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# Sino-Egyptian Renewable Energy Cooperation: Current Situation, Opportunities and Challenges

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***Abstract:*** *Currently, Sino-Arab energy cooperation continues to expand, with a shift from traditional fossil energy to green, clean and renewable energy sources. Egypt, as an important partner of China's Belt and Road Initiative, has close cooperative relationship with China in both traditional and new energy sectors. On the one hand, China is transforming from high-speed development to high-quality development and is committed to energy transition; on the other hand, Egypt is facing challenges such as declining traditional energy reserves, expanding energy demand due to population growth, and global climate change, necessitating an urgent optimization of its energy structure to address national energy security issues. Therefore, the two sides have complementary development strategies. China's mature technology in renewable energy development, coupled with Egypt's abundant resources in wind and solar energy, serves as an important foundation for their cooperation. However, problems such as Egypt's economic reliance on traditional energy sources, development instability, policy shortcomings in the business environment, and unfavorable regional and international factors have also somewhat constrained the further expansion of Sino-Egyptian renewable energy cooperation.*

***Keywords:*** *Egypt; Renewable energy; Energy transition; Green economy*

## 1. Introduction

Since the 1990s, China's energy cooperation with Arab countries has developed rapidly and has become a crucial area of collaboration between China and the Arab world. Amid global challenges like climate change, decreasing reserves of traditional fossil fuels, and international initiatives promoting sustainable development, the focus of Sino-Arab energy cooperation has shifted from traditional energy sources to low-carbon renewable energy, leading to continuous expansion of collaboration in solar, wind, hydro, nuclear, and hydrogen energy, elevating their energy partnership. Due to Egypt's strategic geographical location at the crossroads of Asia and Africa, as well as its demographic, historical and political significance, it holds prominent influence in both the Arab world and Africa. Consequently, Sino-Egyptian cooperation has become a core component of Sino-Arab and Sino-African partnerships. Renewable energy, as a focal point of international concern, has also become a vital aspect of energy and economic cooperation between the two countries.[1]

## 2. Current Situation of Sino-Egyptian Renewable Energy Cooperation

In 2015, China and Egypt signed an agreement to establish a national joint laboratory for renewable energy, which was completed in 2019, with the aim of conducting joint research, fostering talent, enhancing Egypt's scientific and technological capacity, and improving its independent development capabilities. In 2016, the two governments reached a "Five-Year Implementation Program on Strengthening the Comprehensive Strategic Partnership" between the two countries, outlining their shared objective of further bolstering energy cooperation, particularly in the realm of renewable energy, within the framework of the "Belt and Road" initiative. China actively supports local production of renewable energy components such as wind turbines, solar panels, and silicon panels in Egypt, and assists Egypt's capacity building through various training programs. Egypt seeks collaboration with China to leverage its rich technical expertise in areas like pumped hydro energy storage, clean coal-fired power generation, power grid optimization and efficiency improvement.

Over the years, China and Egypt have deepened their cooperation in the field of renewable energy, jointly advancing energy transition and cultivating a green and low-carbon economy. At the China-Egypt Economic and Investment Forum during the early months of 2023, business representatives from both countries engaged in discussions and exchanges on topics such as China-Egypt economic and trade

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cooperation zone, renewable energy, infrastructure development, manufacturing, and automobile industry, all with the aim of cooperating to promote Egypt's energy structural transformation and enhancing its energy efficiency. At present, China and Egypt's cooperation in the field of renewable energy is thriving, primarily focusing on wind, solar, and hydrogen energy sources.[2]

### *2.1. Wind Energy Cooperation*

At the end of 2022, during the Global Climate Summit, Power Construction Corporation of China and Egypt's AMEA Power signed an agreement for the 500MW Suez Gulf wind power project, which encompasses various aspects, including foundation construction, wind turbine installation, power collection lines, wind measurement towers, and booster station construction. The completion of this project is expected to significantly advance Egypt's national energy structure transformation and contribute to implementation of the Egyptian government's "Integrated Sustainable Energy Strategy 2035" and "National Strategy for Climate Change 2050". In March of 2023, China's Guodian United Power signed a wind power development cooperation agreement with the Egyptian government, under which the two parties will leverage United Power's intelligent wind turbine platform to further develop Egypt's wind energy resources and promote renewable energy development, taking into account Egypt's unique environmental features, characterized by high temperatures, strong winds, and abundant sunshine.

