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Full Length Research

The Environmental Economic Impact Of Green Technology A Case Study: Egypt Versus Denmark

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The purpose of this research is to identify and illustrate the impact of green technology from an environmental economic aspect. Green technology is known as a vital factor that helps to protect the environment, conserve nature, and fix the negative impacts that are caused by humans. Green Technology is not only used in developed countries but also in developing countries. Although, Green technology may have many positive effects on both developed and developing countries; however, it has disadvantages that may harm the environment. In addition, the research focuses on using of renewable sources in Egypt, including, how renewably produced energy has been developed in the country over the past few years and still developing. Also, it covers the other steps taken by Egypt towards environmental and sustainable development as pillar of its 2030 ambitious sustainable development strategy. This study also uses Denmark as a developed country and one of the best performers in green technology. Finally, the findings may be useful in implementing green technology in Egypt with keeping the negative impact of this technology under control.

Key words: Green technology, Environmental pollution, Renewable energy, Electric vehicles, eco-friendly technology, Environmental Sustainability, Egypt 2030 Sustainable Development Strategy.

INTRODUCTION

Background of the study

Green technology is the development and application of products, equipment, and systems used to preserve the environment to minimize the negative impact resulting from human activities. This technology can be in the form of green buildings or renewable energy such as hydroelectricity, solar energy, and biogas. Developed countries, including Denmark, Germany, and Sweden have shown that clean energy can be produced from green technology to achieve sustainable development. Green technology refers to any technology intended to adjust the impact of human activities on the environment by reducing the usage of nonrenewable resources, while shifting the emphasis on the usage of renewable resources. This also includes soil remediation methods and carbon sequestration technology. The main goal of green technology is to slow down global warming in order to reduce the greenhouse effect. The main idea is to create new technologies that do not harm natural resources. This will lead to less harm to people, species, and the biodiversity of our planet.

Objectives of the study

The main objectives of the study are to compare green technology and renewably produced energy in Egypt as a developing country with Denmark, which is a developed country, and one of the best practices in the world when it comes to the green technology field, also to shed some light on the environmental economic impact of green technology. Thus, the paper is divided into five sections:

1. A general introduction and definition of Green Technology including its objectives and challenges.
2. Case study on Denmark, which is a developed country and one of the best performers of green tech.
3. Case study of a developing country (Egypt).
4. The impact of Green technology.

5. Concluding remarks, and recommendations.

Research Questions

The study attempts to answer these important questions.

i. How is Denmark performing in the green technology field?
ii. How Egypt is dependent on green technology and renewable energy sources?
iii. How is Egypt performing in its vision 2030 and using green technology as a part of this ambitious agenda?
iv. How are both countries (Egypt and Denmark) economically benefiting from green technology?
v. Unlike the prevailing beliefs, how does renewable energy have negative impacts on the environment/society, as it is one of the most important objects for the "Go Green" environment?

Organization Of Study

The study is organized into five chapters, which are as follows:

The first chapter covers the background to the study, thus a general introduction, objectives of the study, research questions, and Organization of study. Chapter Two is entirely on the literature review. The chapter concludes the need for green technology whether in developing countries or developed countries and the policymakers' influences. Chapter Three is about Green Technology in Denmark, how started, developed until 2030. Chapter Four investigates the current position of Egypt and its renewable resources, and how the country working to depend more on renewable resources and reduce CO_2 emissions. Chapter Five covers the analysis of data collected during the study and comparing between Egypt and Denmark from economic aspects. Chapter Six shows the environmental impact of using green technology and how for example extractions of resources needed in green technology may harm the environment. Chapter Seven is the summary of findings of the study, conclusion, useful suggestions, and recommendations to the research findings made.

LITERATURE REVIEW

Green or clean technology is a type of improving the equipment, systems, and products that make an environmentally friendly technology. The main goal of green technology is conserving natural resources to decrease the negative impacts of human activities (Iravani et al., 2017). There are four main concerns of green/clean technology: First, it diminishes the damage to the environment caused by humans. Second, it decreases greenhouse gases. Third, it reduces the usage of natural resources and energy. Fourth, it enhances the usage of renewable resources.

In fact, green/clean technology became an important option for investors to avoid global warming and the increase of natural resources of scarcity. One additional advantage of investing in green technology is its long-term viability as it reduces the operating costs, because it requires less maintenance cost, in spite of it has high initial cost. Green technology helps in all recycling solutions, it provides for renewal energy, and it reduces the usage of substances which harms the environment and cannot be removed, such as plastic (European Commission, 2018). In addition, some challenges are facing green technology including the collection of data related to energy consumption, water, and transportation pollution due to lack of data, and political decision-makers (policymakers) influences.

On the other hand, there is a lack of awareness concerning green technology, because people believe that green technology does not have any disadvantage and has only a positive impact on the environment. Accordingly, this paper evaluates green technology neutrally. To support the argument, this research paper attempts to analyze two case studies by comparing two different countries, Egypt as a developing country versus Denmark as a developed country.

DENMARK AND GREEN TECHNOLOGY

Denmark's green technology transition started during the oil crisis immediately after 1973. For many years of development, now Denmark became one of the leading countries the field of wind and solar power generation technology. Due to Denmark's position in green technologies manufacturing, Denmark plays a big role is in sharing and transferring green technologies to other countries. Today, fifty percent of Denmark's electricity are generated from wind and solar energy. By 2030, the goal set by the Danish Parliament is that the Danish electricity system to be completely independent of fossil fuels (Danish Ministry of Climate Energy and Utilities, 2019).

According to Peter Jørgensen, Vice President of Energinet, "In addition to wind and solar energy, we have a large proportion of biomass in the energy sector. Therefore, in Denmark, we have used renewable energy to meet approximately two-thirds of the electricity demand," (IRENA.2018). The Global Clean Technology Innovation Index (GCII) shows that Denmark is a leading country in the adoption of green technologies. 44%[1] of electricity provided by wind and solar energy, making its energy generation system one of the most advanced in the world. For decades, green technology has been Denmark's top priority, making Denmark one of the best countries in the whole world in terms of green technology development (Figure 1).

