



# The Role of Nuclear Power in Sustainability of the Electricity Sector

**Abeer Mohamed Abdel Razek Youssef**

Department of Economics, Faculty of Commerce, Ain Shams University, Giza, Egypt

**Email address:**

abeer\_yussef@yahoo.com

**To cite this article:**

Abeer Mohamed Abdel Razek Youssef. The Role of Nuclear Power in Sustainability of the Electricity Sector. *American Journal of Environmental and Resource Economics*. Vol. 8, No. 2, 2023, pp. 19-27. doi: 10.11648/j.ajere.20230802.11

**Received:** March 17, 2023; **Accepted:** June 21, 2023; **Published:** July 6, 2023

---

**Abstract:** Energy is the basic building block of all sectors of modern economic growth and is considered a basic factor of production, including capital and labor. However, energy consumption has become a crucial aspect of the economic growth (GDP) of any nation. Due to the rapid growth of the global economy, energy consumption is rapidly increasing because of globalization and industrialization. Most of this demand is fulfilled through fossil fuel energy sources: coal consumption (CC, 38%), and oil consumption (OC, 23%) globally. Fossil fuel combustion is the primary cause of global warming, which has resulted in greenhouse gas (GHG) emissions, with carbon dioxide (CO<sub>2</sub>) being the most significant contributor to environmental pollution. Growing concerns including rapid climate change, environmental degradation, and requirements for clean energy justice, have become human rights issues globally. However, ecologists and energy economists are urging policymakers to shift their energy usage toward clean energy sources (renewable and nuclear) to address the environmental and health challenges. In this regard, the use of nuclear energy and renewable energy plays a crucial role in CO<sub>2</sub> emission reductions as well as establishing substantial economic and socioeconomic benefits. Globally, both nuclear and renewable energy sources are important for controlling energy security and pollution emission. Renewable energy and nuclear energy may have an adverse influence on CO<sub>2</sub> emission, an effect that is beneficial to the atmosphere.

**Keywords:** Economic Growth, Sustainability, Nuclear Energy, Technological Innovation, Job Creation

---

## 1. Introduction

The nuclear energy option is one of the alternative options to meet the desires of society. Being an ideal source that can contribute to achieving the sustainability of electricity, in addition to its close connection with the various fields and dimensions of sustainable development. Sustainability assessment is an indicator that determines the quality of technology and how it is integrated into the electricity mix. It is very important to identify and follow up more sustainable energy options to maximize the well-being of society, the environment, and the economy.

One nuclear plant provides about a thousand job opportunities, in addition to increasing the demand for local services. Reports indicated that every dollar used in building a nuclear plant brings back three dollars to the state's economy, and the amount of electricity consumption reflects the state of economic development. Sustainable development is a triangle consisting of energy, the environment, and the

economy, and meeting a large part of the demand for electricity using nuclear technology has clear benefits in the field of trade, employment, and environmental benefits. Therefore, diversifying the energy mix is imperative to maintain the domestic growth of the economy while ensuring the security of the national income resulting from its oil exports. [1].

One nuclear plant provides about a thousand job opportunities, in addition to increasing the demand for local services. Reports indicated that every dollar used in building a nuclear plant brings back three dollars to the state's economy, and the amount of electricity consumption reflects the state of economic development. Sustainable development is a triangle consisting of energy, the environment and the economy, and meeting a large part of the demand for electricity using nuclear technology has clear benefits in the field of trade, employment and environmental benefits. Therefore, diversifying the energy mix is imperative to maintain the domestic growth of the economy while ensuring the security of the national income

resulting from its oil exports.

*In this second topic, the following points will be addressed: The first axis: the development dimension of the use of nuclear energy in strengthening the infrastructure The second axis: the global economy of nuclear energy in the western countries and the countries of the Middle East The first axis: the development dimension of the use of nuclear energy in strengthening the infrastructure.*

## 2. Development Dimension of the Use of Nuclear Energy

### 2.1. A Nuclear Energy and Its Role in Achieving Sustainable Development

Sustaining preventive operations to develop the components of comprehensive national development is represented in enhancing the productivity of developing countries. Which relies on traditional systems associated with carbon energy, and this requires that work be done to establish renewable energy production bases based on natural capabilities and local resources, within the framework of diversity and strengthening the ability of fragile societies to face changes affecting social components and rehabilitating institutions and motivating them considering the development of capital accumulation quantitative and qualitative. [2]

In light of this, the sustainable development of any country

is linked to an increase in the demand for electricity and energy, and the increased demand for energy is covered mainly through the establishment of new power generation plants, and the transition to renewable sources affects the gross domestic product and its structure, and the rate of industrialization in any country is proportional to the amount of energy available and the rate of its use. It is worth mentioning that the nuclear options have a low cost compared to that electricity produced by gas stations.