### *2.2. Solar Energy Cooperation*

In 2018, two Chinese companies, Chint Group and TBEA SUNOASIS, took on the construction of two large-scale projects within the Benban Photovoltaic Industrial Park located in southern Egypt. Upon completion, these projects will play a crucial role in ensuring the efficient power transmission of the Aswan Solar Industrial Park, meeting the electricity demands of local industries and residents. Furthermore, these initiatives will contribute significantly to Egypt's ambition of becoming a global leader in the field of renewable energy, and deepen China-Egypt renewable energy cooperation.

### *2.3. Hydrogen Energy Cooperation*

In late 2022, China Energy International Group signed a memorandum of cooperation for green hydrogen projects in the economic zone with the Egyptian Renewable Energy Authority, the Suez Canal Economic Zone Authority, sovereign funds, and power transmission companies. Notably, this makes China Energy International Group the sole Chinese-funded enterprise among internationally renowned investment developers to have signed a cooperative agreement with the Egyptian government. This marks a new phase in China-Egypt cooperation in the field of renewable energy.

## 3. Opportunities and Advantages of Sino-Egyptian Renewable Energy Cooperation

### *3.1. Alignment of National Development Strategies*

Egypt's population growth has led to an increasing demand for energy and industrial production, exacerbating urbanization challenges. Due to the inability of fossil fuels to meet the country's growing energy needs, the adverse effects of ecological degradation and global climate change, as well as the international trend towards energy efficiency and emission reduction, Egypt has turned to explore and utilize renewable energy sources. Its goal is to ensure future energy supply, foster energy transition, promote green economic development by reducing carbon emission, lessen dependence on traditional fossil fuels, and achieve sustainable development of the country.

In 2021, Egypt's Ministry of Environment launched the " National Strategy for Climate Change 2050", extending the low-emission strategy to 2050, which includes a 2035 renewable energy plan, increasing the contribution of wind, solar and other renewable energy sources to power generation, enhancing energy efficiency, and becoming a regional energy center via clean energy like green hydrogen. After the United Nations Climate Change Conference (COP27), Egypt accelerated renewable energy development, bolstered industry policies, and signed energy cooperation agreements worth over 80 billion US dollars. The plan is for renewable energy to achieve 42% of total power generation by 2035, and for green hydrogen to reach 5% of the global total by 2040.[3]

At the same time, China's energy development model is shifting from extensive to intensive, with a dedicated focus on energy transition and sustainable development. China is committed to establishing a

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clean, low-carbon, and efficient energy framework, facilitating the transition to a green economy and ensuring national sustainability. In 2006, the "Renewable Energy Law" was enacted, providing policy subsidies that promoted the early-stage development of renewable energy. Subsequently, the government continued to encourage the growth of high-tech renewable energy industries, fostering technological advancement and energy quality improvement. The latest report from CINNO Research underscores China's substantial commitment to renewable energy, with investments exceeding 9 trillion RMB in 2022. Renewable energy has become a crucial investment sector within the realm of emerging technology industries. Furthermore, China actively contributes its wisdom and solutions to global environmental governance. In 2016, it proposed the concept of "Green Silk Road" with the aim of achieving global sustainable development goals. In 2021, China, along with dozens of countries, jointly launched the "Initiative for Belt and Road Partnership on Green Development", advocating for collaborative efforts to promote global green, low-carbon and sustainable development.

### *3.2. Enormous Development Potential in Egypt's Renewable Energy*

#### *3.2.1. Abundant Natural resources*

With the exception of the Nile Delta and the northern coastal areas, most of Egypt experiences a tropical desert climate characterized by abundant sunshine throughout the year but limited rainfall. This results in an of average more than eight hours of sunshine daily, making Egypt rich in solar energy resources. Furthermore, research data indicates that the average wind speed near the Gulf of Suez along the Red Sea coast in eastern Egypt reaches up to 10.5 meters/second, offering excellent conditions for wind power development. Additionally, the eastern bank of the Nile River, the western desert, and parts of the Sinai Peninsula also have significant potential for large-scale wind power development.

#### *3.2.2. Vast Electricity Market Demand*

Egypt, historically an agricultural country with a less developed industrial base, faced challenges in its aging power station infrastructure and outdated equipment technology. The national power supply system bore a heavy burden, further exacerbated by social unrest after the outbreak of the Arab Spring. In response, the government invested heavily in the energy industry development, promoted diversification, and initiated multiple power grid projects to increase the participation of renewable energy. The 2030 strategy specifically outlines the goal of increasing the contribution of renewable energy sources like wind energy and solar energy in power generation, further optimizing the energy structure, enhancing the adaptability of the national power supply system, and ensuring social stability.