Denmark as a leading country in green technology conducted in its capital Copenhagen a leading bicycles policy to reduce fossil fuel consumption and to promote a healthy lifestyle for a positive healthy environment. Denmark shared its experience with many other European cities such as Paris in France, and Barcelona in Spain, and these cities adopted the same bicycle

[1] Global Innovation Index 2020, Denmark. URL: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020/dk.pdf

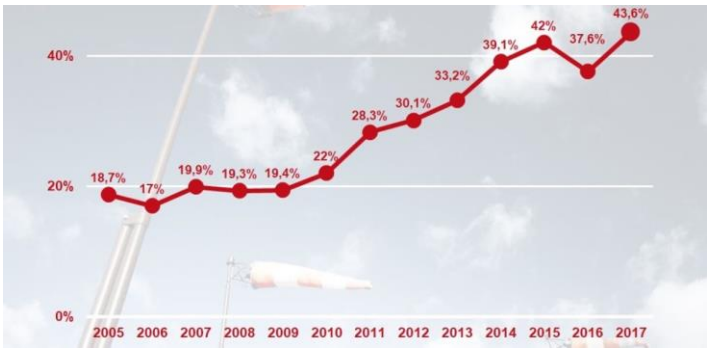

Figure 1 - 44% wind: Denmark set a new world record.
Source: Berggreen, Jesper. "44% Wind — Denmark Set New Wind Energy Record In 2017." CleanTechnica, 6 Jan. 2018, cleantechnica.com/2018/01/06/44-wind-denmark-smashed-already-huge-wind-energy-records-2017

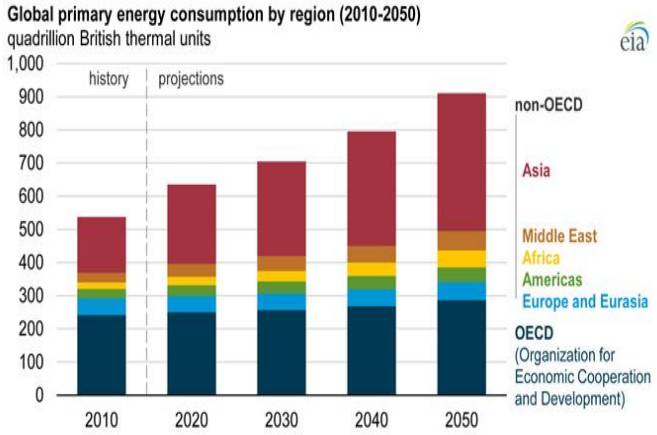

Figure 2 - Global Energy consumption UP TO 2050
Source: IRENA (2018), Global Energy Transformation: A roadmap to 2050, International Renewable Energy Agency, Abu Dhabi.

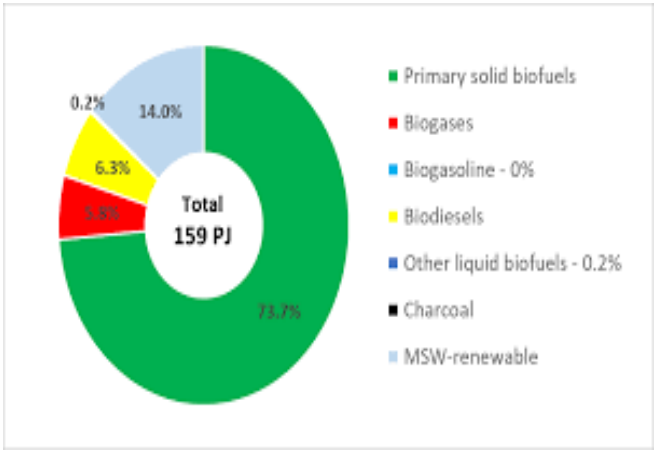

Figure 3 - Composition of electricity generation from renewable energy in Denmark
Source: World Energy Balances © OECD/IEA 2018

lending policy. The reason behind Denmark's ability to spread the implementation of green technology is that Danish policy makers issued new rules and laws for using and implementing green technology within the institutional structure which is defined by the Danish Government. Denmark's Government promotes developed education that creates a culture against the negative impacts of harming the environment without using green technology. As a result, a nationwide avoidance of fossil fuel consumption is carried out for the first time. Furthermore, instead of fossil fuel usage, Denmark is promoting clean energy sources by using wind energy and biomass as the main source of energy supply. The main objective to be achieved by 2050 is to change Denmark to be completely independent of the usage fossil fuel across the country (Climate Programme, 2020). To achieve this goal, Denmark Government has already begun to support some new startup companies that have adopted green technology in their industry, and in all economic activities (Figure 2). In Denmark, the wind energy industry is one of the most advanced industries. During the 1980s, Denmark was one of the first countries to install wind turbines. Today, onshore and offshore wind turbines provide about 44% of Denmark's total electricity consumption, putting it among the highest level of wind energy integration in the world. From 1980 to 2010, the share of renewable energy in Denmark increased rapidly from 3% to 19%. Nuclear power is not part of Denmark's fossil-free energy replacement strategy[2](Energy & Green Technologies).

In addition, Denmark is a "global center" for innovation of green technologies, especially sustainable energy through its advanced research and development applications. Currently, more than 350 companies employ approximately 25,000 people in the wind energy industry (Energy & Green Technologies). Because of Denmark's technological sophistication, one-third of the world's wind turbines and nine out of ten marine turbines are based on Danish sharing technology or sharing expertise.

Denmark depends heavily on the wind energy, but still uses sources of biomass, such as organic waste, agricultural residues, and wood residues. Approximately 70% of the renewable non-wind energy consumed is performed by biomass, which puts Denmark as a worldwide biomass power leader. Therefore, Denmark is one of the most renewable energy-efficient countries among the EU countries and the OECD. In fact, the usage of renewable energy, led to the reduction of greenhouse gas emissions. By 2050, Denmark will be fossil fuels free country.

Denmark is making progress in the implementation of green technologies and achieved significant results. "Denmark has substantially reduced greenhouse gas (GHG) emissions since the mid1990s and has an ambitious national-level commitment to reduce emissions 70 percent by 2030 relative to 1990 levels and to reach net-zero GHG emissions by 2050 at the latest." [3] (Batini, Nicoletta. Parry Ian and Wingender Phillipe 2020) In

[2] "Energy & Green Technologies." Energy & Green Technologies. URL: https://japan.um.dk/en/about-denmark/denmark/energy-and-green-technologies
[3] Batini, Nicoletta. Parry Ian and Wingender Phillipe. "*IMF working paper Climate Mitigation in Denmark: A prototype for Other Countries".* European department. November 2020

addition, Carbon pricing is strengthened by applying a domestic carbon surcharge to emissions covered by the EU Emissions Trading System (ETS) to meet a target price for these emissions through the domestic carbon tax (for other emissions sources) equal to this price (Batini, Nicoletta, Parry Ian and Wingender Phillipe, 2020). Denmark has made considerable progress in reducing emissions. CO2 emissions from 4,444 fossil fuels in 2018 were about 50% of the peak emissions in 1996. The IMF staff expects that CO2 emissions from fossil fuels in 2030 will be 37% lower than that of 2018 CO2 emissions is declining faster than the other EU countries. In absolute terms, Denmark's carbon dioxide emissions in 2030 will be lower than the other EU countries, while per capita emissions will slightly be lower than the EU's average.