In light of this, the sustainable development of any country is linked to an increase in the demand for electricity and energy, and the increased demand for energy is covered mainly through the establishment of new power generation plants, and the transition to renewable sources affects the gross domestic product and its structure, and the rate of industrialization in any country is proportional to the amount of energy available and the rate of its use. It is worth mentioning that the nuclear options have a low cost compared to that electricity produced by gas stations. [3]

To generate energy in an environmentally sustainable manner, nuclear energy is an option for generating electricity at competitive prices and supplying energy locally and regionally. It expands the supply of electricity and increases the world's stock of technological and human capital, by removing carbon and converting it into more sustainable energy systems in the future. The following table indicates a proposal for sustainability standards:

*Table 1. Metrics sustainability energy Nuclear.*

| Nuclear security measures requirements  | Technical sustainability in energy   |
|---|--|
| 1) Regulatory oversight.  | Enhancing safety in nuclear reactors and nuclear fuel facilities.<br>a. High-level exploitation of natural nuclear materials.<br>b. Reducing the radioactive stock in the waste.<br>c. Develop anti-proliferation technologiesradioactive. |
| 2) Consolidationand hemeanj Reducing the number of sites makes it possible to achieve higher levels of security at a lower cost; So it isHAN essential part of strengthening and sustaining nuclear security. |  |
| 3) International cooperationAndFunding and resources.   |  |

Source: Prepared by the researcher

### 2.2. Indicators and Dimensions of Sustainability of Nuclear Energy

Energy sustainability is a tripartite concept that includes the pillars of economic, social, and environmental sustainability. The concept of sustainable development includes four interrelated pillars: social development,

economic development, environmental protection, and technology. Sustainability assessment focuses mainly on sustainability criteria. environmental, health and technological.

While social norms are limited to the impact that new nuclear power plants can have on job opportunities and the well-being of local communities. [4]

*Table 2. A set of basic indicators of sustainable development.*

| Economic indicators          |   |
|------------------------------|---|
| economic growth (prosperity) | Determining, measuring (or properly evaluating) all costs related to the nuclear system, and issuing invoices to the end users of nuclear energy.<br>Real economic wealth is based on the costing of products, services, activities, and practices that comprise the gross domestic product. Therefore, it is necessary to identify and estimate the external costs, benefits, risks, and impacts inherent in the lifetime of the nuclear fission cycle. End users should also pay the full cost.<br>Electricity bills are affordable, and power generation costs are included in electricity bills, in addition to transmission and distribution costs, interest, taxes and fees. Nevertheless, the costs of nuclear power generation charged to the consumer remain reasonably low. |
| Governance and politics      | It is necessary to have a scientifically independent body or committee (such as the Intergovernmental Panel on Climate Change) to study and follow up the performance of nuclear energy.<br>-that controlling nuclear technology, investment and practices requires a high level of technology, which confirms the need for experts who can protect the interests of the public, and it is necessary to establish separate nuclear regulatory   |

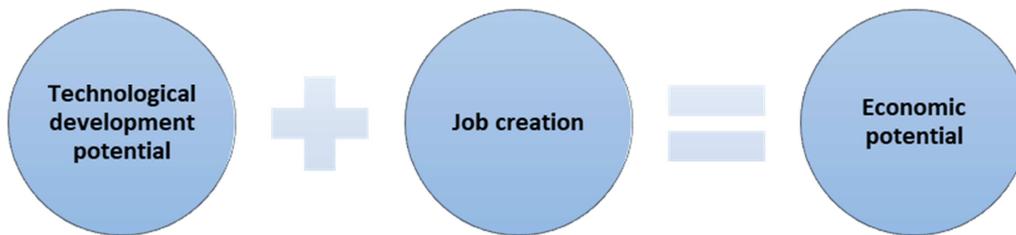
|   |   |
|---|---|
| <b>Economic indicators</b>  |   |
|   | institutions with regulations and independent attention to the public interest.   |
| <b>Social indicators</b>  |   |
| Energy security   | Energy security includes "the constant availability of energy for all at a reasonable price" and refers to the effective management of primary energy supplies from domestic and foreign sources, the provision of energy infrastructure, and the ability of energy providers to meet current and future demand.  |
| Managing limited, exhaustible resources in light of future alternatives                                 | It includes providing uranium at competitive fuel prices, and the International Energy Agency must Provide a solution to the scarcity of conventional uranium in the future.  |
| <b>environmental indicators</b>   |   |
| Reducing climate change problems (mitigation and adaptation)  | Energy supply systems will soon need to shift completely to low-carbon resources and technologies on a global scale, just as nuclear systems cause low carbon dioxide emissions, and the selected low-carbon options should also be robust enough to withstand the increasing impacts of climate change such as droughts, floods, And scarcity of water, and storms.  |
| Waste risk management   | The need to establish regional international bodies to monitor the movement of hazardous wastes from developed countries to developing countries and to develop a strategy for waste collection and transportation for treatment.   |
| Nuclear fuel  | Nuclear reactors to generate electricity only need a limited amount of nuclear fuel annually, and therefore it is easy to transport and store as a strategic stockpile, in quantities sufficient to operate the stations for many years.  |
| <b>technological indicators</b>   |   |
| The development of technology leads to economic efficiency and increases production when costs decrease | New technology is adopted that lowers the cost price for development purposes in the future, as unit costs decrease as technologies are increasingly spread and applied, and this requires tremendous ability to manage complex operations in both construction and operation; Access to electricity is a condition for sustainable development, and the electricity supply is secure when users are guaranteed continuous delivery at reasonable prices. |

