres and the development of renewable energy technology.
- Focusing on training and developing skills and competencies in the field of renewable energies.

- Supporting the growth of businesses engaged in this sector and offering assistance in order to develop the local industry.
- Adopting a practical, flexible, decentralised approach that enables local administrations to take part in the formulation and execution of carefully considered plans and strategies that enable the provision of services to the greatest number of citizens at the local level, wherein the specific plans are in line with the overarching programme and goals established at the national level.
- Due to the different patterns of electricity consumption in rural and urban areas, the development of renewable energy should be done gradually. This is because connecting local networks in villages and rural areas to the regional or national grid first necessitates updating and expanding the transmission and distribution system.
- Attempting to strike a balance between the supply and demand for renewable energy and related technologies in order to protect green technology markets in their early phases of development and help long-term business development organisations compete on a global scale.

## **2- The lessons learnt from the Chinese experience in the field of renewable energy development:**

After discussing China's experience in investing in the field of renewable energy, we can draw a set of lessons that can be benefited from: (Boussis, 2020, p. 53)

- The process of developing renewable energies is lengthy and involves building a balanced model, implementing integrated and consistent reforms, investing in institutions, infrastructure, and human resources, as well as fostering an environment that is conducive to business.
- A future vision for the development of renewable energies is vital, encompassing integrated and sequential developmental strategies and a concerted effort to realise the anticipated outcomes.
- The significance of establishing precise, doable policies with defined objectives, a strict implementation schedule, strong government support, and on-going evaluation.
- Innovation and creativity are essential to the development of renewable energy sources. Investing in technical and technological knowledge can lower expenses while boosting effectiveness and production.
- Coordination among the implementing agencies of renewable energy laws is essential.
- It is imperative to establish market deployment rules that address the expenses associated with bringing new technologies to the market in order to improve technical performance and support the growth of the renewable energy sector.
- The importance of focusing on attracting private capital will help achieve better efficiency and introduce new technologies.

## Conclusion

As part of its strategy to lower the risks associated with reliance on fossil fuels, address various regional and global challenges related to its energy security, and fulfil its international commitments regarding climate change mitigation, China has been keen to see the continued development of the renewable energy sector.

Thanks to careful and well-coordinated policies aimed at gradually expanding renewable energies and relying on a number of mechanisms, such as pricing policies, financial support, tax exemptions, and innovation encouragement, China has been successful in developing renewable energies and has become a focal point for the global energy transition. This has increased China's participation in energy production and consumption by enabling it to make notable advancements and develop technologies and applications for renewable energies. One of the most well-known and effective models for attaining comprehensive and sustainable development is the Chinese experience.

Despite the efforts made in the development of renewable energies, China still faces significant challenges in achieving its energy security, especially in the renewable energy sector. Therefore, we propose:

- Reducing the use of coal as a primary energy source in the country.
- Working towards greater efforts in developing its renewable energy sources to reach top global ranks in other types where it has not yet achieved that.
- Undertaking partnership projects with countries rich in such renewable sources but lacking the necessary technology.
- China, through its experience, has provided several ideas and policies that can be adopted within countries, especially in the developing world.

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