In 2020, Denmark achieved its goal of the "No Emissions Trading System" set by the United Nations, which is to reduce greenhouse gas emissions by increasing costs. "Denmark exceeded its goal of participating in the EU's non-ETS (Emission Trading System) sector from 2013 to 2020. "The idea behind the European Emissions Trading System is to create an incentive to reduce greenhouse gas emissions in an economically beneficial way by pricing emissions." (Geddes, 2017).

Biomass Energy in Denmark: Bioenergy is one of the most important used renewable energy sources in Denmark. Today, some large-scale power plants are converting from fossil fuels to solid biomass, and in parallel manner, biogas production is increasing quickly. Bioenergy plays an important role in the green transition.

Bioenergy is one of the major sources required for the total renewable energy consumption in Denmark."[4] (Jensen and Nora 2020). Denmark is using more of bioenergy. Many power plants are switching from fossil fuels to wood pellets, wood chips, or straw. Biogas production is growing rapidly, and it tripled between 2012 and 2020. The use of biomass has increased over the past two decades, making bioenergy one of the most widely used renewable energy source in Denmark. Most large-scale cogeneration plants have now switched from fossil fuels to wood biomass. Therefore, the consumption of wood biomass for heat and electricity is increasing. Bioenergy is energy stored in organic matter or biomass. Biomass can be burned directly, or it can be produced into various fuels, for example, wood pellets, biogas, or bio alcohol. The most common types of bioenergy used in Denmark are:

1. Biogas Energy: Biogas is produced by the decomposition of organic matters, such as manure, sewage sludge, and organic waste. It is composed mainly of methane and can replace natural gas.
2. Cogeneration Energy: Cogeneration plants (CHPs) use solid biomass to generate both electricity and heat.
3. Liquid Biofuels Energy: Plant biomass and crop by-products can be used to produce liquid biofuels. Bioethanol is produced by fermentation and distillation of biomass. Biodiesel is produced by processing plant-based oils
4. Gasification Energy: Thermal gasification is the process of heating biomass with a limited amount of available oxygen. The biomass is converted into a combustible gas that can be burned or upgraded.

Most renewable energy sources are fluctuating and produced from solar panels or wind turbines depending on the weather conditions. Until present, it is not possible to store electricity in large quantities. On the other hand, it is possible to store bioenergy and use it in times of high energy demand. Therefore, bioenergy is likely to play an essential role in ensuring supply security in a future energy system with a high percentage of renewable energy. The Danish Energy Agency (DEA) is supporting the role of this bioenergy in the future Danish energy system. This is done by establishing several energy scenarios that outline options for how we can meet any energy future risks with renewables. Scenarios vary considerably in terms of using different types of bioenergy for heating, electricity, and transportation.

Denmark 2030 vision in Rrenewable Eenergy: Denmark's net-zero commitments and progress in renewable energy make it a leader in the energy transition. The country aims to reduce greenhouse gas emissions by 70% from 1990 levels by 2030, and for renewables to meet at least 50% of the country's total energy consumption by 2030. Close Le Dan is committed to achieving net emissions by 2050, in line with the Paris Agreement. In addition, the government has agreed to phase out all coal-fired electricity by 2030. 90% of district heating will come from non-fossil sources by 2030.

The government is also aiming to end the sale of petrol and diesel cars by 2030. Denmark has the highest share of wind in total primary energy and electricity consumption of all the EU countries. Backed by a flexible home electricity system and high levels of connectivity, Denmark is considered to be one of the world leaders in integrating variable renewable energy while maintaining a highly reliable secured grid. The large-scale use in Denmark of cogeneration plants with heat storage capacity and the increasing deployment of wind power offers great potential for efficient integration of both heat and electricity systems (Central Denmark Region. 2021)

GREEN TECHNOLOGY IN EGYPT

Energy production in Egypt

Egypt is ranked 94 out of 180 countries (EPI 2020). This makes Egypt among the middle of the list in the Environmental Performance Index (EPI) report. The EPI measures Environmental health, which contains air quality, water and sanitation, and ecosystem vitality, which includes climate

[4] LARSA Martin. Jensen, Skjernaa Hansen. Nora. *Facts about Bioenergy in Denmark.* Danish Energy Agency. 2020. URL: https://ens.dk/en/our-responsibilities/bioenergy/facts-about-bioenergy-denmark

Table 1 - Egypt's AL-Dabaa Nuclear Power Plant Specifications

Reactor Type	PWR (VVER-1200)
Reactor Design	AES-2006
No. Of Units	4
Thermal Power (MWth)	3200
Electrical output (MWe)	1194
Fuel Cycle Length (months)	Up to 18
Availability Factor (%)	>90
Design lifetime (years)	60+

Source: *Egyptian Nuclear Power Plants Authority (September 14, 2021)*

Table 2 - Egypt's Hydroelectric Plants (2017/2018)

Refinery operator	Commissioning date	Installed capacity (MW)
High Dam	1967	2,100
Aswan Dam 1	1960	280
Aswan Dam 2	1985 – 1986	270
Esna	1993	86
Naga Hamadi	2008	64
Assuit	2018	32

Source: Ministry of Electricity & Renewable Energy Report 2021

change, biodiversity, fisheries, pollution emissions, water resources, agriculture, energy, and forests.[5] The air quality in Egypt is ranked as 103 at the same EPI report[6] simultaneously. The energy demand is increasing due to the high growth in population. Thus, Egypt is conducting many mega projects to expand its energy capacity, there are a few of these projects that depend on green technology. However, most of the generated energy comes from: natural gas power plants, Oil- and gas-fired thermal power plants. The new energy mega player will be "AL-Dabaa Nuclear Power Plant" which will is financed by Russia. It consists of four water-water energetic reactors 1200 MWe Pressurized Water Reactor (PWR) units each using the Russian design VVER-1200 (AES-2006). The Nuclear Station will start operation at 2026 to add 4,800 MW to the Egyptian total electrical capacity. These Pressurized Water Reactors (PWR), Selected for Al-Dabaa NPP are the most advanced used reactor type worldwide. This design also belongs to the latest Generation 3+ Nuclear Reactors, which is fully compliant with all post-Fukushima International Atomic Energy Agency (IAEA) requirements and safety levels (Table 1). Al-Dabaa Site is located along the Northern West Coast of Egypt on the Mediterranean Sea. The Project Owner and the Operator for El-Dabaa NPP Project is the Nuclear Power Plants Authority (NPPA) of Egypt, while the main contractors are entities from the ROSATOM group, which will provide Engineering, Procurement, and Construction (EPC) services, nuclear fuel supply, operation support and maintenance, and spent nuclear fuel treatment[7].

Green Energy Production In Egypt

Hydroelectric Sources

Despite that most of the Egyptian energy comes from fossil fuel-based technologies, Egypt also has developed renewable energy sources. Currently the most produced green technology-based energy in Egypt comes from hydroelectric power, i.e.; Aswan High Dam[8], Aswan Dam 1, Aswan Dam 2, Esna, and Nagaa Hamadi barrage with a total of 2800 Mega Watt (Table 2).