Source: Preparation of the researcher

**2.3. Assessment Criteria Energy's Economic Potential of Nuclear Energy**

*Job creation:* Job creation represents the economic and social dimensions of sustainable development, when jobs are created by energy systems, it improves the quality of life of

the local community and reduces unemployment throughout the life cycle of power plants, as many people work either in direct jobs such as manufacturing installation, operation, maintenance, or indirect jobs.



Source: Preparation of the researcher.

**Figure 1.** Job creation.

As a result of these factors, the use of renewable energy sources by 25% of the total other energy sources by 2025 will create more than three times the job opportunities provided by the use of an equal amount of fossil fuels to generate electric power, which will result in 202,000 new job opportunities in the year 2025 AD. Nuclear energy is also a technology with a relatively high labor intensity, which confirms the positive economic impact of spreading alternative and renewable energy technologies on any country. [5]

(i) Development of human resources for the station Nuclear energy in emerging countries

Considering the foregoing, skilled human resources are a vital step to ensure a sustainable supply of qualified personnel for the safe use and sustainable management of

nuclear power plants during construction, operation, maintenance, and repair. The country seeking progress needs a national program for the development of human resources for nuclear technology, education and training, and knowledge management at the national, regional, and international levels, and the main components of the national program must include safe operation, emergency preparedness and response, organizational effectiveness, and the pursuit of national systems based on building Capabilities (schools, applied institutes and universities).

(ii) The role of technological innovation in the field of renewable energy to treat climate change (RETI)

a. Modern technologies and technology used in electricity generation contribute to reducing production costs, through carbon price policies and fossil fuel prices,

b. As the following chart shows, technological innovation has a positive impact in the field of energy and an important means to achieve conservation and reduce emissions from it. [6]

It encourages the development of energy generation from renewable sources, and in turn improves efficiency and thus reduces its consumption in the production process.

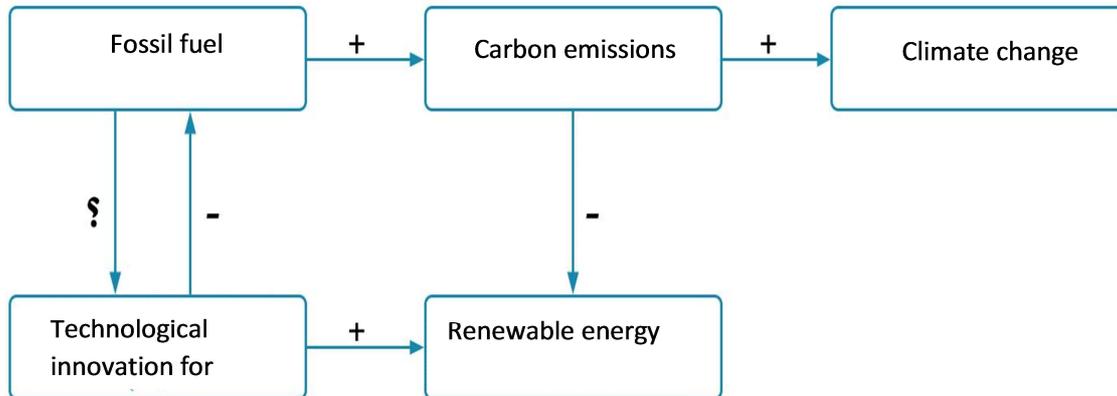


Figure 2. The impact of technology on climate change.

Source: Lin, B., & Zhu, J. (2019). The role of renewable energy technological innovation on climate change: Empirical evidence from China. *Science of the Total Environment*, 659, 1505-1512.

(iii) Government responsibility in managing nuclear energy affairs.

Spreading the use of nuclear energy will lead to great economic benefits, despite the high cost of capital, the long period of completion of the project, and the political risks that reduce the commercial attractiveness of the effective participation of the private sector. Therefore, government participation in the deployment of nuclear energy becomes necessary, as the government has the powers and the necessary capabilities to influence and mitigate the risks, especially the political and social risks, and it can also bear the burden of the capital increase associated with the deployment of nuclear energy. [6]

Also, environmental systems that seek to reduce emissions and their trade make nuclear energy more competitive than fossil energy, and the effects of climate change attributable to greenhouse gas emissions are based on the social costs of carbon estimates, and given the huge energy gaps and infrastructure deficiencies facing developing countries, the need to shift the global economy toward a low-carbon energy future; It led to the trend towards diversifying the global energy portfolio to meet the goals of sustainable development.