#### *3.2.3. Significant Progress in China's Renewable Energy Development*

The inception of renewable energy development in China dates back to the previous century, but experienced rapid growth around 2010. Currently, installed capacity exceeds 1 billion kilowatts, accounting for over 40% of the country's total installed electricity generation capacity. Among these, hydropower, wind power, photovoltaic power, and biomass power generation have consistently held the top positions globally in installed capacity for 17, 12, 7, and 4 consecutive years respectively. Particularly, the photovoltaic and wind power sectors have shown significant advantages in international competition.[4]

In 2022, China's photovoltaic industry experienced remarkable growth, achieving a total export volume exceeding $51.2 billion, marking an 80.3% year-on-year increase. The applications of photovoltaic power generation are diverse, including the telecommunication industry, rural areas, photovoltaic grid-connected power generation systems and other commodities. China's wind power sector maintains a prominent global position and has become the world's largest installed wind power market since 2010. According to data from Ember, an independent energy think tank, China's wind power production in 2022 exceeded Europe's by 46%. Nuclear power constitutes China's third largest source of power generation, with 24 nuclear power units currently under construction, ranking the country first globally in total installed capacity. In 2022, China's nuclear power generation reached 417.78 billion kilowatt-hours, a 2.5% year-on-year increase, ranking the second-largest in the world. When compared to coal-fired power generation, China's nuclear power generation in 2022 is equivalent to reducing the consumption of standard coal by nearly 120 million tons and reducing carbon dioxide emissions by nearly 310 million tons.

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## 4. Domestic and International Challenges facing Sino-Egyptian Renewable Energy Cooperation

### *4.1. Domestic Factors*

#### *4.1.1. Unstable Economic Development and Long-term Dependence on Traditional Energy Sources*

Egypt's economic structure is fragile, with a relatively high proportion of traditional agriculture, energy and service sectors in the domestic economy. The surge in Egypt's population has outpaced the capacity of its domestic resources to meet the growing demands of its citizens. Consequently, the government has begun importing a significant amount of consumer goods from foreign countries, engendering a measure of dependence on the international market, which compromises its autonomy and dominance. Simultaneously, the insufficient supply of national energy and food and products has led to price increases. This, coupled with the government's economic policies, has triggered inflation and currency depreciation. High subsidies for energy and food have further increased government fiscal expenditures, resulting in widening public budget deficits and accumulating international debts, thereby posing significant concerns for the national economic situation.

Egypt's economic development relies heavily on traditional energy sources. The country stands as the third-largest natural gas producer in Africa and ranks as the largest oil producer in Africa outside OPEC membership. Oil and gas resources play a pivotal role in the national economy. Given the prevailing national circumstances and the overall development trend of the national economy, Egypt faces challenges in reducing its dependence on traditional fossil energy in the short term. Although the government is increasingly aware of the importance of developing green and renewable energy, and has introduced numerous supportive policies and increased investment in related sectors, it will still require a significant amount of time to achieve energy and economic transition, along with sustainable economic and social development.

#### *4.1.2. Needs for Improvement in the Business Environment*

Egypt's framework of policies and regulations pertaining to foreign investments exhibits imperfections. The legal processes lack transparency and openness, and the interpretation of the law is not sufficiently clear. The government demonstrates generally low administrative efficiency, plagued by bureaucratic inefficiencies. According to the "2020 Business Environment Report" published by the World Bank, Egypt ranks 114th out of 190 countries globally, indicating a relatively low level of business environment quality. Although the Egyptian government has issued multiple policies aimed at attracting foreign capital in recent years, practical implementation encounters challenges related to transparency and efficiency, which affect the investment process for external capital.

#### *4.1.3. Low Labor Productivity and Rising Costs*

Egypt has a rich pool of local labor resources; however, the local workforce exhibits low labor productivity, limited technical skills, slow adoption of new technologies, and a lack of skilled and semi-skilled industrial laborers and management personnel. Egypt's "Labor Law" guarantees lifelong job positions for workers, potentially hindering their motivation for enhanced productivity. The "Investment Law" stipulates that the proportion of foreign employees must not exceed 10% of the total workforce. Consequently, Chinese companies investing in Egypt are obligated to conduct extensive specialized technical training for local labor, indirectly increasing economic and time costs.