Solar Energy Sources

Besides the hydroelectric sources in Egypt, there are also Solar power projects like Benban Solar Park in Aswan, Kuraymat

[5] Yale Center for Environmental Law & Policy
Center for International Earth Science Information Network Earth Institute, Columbia University | *Environmental Performance Index*, https://epi.yale.edu/epi-results/2020/component/epi

[6] Yale Center for Environmental Law & Policy
Center for International Earth Science Information Network Earth Institute, Columbia
Egypt | Air Quality
https://epi.yale.edu/epi-results/2020/component/air

[7] Egyptian Nuclear Power Plants Authority (14 September 2021). URL: https://nppa.gov.eg/en/el-dabaa-npp-project-2

[8] Abul-Ata, Abdel Azim, "Egypt and the Nile after the Construction of the High Aswan Dam", Ministry of Irrigation and Land Reclamation, Cairo, 1978, quoted by Asit Biswas and Cecilia Tortajada, 2004; Collins, Robert O. (2002). The Nile. Yale University Press. p. 181. ISBN 0-300-09764-6. robert collins the nile.

Table 3 - Egypt's Solar Plants Installed Capacity (2020)

Station	Installed Capacity *(MW)*
Kuraymat Solar / ST	140
Benban	1465
Kom Ombo	26
Roof-top and Central plants, off-grid	132

Source: *NREA Annual Report (2020)*

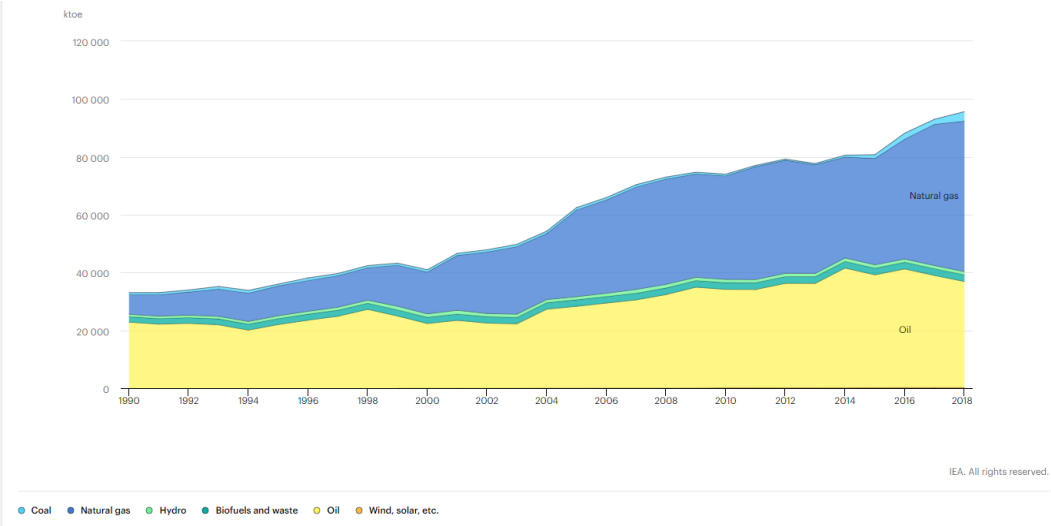

Figure 4 - Primary Energy Supply by Source
Source: IEA, Primary Energy Supply by Source in Egypt, IEA, Paris (IEA, 2019)

Solar Thermal Integrated Power Plant, Kom Ombo PV Power Plant with a total installed capacity of 1763 MW and 820 MW under development (Table 3). Benban solar project in Aswan in Egypt is the largest solar generation power plant in the whole world (without saving). This solar park consists of 32 projects with a total capacity of 1465 MW. This Solar Park has strengthened its standing with the third International award, the Arab Government Excellence Award awarded by the government of the United Arab Emirates, to be added to two previous awards received by the Complex in 2017 and 2018, the IJ Global Award and the World Bank.

Benban solar park is located on an area of 37.2 KM^2 and the current saved capacity of Benban Park is 1650 Mega Watt. Accordingly, Benban Solar Park as the 4^{th} largest photovoltaic power station (with saving) in the world after Bhadla Solar Park, India with a saved capacity of 2245 MW, Huanghe Hydropower Hainan Solar Park, China 2200 MW, and Pavagada Solar Park, India, 2050 MW (Figure 4).

Wind Energy Sources

Egypt currently produces about only 1375 MW of wind power plants in operation and 2200 MW under construction and development[9]. Also, there are three privately owned independent power producers (IPPs), with a total generation capacity of about 2.5 GW, that started operations in 2002-2003 subject to 20-year long power purchase agreements with the state-owned Egyptian Electricity Holding Company (EEHC). The Egyptian government's renewable energy plan for 2015-2023 includes 3.2 GW of government projects, including 1.25 GW through BOO mechanisms and 920 MW as IPPs[10]. In 2016 NREA has established a monitoring system as a commitment to the international environmental standards for renewable energy projects, this monitoring system has been deployed for migratory bird paths in Jabal Al-Zayt region, which includes the wind energy complex that has a total capacity of 580 MW. The operating number of turbines reaches 290 turbines. In order to preserve the birds during their transit, monitoring is carried out using two radars that allow detecting and monitoring the birds from 12 km away before they reach the

[9] Egypt's New and Renewable Energy Authority (2020)
URL:
http://nrea.gov.eg/Content/reports/Annual%20Report%202020%20En.pdf
[10] Department of Commerce, USA – Egypt Renewable Energy (15 September 2020)
URL: https://www.trade.gov/country-commercial-guides/egypt-renewable-energy

Table 4 - Egypt's Wind Plants Installed Capacity (2020).

Station	Installed Capacity *(MW)*
Gulf El-Zayet	580
Zafarana	545
Ras Gharib	250

Source: *NREA Annual Report (2020)*

Table 5 – Development in Electricity Generated from Renewable Energy Sources (Wind and Solar) (2013/2014 – 2018/2019).

Year	Generated Electricity *(million KWh)*
2013/2014	1446
2014/2015	1444
2015/2016	2226
2016/2017	2780
2017/2018	2871
2018/2019	4543

Source: Egypt's Central Agency for Public Mobilization and Statistics

Table 6 – Development in installed Capacity by Generation Type (MW).

Description	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
Gas	7845	13345	5745	4055	4055
Steam	14798	15449	15449	16749	17179
Combined Cycle	12630	12630	30030	32470	32448
Hydro	2800	2800	2832	2832	2832
Renewable	887	887	1157	2247	3016
Total	38960	45111	55213	58353	59530

Source: Egyptian Ministry of Electricity and Renewable Energy Annual Report 2021

site. Then determining their path and closing the sites turbines while they pass through them, to prevent any possible collisions with the turbines. The management of the site restart the turbines after birds leave the wind station (Tables 4 and 5). From the above table, we can understand the jump in the electricity generated by wind and solar in Egypt in 2018/2019 which is a proven record for Egypt's approach toward developing green technologies.