From another angle, the political economic school focused on developing the structure of the authorities influencing the productivity of renewable energy. Accordingly, nuclear energy has become the first basic element in generating clean and modern energy. This is through technical progress, which plays an important role in global energy production in the long run; As it costs the lowest types of renewable energies in terms of cost and operation and gives a thousand times higher production than other energy sources. Hence, nuclear energy was the ideal solution to energy problems considering the decline in natural gas and oil resources. It is from this principle that its deficiency led the developing countries to

choose nuclear energy as a sustainable option for them. [7]

According to that vision, we point out that nuclear power plants can be built reliably at a competitive cost if they are built with government support, and any decision regarding building new nuclear reactors depends on government support, and the integration of environmental costs into the economies of power plants will be an important positive factor in favor of the nuclear industry.

#### 2.4. Initiatives Potential Sustainability of the Development and Management of Nuclear Power Systems

Energy management has become a vital field of research due to the increasing importance of preserving energy resources and fossil fuels that are not sustainable from an environmental point of view, and issues related to energy demand in emerging economies. Sustainability initiatives to support nuclear systems are represented in the following:

1) Technical Cooperation Program to support nuclear projects.

The IAEA uses the Technical Cooperation Program to help countries design, formulate, implement, and evaluate regional cooperative activities. The applied regional cooperative modalities included technical cooperation among developing countries, such as a cooperation agreement for Arab countries in Asia for research, development, and training in the field of nuclear science and technology, as the agreement includes providing support for regional projects across national borders and meeting the needs of many member states in various regions, in addition to increase the number of professionals trained in nuclear applications. [8]

The support provided through the Technical Cooperation Program was effective in enhancing the capabilities of member states to initiate and manage cooperative activities efficiently, with developed countries guiding less developed

countries by hosting training activities and field experts and their contribution to building human capacities, and promoting the exchange of information, knowledge, and expertise to facilitate science, technology, sustainable energy planning and development, including the nuclear power option for electricity generation, environmental management, and nuclear safety and security; The Global Partnership for Sustainable Development within TCP adds value to technical cooperation work through broader strategic communication, technical innovation, and additional financial resources.

#### 2) Transfer of nuclear technology and technology considerations for developing countries

Building a successful nuclear program must ensure building participatory policies with developed countries in exporting technology to achieve economic integration between the two regions. The transfer of technology to developing countries contributed greatly to energy production, such as Brazil, China, India, Korea, Argentina and South Africa. This continuous transfer of technology is based on building technical capabilities to manage nuclear materials and the ability to regulate and supervise them and ensure their safety. As a result, it requires building the scientific basis in the developing world to promote the beneficial uses of nuclear science and technology in the future. [9]

Also, linking technology transfer with industrialization is a remedy for the problem of underdevelopment and a key factor that allows bridging the existing technological gap between it and the developed countries. The success of the localization of industry depends on the presence of local capabilities related to the development and production of nuclear technology. Manufacturers need to master continuous technological adaptation and improve cost and performance to compete in the domestic and international market by means of international joint ventures to attract foreign know-how in design and production.

#### 3) International cooperation in the nuclear field

International cooperation is a prerequisite for the success of efforts to provide safe, clean and affordable energy sources, while at the same time reducing reliance on carbon energy. Among the most important goals that this transformation seeks to achieve are: reducing the global demand for carbon energy, ensuring the provision of sustainable and modern energy services to all peoples, and developing new technologies that are less dependent on carbon energy in various sectors, the most important of which are transportation, construction, and industry.

International cooperation is necessary to accelerate the pace of development of the main technological means in this regard, and to facilitate their dissemination in the world. In general, Europe views the economies of North Africa, including Egypt, as key partners in the efforts to transition towards a low-carbon economy. In sum, international cooperation should focus less on individual projects and

more on systemic changes; With the aim of developing joint development strategies consistent with climatic, environmental and growth considerations. Undoubtedly, this trend towards reducing dependence on carbon energy represents new horizons for cooperation between Europe and North Africa.

#### 4) develop human resources for station nuclear energy in the Countries Emerging

Skilled human resources are a vital step to ensure a sustainable supply of qualified personnel for the safe use and sustainable management of nuclear power plants during construction, operation, maintenance, and repair. The country seeking progress needs a national program for the development of human resources for nuclear technology, education and training, and knowledge management at the national, regional, and international levels; Key components of a national program should include safe operation, emergency preparedness and response, and organizational effectiveness; And seek the existing national systems for capacity building (schools, applied institutes and universities).