#### *4.1.4. Harsh Natural Environment in Some Regions*

While Egypt possesses abundant wind and solar resources, a significant portion of these resources is distributed in desert areas characterized by year-round arid and hot conditions, constituting a harsh natural environment. This requires not only high physical fitness from workers, but can also slow down the pace of work progress comparatively.

### *4.2. International Factors*

#### *4.2.1. Impact of International Emergencies on Egypt's Business Environment*

Global economic and social development has faced significant challenges due to impact of the COVID-19 epidemic and the Russia-Ukraine conflict. During the COVID-19 epidemic in 2020, Egypt's tourism industry and foreign investments were directly affected. In 2022, the Russia-Ukraine conflict led to a surge in global prices for food, fertilizer and energy, which had a negative impact on the Egyptian economy once again. Egypt is a major wheat importer in the world, with most of the imported wheat

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originating from Russia and Ukraine in recent years. However, the conflict disrupted trade, causing a severe increase in wheat price. The prices of non-subsidized food in Egypt experienced a short-term increase of approximately 50%, which has exacerbated inflation and constrained economic development.[5]

#### *4.2.2. Intense Competition with Dominance of European and American Capital*

Egypt's engagement with renewable energy in modern times positioned it among the world leaders. While Cairo constructed its first solar thermal power station in the early 20th century, this resource remained untapped over the years. As renewable energy became a focal point for all countries worldwide, Egypt's progress in this domain has been restrained by factors such as its limited economic foundation and technological level. For a long time, Egypt's renewable energy market has been highly dependent on European and American capitals and technologies. Many companies involved in its market development have been European and American enterprises. Notably, the Zafarana wind power project in Egypt, initiated in 2001, was funded by European countries and involved cooperations with companies from Germany, Denmark, Spain and Japan. In recent years, several representative wind power projects in Egypt have also been co-developed and constructed through partnership between Egyptian companies and their European and American counterparts. Egypt's first modern solar power station was supported by Japanese funding, with both parties involved in its construction. Additionally, most of companies participating in Benban Solar Industrial Park, the largest solar energy industrial park in Egypt come from Western countries such as Spain, Italy, and Norway, with limited involvement from countries like China, Saudi Arabia, and the United Arab Emirates.

Furthermore, although China possesses relatively mature development technologies in sectors such as solar and wind energy, there is still considerable room for improvement compared to Western countries. A case in point is the collaboration between SES, an Egyptian renewable energy research company, and the government in 2019 to develop a solar thermal power generation project. This endeavor may entail higher costs compared to China's photovoltaic power generation technology; it also attains a higher level of technical sophistication. Certain facets of China's technology in this sphere bear the risk of higher energy consumption and pollution, making it less competitive than solar thermal power generation in a holistic sense. In summary, China's technology for the high-level development of renewable energy is still in the stage of innovation and progress, necessitating further improvement and development.

#### *4.2.3. Unstable Regional Security Situation*

The Middle East has long been in a state of turmoil and instability. Although there is a gradual amelioration in the overall security situation, sporadic armed conflicts continue to affect regional security. Egypt, being a significant power in the Arab world, is not immune to threats posed by extremism, terrorism and regional unrest. Of particular concern are the ongoing armed riots in Sudan throughout this year, which shows no signs of easing. This situation poses significant challenges to Egypt's border security and subsequently brings risks to its national security.

## 5. Conclusion

China and Egypt are intimately engaged partners in the high-quality construction of the "Belt and Road", with extensive cooperation in economic, trade, energy, politics, and cultural exchanges. Faced with current global challenges such as climate change, economic and energy transitions, and international emergencies, both nations have reached a consensus on the vigorous development of renewable energy to promote sustainable economic and social development, and have launched increasingly in-depth cooperation in wind energy and solar energy. Despite numerous challenges and risks encountered domestically and internationally, Sino-Egyptian renewable energy cooperation stands as an excellent choice, fostering a win-win outcome. For China, optimizing energy consumption structure is of great significance to enhancing the security, stability and reliability of energy supply. From Egypt's perspective, its pursuit of renewable energy cooperation accelerates energy transition, helps cultivate high-quality technical talents, achieves independent and autonomous energy development and promotes sustainable, eco-friendly progress. As Mohamed Moussa, Deputy Minister of Electricity and Renewable Energy of Egypt, remarked: "Whether it pertains to wind power or photovoltaic power generation, China possesses world-leading technology and operates an extensive power transmission network. There exist broad prospects for cooperation between Middle Eastern countries and China in the field of renewable energy."

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