Growth in Electricity Production

The total installed capacity of Egypt in 2020 is 59 Giga Watt consists of 90.4% fossil fuel-based technologies and 9.6% green technology-based energy, out of which 67% is hydropower.

The country has almost developed all major hydropower sites with future potential to expand further. The government's

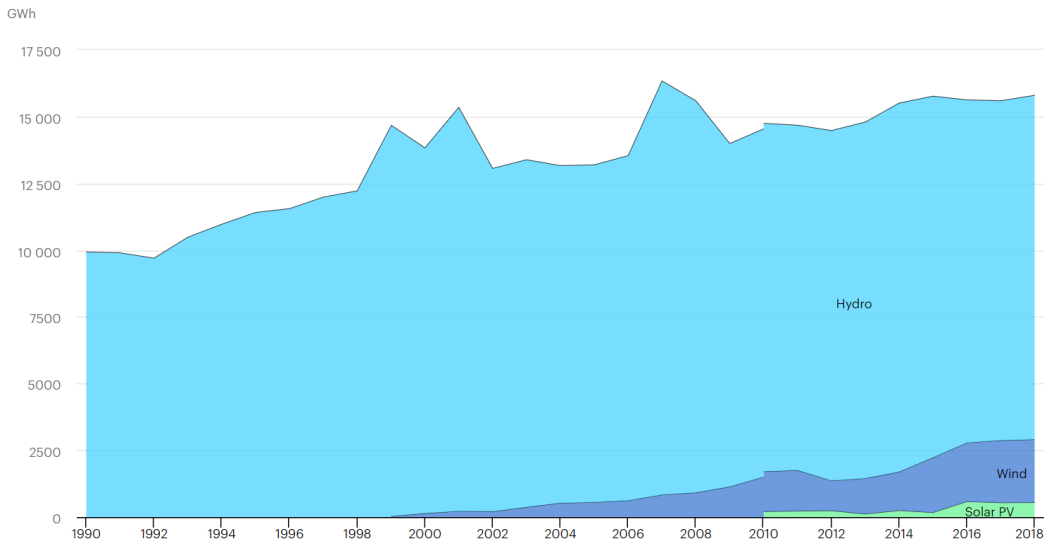

Figure 5 - Generation- Share of Different Renewable Energy Sources in Egypt (1999 – 2018)
Source: IEA (2019), Renewable Energy Sources in Egypt, IEA, Paris (2019)

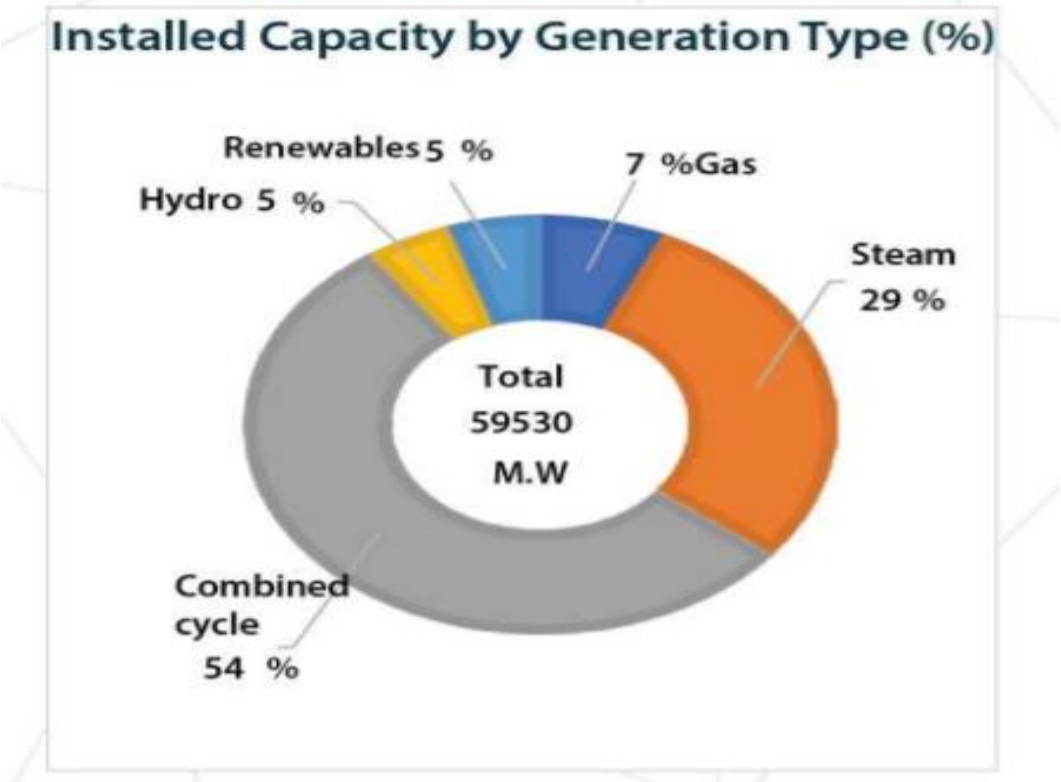

Figure 6 - Egyptian Installed Capacity of Different Energy Sources (2020)
Source: Egyptian Ministry of Electricity and Renewable Energy Annual Report 2020[11]

[11] U.S Egyptian Ministry of Electricity and Renewable Energy Annual report (2020)
URL: http://www.moee.gov.eg/english_new/EEHC_Rep/finalaEN19-20.pdf

Table 7 - No. of Transferred Cars to Work with Natural Gas (2008/2009 - 2017/2018)

Year	No. of Cars Transferred to Work With Natural Gas
2008/2009	17595
2009/2010	23595
2010/2011	22680
2011/2012	16809
2012/2013	20368
2013/2014	10477
2014/2015	11525
2015/2016	7983
2016/2017	6416
2017/2018	13732
2018/2019	32280
2019/2020	42292

Source: Egypt's Central Agency for Public Mobilization and Statistics

Table 8 - Consumption of Natural Gas, Petroleum Products & CO_2 Emissions by Sector

Sector	CO_2 Emissions *(million Ton)*	Petroleum Products & Natural Gas Consumptions *(Thousand Ton)*
Manufacturing Sector	30.80	15639.0
Housing / Commercial Sector	16.83	5893.4
Transport Sector (Vehicle)	38.20	12445.3
Agriculture & Irrigation Sector	2.59	846.4
Electricity Sector	**83.22**	**31396.0**
Petroleum Sector	13.00	5406.4
Tourism Sector	12.17	3792.7
Roads & Contract Sector	3.06	1981.5
Total:	**199.87**	**77400.7**

Source: Egypt's Central Agency for Public Mobilization and Statistics

interest in the diversification of the energy sources mix has been evolving rapidly over the past few years. The total installed capacity is expected to increase to 83 GW in 2025. Egypt's energy mix is expected to be thermal power, solar energy, hydro energy, and wind energy. The first reactor of Al-Dabaa Nuclear power plant is also expected to be introduced during this period, adding 1,200MW to the total installed capacity by 2026. Therefore, we can conclude since, Egypt possesses an abundance of land, sunny weather, and high wind speeds, making it a prime location for renewable energy projects, therefore: Egypt took several steps toward green technology and green technology projects. In addition, the country has already developed all its substantial hydropower sites. Also, the country still has a promising future in terms of Solar and Wind based energy. Egypt intends to supply 20% of its total generated electricity from renewable sources by 2022/23 and 42% by 2035 (Table 6).