### 3. Global Economy of Nuclear Energy in Western Countries and Countries of Middle East

Nuclear energy sources represent an essential element in the future energy paths to achieve economic stability and competitiveness in the international market, and to develop electricity networks as an important element in the process of transitioning towards low-carbon energy systems, and the technological and institutional basis for a safe, large-scale nuclear power that is economically competitive, where energy is based Nuclear power supplies stable and high-quality electricity while reducing pollution in many developed and developing countries. [10]

#### 3.1. Regional Perspectives of Nuclear Energy in Western Countries

The drivers and challenges facing the development of nuclear energy will vary depending on a few factors including the availability of energy resources, the regulatory environment and the structure of the energy market; For some countries, developing the necessary nuclear infrastructure, regulatory frameworks, public acceptance, and a skilled workforce will be important challenges. For some other countries, the focus will be on replacing retired plants and potential expansion of nuclear power. Some of the regional motives and challenges for the development of nuclear energy are highlighted in the main regions that are expected to have important nuclear energy programs in the future, as shown in the following table:

**Table 3. Characteristics of the development of nuclear energy in different countries.**

|                                 | Current status and design of the electricity market   | future developments   | The main challenges   |
|---------------------------------|---|---|---|
| United States of America        | Electricity production increased by 19% (822 TWh) from 100 reactors (105 GW). Five units under construction. Most of the reactors are licensed for 60 years. A mixture of liberalized and regulated electricity markets.                      | All new construction projects in the United States are restricted to regulated electricity markets, which are more favorable in terms of providing a stable, long-term framework for capital-intensive projects such as nuclear; It allows utilities to pass construction costs onto customers through price adjustments. | Finance in liberalized markets. Long term operating economics in competition with gas.  |
| Russian Federation              | Electricity production increased by 17% (172 terawatt hour), From 33 reactors (25 GW). 10 units under construction liberalization of the electricity market.  | Policy to increase the share of nuclear electricity to 25-30% by 2030; Strong support for the nuclear industry, including for export markets.   | Management of phased replacement of reactors (RBMK) (about half of the current electricity production) with reactors from the third generation. |
| Japan and the Republic of Korea | Electricity production increased by 11% (148 TWh), from 71 reactors (66 GW) All of Japan's 48 reactors are idle at the moment. Seven units under construction (two in Japan and five in the Republic of Korea). regulated electricity market. | Electricity costs are competitive, Strong support for the nuclear industry, including for export markets.   | General admission. Restart reactor Nuclear in Japan.  |
| China                           | Electricity production by 2% (117TWh), from 20 reactors (17 GW). 29 units under construction. regulated electricity market.   | Stabilizing electricity costs in the future, local pollution concerns. Strong support for the nuclear industry.   | Public acceptance, Developing internal plans for local supply chains.   |
| India                           | Electricity production increased by 3% (32 TWh), With 21 reactors (5.8 GW). Six units below that. Regulated electricity market.   | Electricity cost stability in the future.   | Financing, foreign sellers access to the market. Opening the Indian nuclear market to foreign investment and technology.                        |
| Europe                          | Electricity production increased by 25% (833) TWh [TWh], with 132 reactors (122) gigawatts. Four units under construction, A mixture of liberalized and regulated electricity markets.  | The UK is planning one of the most ambitious new construction programmes in the Organization for Economic Co-operation and Development.   | Finance in liberalized markets. Develop a neutral policy for investments in low carbon technology.  |

Source: Maria van der Hoeven and William D. Magwood, IV (2015) Nuclear Energy, Technology Roadmap, Nuclear Energy (IEA/NEA), pp. 13-14.

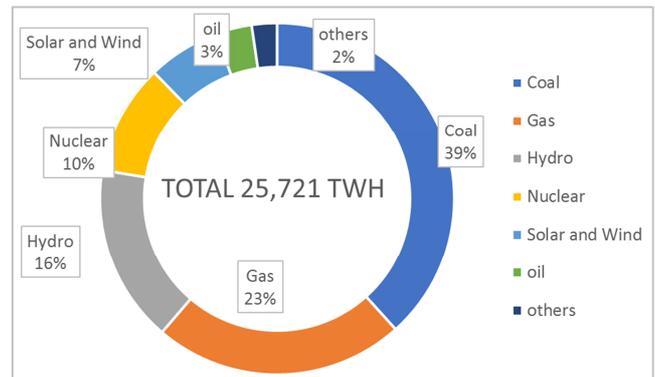
The table shows that the Republic of Korea currently possesses 20.7 gigawatts of nuclear energy, which represents 27% of the total electricity generation in 2013, due to the reduction of dependence on imported fossil fuels, and the Russian Federation is currently the third largest country in the field of nuclear energy - Behind the United States and France - where 33 reactors with a total capacity of 25 gigawatts are operating.