OTHER STEPS TOWARDS REDUCING CO_2 EMISSIONS

Converting Cars to Consume Natural Gas

On the other hand, Egypt has other efforts towards environmental sustainability; one of them is encouraging the people recently to transfer their cars to work with natural gas instead of gasoline for less CO_2 emissions (Table 7).

NASR E70 and Electric Vehicles

In addition, we can see other steps for Egypt towards the green technology and decreasing emissions of CO_2. For example, El-Nasr Automotive Manufacturing Company's project to produce a fully electric car in cooperation with the Chinese company Dongfeng Motor Cooperation, this cooperation is underway to

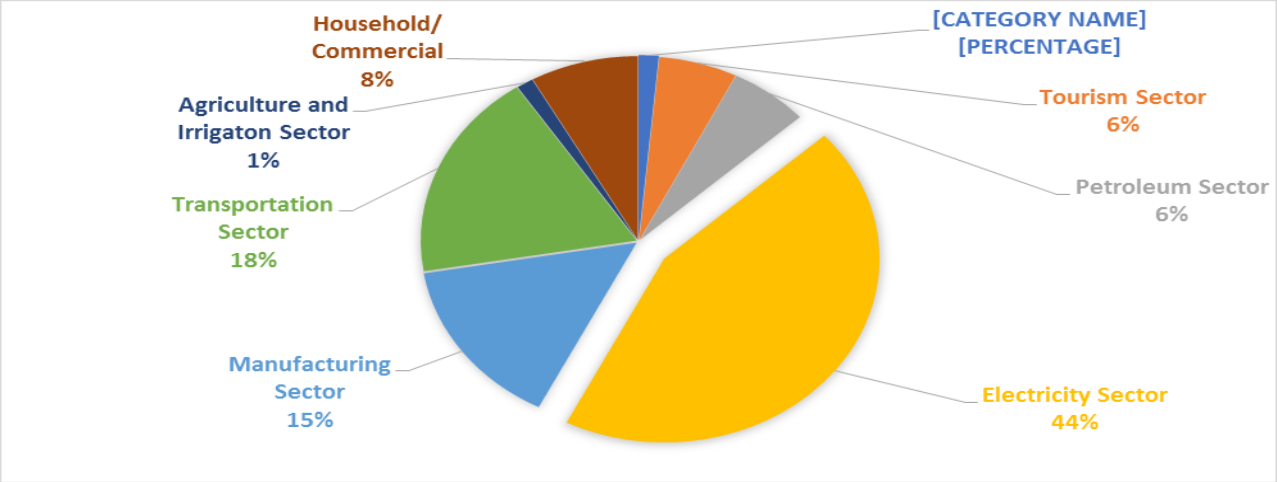

Figure 7 – Co_2 Emissions in Egypt by sector (2018/2019)
Source: Egypt's Central Agency for Public Mobilization and Statistics

Table 9 – Egypt versus Denmark

Item	Egypt	Denmark
Population *(million)*	102	5.831
GDP *(Billion $)*	$363.069	$355.184 (3.1% of GDP derived from renewables).
GDP Per Capita *(USD)*	$3,547.9	$60,908.8
Total installed Electricity Capacity	59530 MW	29111 GWh
Total Energy Generated using Hydro, Solar and Wind.	5848 MW (10%)	23767 GWh (80%)
Co_2 Emissions ^{2018} *(Million metric Ton)*	246,220	33,380
Co_2 Emissions Per Capita ^{2018} *(metric Ton)*	2.502	5.761

Source: World Bank Data (2020)

produce the E70 car model at the factories of El-Nasr Company. Before commencing the production, El-Nasr Company decided to test the E70 in order to determine the best and final specifications of the vehicle that will be produced locally, and El-Nasr Company already signed a partnership with the transportation giant "Uber" for that reason. The company delivered 13 electric cars to Uber drivers who will put them on the road via the Uber application for transportation, these drivers have been trained by Dongfeng on both the use and recharging of electric cars. Over three months, the underway tests will focus on specific criteria; over a distance of up to 30,000 km., El Nasr is expected to start assembling the E70 in Egypt in the second half of 2022 with a plan to produce 25,000 electric cars per year will leave the Egyptian company factory and will be called *"Nasr E70"*.

CO_2 EMISSIONS IN EGYPT

Danish Egyptian Agreement

On August 10, 2020, both Egyptian Ministries for International Cooperation and for Electricity & Renewable Energy have signed the Danish Egyptian Energy Partnership Program Agreement (2019-2022) with the Danish National Energy Agency signed by the Danish Ministry of Climate, Energy, and Public Services to advance Egypt's green transformation and to promote investment in renewable energy to match with Egypt's Energy Strategy 2035 that aims to raise the share of renewable energy to 42 percent. The cooperation between the governments of Egypt and Denmark dates back to 1969 amounting to around USD 560 million in various areas, including new and renewable energies, water and sewage systems, environment projects, culture aspects, and housing projects.

Ensure Environmental Sustainability In Egypt Vision 2030

Egypt vision 2030 is a national comprehensive development agenda that includes eight main goals to be attained by 2030 that aligned with United Nations Sustainable Development Goals (SDGs) 2015 and the Sustainable Development Strategy for Africa 2063.[12] Environmental Sustainability and the economic dimension pillar are among the 17 SDGs that Egypt

[12] Badr-Eldin, Karim. *Global Institute for Arabic Renewal*, Institute Symposium, 31 Mar. 2021, https://www.arabicrenewal.org/421.

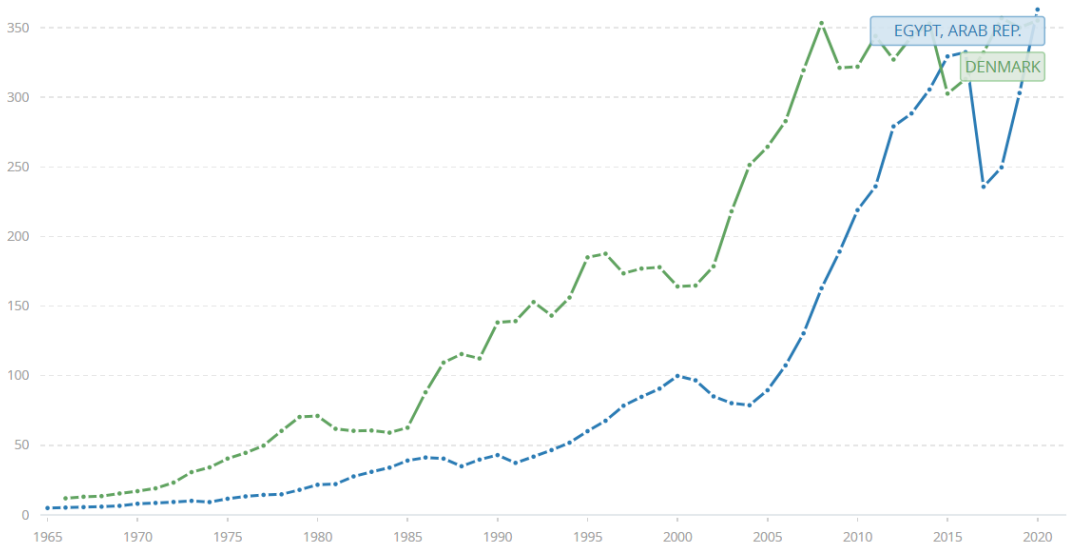

Figure 8 – GDP - Egypt versus Denmark (2020)
Source: World Bank Data (2020)

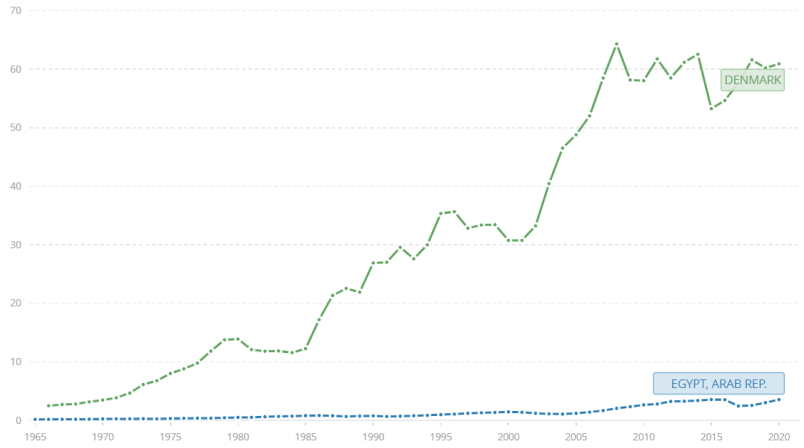

Figure 9 - (Co_2 Emissions) Egypt versus Denmark (2018)

is working on to have an energy sector meeting this sustainable development strategy through the rational use of resources also by maximizing the use and reliance on renewable resources in order to achieve both development and environmental preservation.[13]

ANALYSIS OF DATA

EGYPT VERSUS DENMARK (2020)[14]

This is represented in Table 9, Figure 8 to 10

THE NEGATIVE IMPACT OF GREEN TECHNOLOGY

High Research and Development Costs

The usage of environmental technology at high scale requires allocating big funds to be spent on research and development. This is the main constraint that discourage companies and decrease the development of green technologies to a certain extent.

HIGH IMPLEMENTATION COSTS AND TIME

Not only the costs of research and development green technology is high, but also the transformation costs for companies are still very high. For example, if a company

[13] "Egypt Vision 2030" *SIS*, 7 July 2020, https://www.sis.gov.eg/section/75/7427?lang=ar
[14] World Bank Data (2020) URL: https://data.worldbank.org/

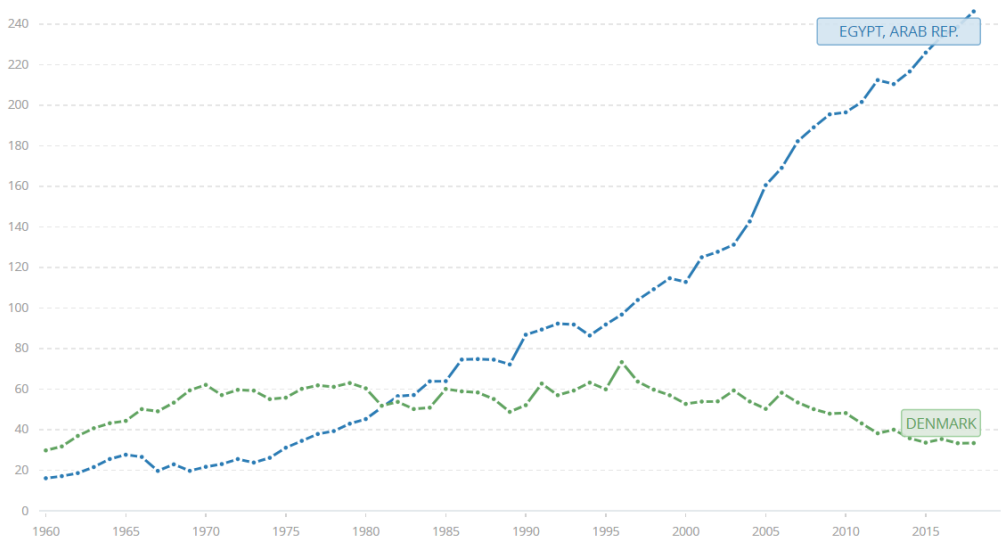

Figure 10 - (Co_2 Emissions Per Capita) Egypt versus Denmark (2018)
Source: World Bank Data (2020)

decided to change from the traditional fossil fuel to renewable resources, then, the equipment, materials, employees, and actions needed will cost very high. Also, most of the world energy is still produced with fossil fuels and most of the world vehicles are still using conventional fuels.[15] Therefore, many companies refrain from moving to green technology because of its high costs and its limited availability.

HIGH PRODUCT COSTS

The products related to green technology will be rather expensive at the beginning because new technology is relatively expensive. Then this cost will decrease overtime with the application of the economies to scale. Therefore, consumers have to expect high product prices at the beginning. Over time the demand on green technology products will increase, and producers will be willing to increase the amount of output to the level that will decrease the average cost per unit of output.

Unemployment And Retrenchment

Companies that will continue to operate with conventional technologies in the future will go out of business. This applies to companies that depend on the fossil fuel sector, If these companies continued to use conventional technologies, they will not be able to survive in the future market. This might have an impact on unemployment. If companies in those industries make retrenchments, then the workers in those companies will lose their jobs.[16]

Lithium And Cobalt Risk

When you consider the trend of electrical vehicles (EVs) to replace fuel combustion vehicles, this looks green, however; dependent on exotic minerals in order to function brings the dark side of green technology. Lithium and Cobalt are used in EVs. However, the method in which lithium and cobalt are mined or extracted from soils results in severe negative environmental impacts because they are extremely toxic. Lithium and cobalt negative environmental impacts are known during their extraction process which is toxic to the soil, water, and air leading to air contamination in specific. Moreover, they have negative social and health impacts. These toxics are spread or leaked through the soil and water, destroying food production, and harming communities, leading to hazardous effects on humans' health (Table 9).