The researcher notes from the table that China has entered the technological platform. The Chinese nuclear program has developed significantly through the development of local reactor schemes and local supply chains, and China has made a stunning transition from importing nuclear technology to developing local capabilities that have already been exported, with 20 reactors operating with a total capacity of 17 gigawatts; So China may reach the tipping point to start decarbonizing its electric system. [11]

**3.2. Nuclear Energy Is the Second Largest Source of Low-Carbon Energy in the World**

As shown in the figure, it provides about 10% of the world's electricity from 450 power reactors. The global nuclear power plants were supplied with 25,721 terawatt hours of electricity in 2019, and from the implications of this, nuclear energy has been accepted on the global scene as a source of clean energy by integrating it with renewable

sources.



Source: IEA Electricity information 2019.

**Figure 3. Global production of electricity from various sources 2019.**

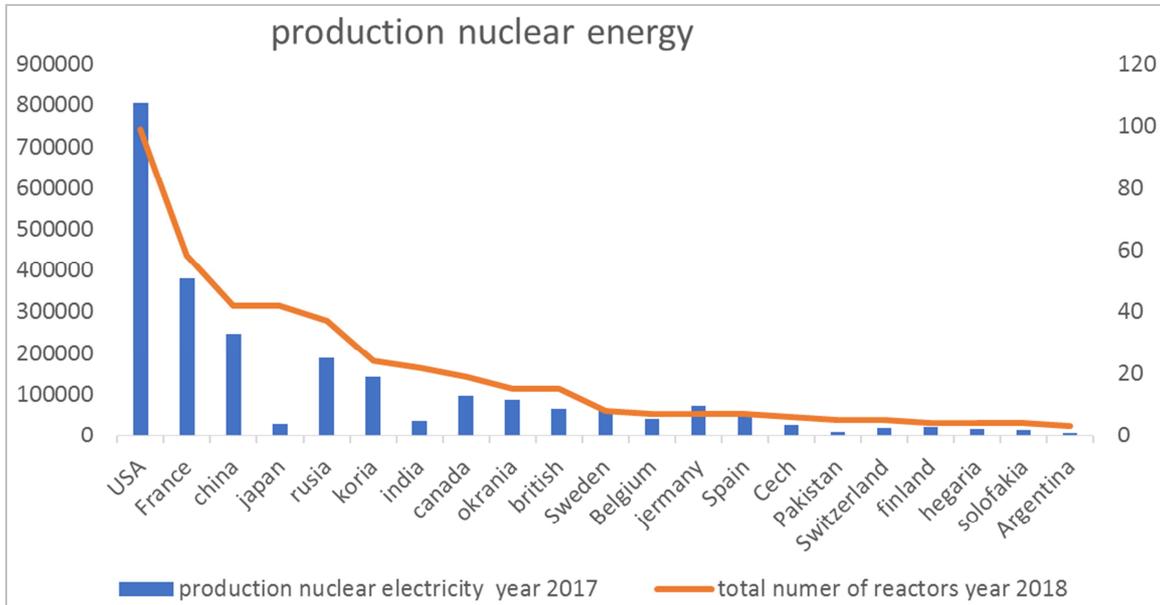
On the other hand, France obtains about three quarters of electricity from nuclear energy. While Hungary, Slovakia and Ukraine get more than half of it; While Belgium, Sweden, Slovenia, Bulgaria, Switzerland, Finland and the Czech Republic get a third or more, and South Korea gets more than 30% of its electricity from nuclear power.

While about a fifth of the electricity in the United States of America, the United Kingdom, Spain, Romania and Russia comes from it. Japan used to rely on nuclear energy for more

than a quarter of its electrical energy, and these percentages are expected to grow significantly in the future, as shown in Figure 13.

Until the vision becomes clear, promoting technologies that guarantee sustainable development all over the world is one of

the strategic goals for developing a peaceful nuclear program in the future. To become a locomotive for the growth of the global energy market by helping to establish effective trade alliances with countries seeking to enter export markets in the nuclear field. [12]



<https://www.iaea.org/PRIS/WorldStatistics/OperationalReactorsByCountry.aspx>Source: The researcher designed from the data available on the website

Figure 4. Nuclear electricity production and the number of reactors by each country in 2017.

The researcher notes from the previous figure that the vast majority of nuclear power plants

is located in America, Europe, and Far East Asia, where the United States appears to be the world leader in generated nuclear energy, then France comes in second place, and the Soviet Union; While in Africa there is almost no share of nuclear electricity production, and this is due to the fact that 98 nuclear reactors with a total capacity of 99.3 (Gigawatts) operate in the United States, which produce 20.05% of electricity in 2018; The nuclear industries enjoy state protection and are a national priority.