BIOENERGY

Bioenergy is one of many diverse resources of renewable energy. It is derived from living organic materials known as biomass, which can be used to produce transportation fuels, heat, electricity, and products. Although Bioenergy appears to be beneficial, but it is still not clean. In fact, bioenergy utilization contributes to global warming emission, depletion of lands and forests, and leads to animal habitat destruction affecting biodiversity. Biomass resources such as forest wood, crops, urban and agricultural wastes are used in electricity production. Although these resources decrease carbon dioxide gas emission, they, on the other hand, increase the emission of methane which is an extremely harmful gas. Furthermore, for these resources to be extracted, lands and forests must be cleared out. Bioenergy production results in negative effects on

[15] Britannica, The Editors of Encyclopedia. "Green revolution". Encyclopedia Britannica, 31 Jan. 2020, https://www.britannica.com/event/green-revolution. Accessed 22 August 2021.
[16] Ronald Stein (02/21/2019) The dark side of green technology URL: The Dark Side Of Green Technology | Newgeography.com

Table 9 – Lithium Versus Cobalt Extraction - Environmental Impact

Extraction of Lithium	Extraction of Cobalt
The biggest environmental danger posed by lithium mining is the huge amount of water needed amounting at 500,000 gallons of water per ton of lithium extracted. This can endanger the communities where the lithium is being mined because it can cause droughts or starvation if operations are not well monitored.	Blasting and electricity consumption in cobalt mining is having a negative impact on the environment causing eutrophication and global warming. Carbon dioxide and nitrogen dioxide emissions are emitted during the cobalt mining.

Source: IOP Science Datu Buyung Agusdinata *et al* 2018 *Environ. Res. Lett.*

the environment in terms of water quantity and quality, greenhouse gas emissions. The adverse impacts on the biodiversity, soil organic carbon, and soil erosion, vary greatly depending on the biomass types, land locations, and the related management practices.[17]

Geothermal Energy

Geothermal energy is a clean and sustainable source of energy that is found under the earth's surface in its hot rocks and fluids. However, the dark side of geothermal energy resides in its extraction process. When geothermal energy is being extracted from beneath the earth's surface the following occurs:

a. Potential emissions of greenhouse gas beneath Earth's surface migrate to the surface and into the atmosphere. Such emissions are associated with sulfur dioxide and silica emissions. Also, and the reservoirs can contain traces of toxic heavy metals including mercury, arsenic, and boron.
b. Geothermal energy plants may cause earthquakes and Surface Instability. In January 1997, the construction of a geothermal power plant in Switzerland triggered an earthquake with a magnitude of 3.4 on the Richter scale.
c. If geothermal energy is transported over a long distances, then, the distribution cost can be very high.
d. Geothermal heat pumps need a power source, and the cost of powering the pumps is very high.
e. The whole process represents a very high cost for electricity, and the total costs usually end up between USD 2 to 7 million for each MW geothermal power plant.[18]

Wind Energy

Wind energy is also considered as another dark side of green technology. Although wind energy is one of the growing energy sources in the world, with its costs falling and wind farms being established dramatically across the globe, this sort of energy is still have negative impacts. "Researchers estimate that 140,000 to 328,000 birds are killed every year in collisions with the turbines' spinning rotor blades and support towers. The risk to birds is highest at night when the blades and towers are cloaked in darkness". [32]

Hydropower Plants

Hydropower is produced when the energy coming from flowing water is converted into electrical energy, and it is a dominant energy source globally. This type of energy is believed to be unconditionally clean and renewable, as it does not depend on any fossil fuel to operate. However, hydropower can negatively impact people and wildlife. The dams can distort the flow of rivers, altering the ecosystem. Dams which store water, may release the stored water all at once, resulting in the sudden flood of the downstream river. This can lead to the demolition of surrounding land, wildlife, and agriculture. [33]

CONCLUSION AND RECOMMENDATIONS

Not as most of us believe that green technology has only positive effects on the environment, of course, it has positive effects and due to green technology life became easier with less pollution and human intervention. However, the shocking truth is that green technology has many negative effects on the environment, which can lead to environmental damage. When considering the environmental costs of technologies, it is important to first consider the materials from which they are made and the source of these materials. A large amount of limited natural resources and precious metals are used to manufacture our electronic devices and other modern technologies and the raw materials needed to make a mobile phone come from all over the world. This can make end-to-end analysis difficult. The main idea to this topic lies in the extent

[17] Bioenergy production and environmental impacts. Geosci. 24 May 2018 URL: URL:https://geoscienceletters.springeropen.com/articles/10.1186/s40562-018-0114-y
[18] Meyers, G. (October, 2017). Geothermal energy Advantages and Disadvantages. Planet save. URL: URL:https://planetsave.com/2016/02/11/geothermal-energy-advantages-and-disadvantages/

[32] Metcalfe, T. (April, 2018). Wind energy takes a toll on birds but now there's help. Nbc news. URL: https://www.nbcnews.com/mach/science/wind-energy-takes-toll-birds-now-there-s-help-ncna866336
[33] Britannica, The Editors of Encyclopaedia. "hydropower". Encyclopedia Britannica, 12 Aug. 2021.

to which green technology can severely harm the environment and damage our planet. In conclusion, although green technology can be very useful, it can be quite dangerous as well.

RECOMMENDATIONS

1. Egypt should rely more on generating energy using renewable sources in order to reduce CO_2 emissions.
2. More reliance on renewable sources will reduce energy prices disruptions caused by fossil fuel prices fluctuations.
3. Investments in power generation using renewable energy sources in Egypt should be increased to decrease the unit cost of generation and create a surplus in electricity which can be exported and maximize GDP consequently.
4. The Egyptian government should work on implementing more motivation programs to encourage its people to adopt and consider the environment and "GO GREEN" while they are making their decisions in order to reduce CO_2 emissions per capita.
5. Egyptian private sector and entrepreneurs should focus more on "GO GREEN" solutions especially in transportation.
6. Egyptian government should apply stricter environmental rules and regulations.
7. Developed countries should recycle their wastes and not dump them into developing countries as developing countries do not have advanced recycling machines so, it worsens the environment as they burn that waste.
8. Developing countries should wisely choose the technology they need and should be able to have specialized skilled workers and advanced machines to regulate.
9. To be able to grasp the fruits of such technology, it is highly recommend that all stakeholders such as policymakers, engineers, and scientists to implement solutions and strategies that keep the negative impacts under control.

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