**3.3. The Status of Civilian Nuclear Programs in the Middle East**

Several countries in the Middle East and North Africa have announced their plans to adopt the nuclear program as part of future energy diversification. The official justification for nuclear energy in the Middle East includes meeting the growing demand for electricity and desalinated water due to economic and population growth and addressing energy security concerns by reducing dependence on imports. Or diversify the sources and opportunity costs of using oil and gas to generate electricity instead of exporting. [13]

The future of nuclear power in the Middle East is represented in the following:

1) Iran:

Iran currently has the most advanced program in the region with one reactor operating, with a capacity of 1000

megawatts. The country's plans include installing Russian and Chinese reactors, and it is estimated that Iran's expected nuclear capacity will reach between 2000 and 3000 megawatts by 2030.

2) Jordan:

Jordan signed an intergovernmental agreement with Russia on a potential nuclear energy project in 2015, but the country still needs to improve its organizational and developmental infrastructure, and some of these improvements must be directed towards expanding the current network that requires improvement to accommodate the next two reactors, and by 2030 the expected nuclear capacity in Jordan is 2000 megawatts. The project will be financed by 30% of the capital with the rest of the debt (borrowing), which means that the Jordanian government will have to contribute \$1.5 billion in equity, and to reduce this burden on the Jordanian government, it was requesting tenders to build the traditional part of the station from suppliers such as the company Chinese.

3) United Arab Emirates:

The United Arab Emirates has become one of the modern countries that use nuclear energy to produce electricity. The UAE began building the first nuclear power plant in 2012, and the UAE National Nuclear Authority has concluded an agreement with South Korea to obtain four reactors by 2020, and it will provide nuclear fuel supplies, and the expected capacity is estimated at 5,600 megawatts by 2030. [14]

4) Egypt:

The Russian company Rosatom signed an

intergovernmental agreement with Egypt to construct and operate four reactor units, each with a potential capacity of 1,200 MW, and the expected capacity by 2030 is estimated at about 4,800 MW. Future training on fuel supplies and resources was also part of the cooperation.

#### 5) Saudi Arabia:

The recent collapse of oil prices may be the reason for the development of the country's nuclear energy program. In 2011, Saudi Arabia announced ambitious plans to build 16 nuclear reactors in the next twenty years. Since then, the King Abdullah City for Atomic and Renewable Energy has extended its timetable. until 2040; Where it is estimated that the expected capacity will reach 17,000 megawatts.

#### 6) Turkey

Turkey has signed a governmental agreement with France, Japan and China, and it is expected that the nuclear energy will range between 3350 megawatts and 9400 megawatts by the year 2030. All in all, the contribution of nuclear energy to the diversification of energy sources in some countries of the Middle East and North Africa will become an established fact, but on the region addresses structural, economic, and institutional problems with the aim of reaching a comprehensive solution to society's needs and development requirements.

Similar to the above, it has become the prevailing trend in most regions of the world to devote science, engineering and nuclear technology as vital elements of national security, and the reason is that global climate change has risen to the point of national security concern, and developed countries have sought to be able to compete globally, and to maintain Its global leadership in the field of nuclear research and development as a foreign policy, in addition to maintaining the maturity of its infrastructure from domestic energy resources.

The researcher's motives in selecting the study cases are since South Korea and China are similar to Egypt in terms of the level of consumption and growth, and that they are characterized by creative solutions that contributed to economic development in light of a safe investment environment in the electricity sector. The researcher adopted the method of benefiting from countries that are similar in growth indicators and with an emerging global reference in the global economy, which is described as a sustainable energy economy. [15]

The researcher chose the model of China, where the reason is that its nuclear energy experience is the leading one in the world, and it surpasses the United States of America as the largest user of nuclear energy in 2030; In addition to the role it plays in removing carbon from the global electricity mix, China ranks eleventh in terms of nuclear power generation, and it currently produces 8587 megawatts of nuclear electricity with 11 nuclear reactors, and then China provides only 1.9% of its electrical energy from nuclear plants.

Likewise, the researcher's choice of the Chinese experience is due to the importance of upgrading and advancing modern technologies in linking sustainable economic development with electric power generation

strategies in China. As China possesses many human and material resources, which was an opportunity to build electric power plants through peaceful nuclear reactors, thus securing the national development needs in the social, economic and infrastructure fields.

This contributes to reducing pollution and reducing the spread of greenhouse gases, especially carbon gases. China has distinguished itself in building national development policies related to Chinese nuclear energy, and has deliberately involved the private sector and facilitated investment operations in the peaceful exploitation of nuclear energy in electricity generation; All the previous factors were an opportunity to benefit from in building comparison models to analyze the local situation and discuss the results, and to link the positive formation of building nuclear plants in Egypt with what could contribute to solving the available deficit in electrical energy and getting rid of the energy crisis.

*The researcher also chose the South Korea model because it is characterized by many pioneering development fields that made it one of the countries ranked second in the world. As it has development experiences in all areas of life, the most prominent of which is the developmental investment in nuclear energy. With the aim of reducing its proportion of carbon output and reducing the emission of gases harmful to the environment, to improve the level of quality of national development within its sustainable framework.*

In the same context, the Korean government has endeavored to present unique experiences in the peaceful harnessing of nuclear energy. In a way that contributes to restoring the environmental balance between the national requirements for electric energy and the development needs of society, and in a way that positively affects the reduction of harmful emissions that contribute to environmental deterioration, and from it stems the vision of South Korea in the energy industry using all means that meet the aspirations of Korean society with the least resources affecting the share Future generations for sustainable environmental, economic and social development.

## 4. Conclusion

The fossil fuel burning is the main culprit behind global warming which resulted in greenhouse gases (GHG) emissions led by carbon dioxide (CO<sub>2</sub>) emission, key contributor to environmental pollution. The rising CO<sub>2</sub> emissions intensity and global warming complexities have raised the importance to focus on alternative energy generation options. The serious concerns over fossil fuel consumption, issue of energy security, and GHG emissions challenges have brought attention to clean energy sources among public and policy analysts as well. Clean energy options (nuclear energy and renewable energy) have emerged as alternate energy sources and effective tools to combat the hazards of climate change. As a part of the new energy policy strategy, many countries are focusing on increasing the share of nuclear energy supply to diversify energy supply, reduce dependence on imported fossil fuels with volatile prices,

increase energy stability and security. Accordingly, The current study contributes to expanding knowledge and starting to improve Egypt's nuclear power infrastructure by investigating the relationship between nuclear power, economic growth and CO<sub>2</sub> emissions in the context of the experiences of the devastated countries such as China and South Korea.

---

## References

- [1] Usanov, V. I., Kviatkovskii, S. A., & Andrianov, A. A. (2018). Elaboration of approach to nuclear energy systems assessment by criterion of sustainable development. *Nuclear Energy and Technology*, 4, 27.
- [2] Vidadili, N., Suleymanov, E., Bulut, C., & Mahmudlu, C. (2017). Transition to renewable energy and sustainable energy development in Azerbaijan. *Renewable and Sustainable Energy Reviews*, 80, 1153-1161.
- [3] Sofu, T. (2018, January). A roadmap for nuclear energy technology. In *AIP Conference Proceedings* (Vol. 1924, No. 1, p. 020004). AIP Publishing. pp 1-12.
- [4] Udoka Nwaneto, Peter Udenze et al, (August 2018) Economic implications of renewable energy transition in Nigeria Conference: IEEE International Conference on the Industrial and Commercial Use of Energy At: Cape Town, South Africa. pp1-9.
- [5] Kavvadias, K. C., & Khamis, I. (2014). Sensitivity analysis and probabilistic assessment of seawater desalination costs fueled by nuclear and fossil fuel. *Energy Policy*, 74, S24-S30.
- [6] Quek, A., Ee, A., Ng, A., & Wah, T. Y. (2018). Challenges in Environmental Sustainability of renewable energy options in Singapore. *Energy policy*, 122, 388-394.
- [7] Bunn, M., & Kovchegin, D. (2017). Nuclear security in Russia: can progress be sustained?. *The Nonproliferation Review*, 24 (5-6), 527-551.
- [8] Evangelos Grigoroudis, Vassilis Kouikoglou et al., (January 2017) Energy Sustainability of Countries, In book: *Renewable and Alternative Energy: Concepts, Methodologies, Tools, and Applications*, pp99.
- [9] Alexander Ochs, Ieva Indriunaite (October 2018), Raising climate ambition through long-term energy sector plans and sound participatory processes, Affiliation: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit. Pp1-7.
- [10] Alam, F., Sarkar, R., & Chowdhury, H. (2019). Nuclear power plants in emerging economies and human resource development: A review. *Energy Procedia*, 160, 3-10.
- [11] Liang, Y., Yu, B., & Wang, L. (2019). Costs and benefits of renewable energy development in China's power industry. *Renewable Energy*, 131, 700-712.
- [12] Shih, Y. H., Shi, N. X., Tseng, C. H., Pan, S. Y., & Chiang, P. C. (2016). Socioeconomic costs of replacing nuclear power with fossil and renewable energy in Taiwan. *Energy*, 114, 369-381.
- [13] Proskuryakova, L. (2018). Updating energy security and environmental policy: Energy security theories revisited. *Journal of environmental management*, 223, 203-214.
- [14] Rečka, L., & Ščasný, M. (2018). Brown coal and nuclear energy deployment: Effects on fuel-mix, carbon targets, and external costs in the Czech Republic up to 2050. *Fuel*, 216, 494-502.
- [15] Mangla, S. K., Luthra, S., Jakhar, S., Gandhi, S., Muduli, K., & Kumar, A. (2020). A step to clean energy-Sustainability in energy system management in an emerging economy context. *Journal of Cleaner Production*, 242, 118462.