

TOWARDS GREEN ECONOMY IN EGYPT: DECOUPLING ECONOMIC GROWTH AND CARBON EMISSIONS

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ABSTRACT

Egypt, as a developing country, has faced significant challenges in addressing the impacts of climate change and ensuring sustainable development. Furthermore, the country is facing the challenge of reducing its carbon emissions while simultaneously growing its economy. To address this challenge, the Egyptian government has recently initiated policies aimed at transitioning towards a green economy. This paper aims to explore Egypt's efforts to transition towards a green economy essentially by decoupling GDP growth from carbon emissions, highlighting the progress made so far and the challenges ahead. The paper presents an overview of the various policy initiatives, investment strategies, and technological advancements that Egypt has employed to reduce its carbon footprint and promote sustainable development. The paper recommends that Egypt adopt a complementary strategy that integrates climate action into its broader development objectives which would require concerted efforts from various stakeholders. Furthermore, Egypt needs to continue implementing sustainable policies and innovative solutions to reduce its carbon footprint while promoting economic growth.

Keywords: Egypt green economy, decoupling, energy intensity, energy efficiency, renewable energy

INTRODUCTION

Since the industrial revolution when man first discovered the ability to obtain energy by burning fossil fuels, economic growth and prosperity have taken off into unprecedented levels. However, such prosperity came at the heavy price of increased local pollution as well as carbon emissions and the subsequent dire impacts of climate change on the planet. While humanity has been grappling with climate change, humanity has aspired to build a zero-carbon world while achieving the highest levels of quality of life and sustainable development. In order to continue (or even maintain) economic growth and prosperity, the world has to move forward adamantly with decoupling economic growth from carbon emission. The Inter-governmental Panel on Climate Change (IPCC) defines decoupling (in relation to climate change) as economic growth materializes without any strong association with consumption of fossil fuels being the primary source of carbon emissions (IPCC, 2013). In this regard, a distinction is made between relative and absolute decoupling. Relative decoupling is when both economic growth and use of fossil fuels grow but at different rates; the former growing at much higher rates. On the other hand, absolute decoupling, is where economic growth occurs but consumption of fossil fuels, and subsequently, carbon emissions, decline (Parrique, 2019). More recently, an increasing number of countries have managed to achieve decoupling as these countries were able to achieve economic growth while reducing emissions.

Egypt, like many countries, has been facing a significant challenge in the form of climate change, which poses a threat to the country's economic and social stability. The country has been experiencing a high level of carbon emissions due to its reliance on fossil fuels, particularly oil

and gas. However, the country has started transitioning towards a green economy, which involves decoupling its GDP from carbon emissions.

This paper will start by providing an overview of Egypt's environmental. Then, it will provide a general analysis of the trend of Egypt and Arab countries to pursue decoupling and reduce carbon emissions. The paper will then present the challenges facing Egypt to fully pursue a green economy. Then the paper presents a recommended set of measures and strategies for decoupling GDP and carbon emissions as means of expediting and strengthening the impact of Egypt's transition to a green economy.

LITERATURE REVIEW

The Green Economy has gained significant attention in recent years due to the increased awareness of environmental degradation caused by human activities. Many industrialized countries have adopted Green Economy policies to reduce their carbon footprint and increase sustainable production and consumption patterns. Despite some challenges, the Green Economy concept is gaining momentum as a viable alternative to traditional economic growth models (Bowen, 2011). Decoupling GDP from carbon emissions has been demonstrated in several studies as a viable approach to reduce environmental impact and achieve green growth. The International Energy Agency (IEA) reported that CO₂ emissions from energy use remained almost unchanged in the period of 2014-2016, while the global economy grew by 3.3% per year (IEA, 2017). This decoupling is also evident in the European Union (EU), where the GDP grew by 1.7%, while CO₂ emissions from energy use decreased by 1.8% in 2016 (Eurostat, 2017).

As regards Egypt, several studies have been conducted on the potential for green growth in Egypt (Abounaga, 2018; Elhedhli&Goueli, 2019; Soliman & Eid, 2020). These studies highlight the country's abundant renewable energy resources, particularly solar and wind power, and emphasize the importance of transitioning to a more sustainable economic model. A more recent study provided a review of green economy policies in Egypt and the government's efforts to pursue a green growth pathway (Ahmed, 2021).

1) Egypt's Pathway Towards A Green Economy: A green economy is defined as low carbon, resource efficient and socially inclusive. It is usually referred to as an economic system that balances economic growth, social inclusion, and environmental sustainability. Furthermore, a green economy aims to reduce carbon emissions, preserve natural resources, and promote sustainable economic growth (UNEP, 2011). In a green economy, growth in employment and income are characterized by reduced carbon emissions and pollution, enhanced energy and resource efficiency, and prevention of the loss of biodiversity and ecosystem services. Green economy has been widely recognized as an important tool to achieve sustainable development and the United Nations' Sustainable Development Goals (SDG) more specifically.

However, one of the main challenges of transitioning towards a green economy is decoupling economic growth from carbon emissions. Decoupling GDP and carbon emissions are key components of the Green Economy as they seek to reduce carbon emissions while maintaining or without compromising economic growth. Decoupling GDP and carbon emissions is essential for achieving long-term sustainable development, mitigating the effects of climate change, and reducing environmental degradation.

Egypt has recognized the need for a green economy and has taken significant steps towards achieving this goal. To this end, the Egyptian government has prepared and implemented several strategies, policies and initiatives aimed at transitioning towards a green economy essentially to promote sustainable development and reduce carbon emissions (that is, decoupling GDP and carbon emissions). These include:

- **Sustainable Development Strategy**: Egypt Vision 2030: Egypt launched its National Sustainable Development Strategy (NSDS) in 2015, titled "Egypt Vision 2030". Egypt's Vision 2030 is a comprehensive national development strategy that has an overall objective of transitioning towards a green economy and achieving sustainable development (CAPMAS, 2015).
- **The National Solid Waste Management Program (NSWMP)** which was launched in 2012, and still ongoing, aims to build the capacities of governmental and non-governmental actors to set up, sustain and operate an effective and cost-covering waste management system at national, governorate and local level by reducing the amount of waste sent to landfills and promote recycling (NSWMP, 2014).
- **Feed-in Tariff (FiT) Program**: as part of the Energy Efficiency Law of 2014, Egypt introduced a Feed-in Tariff (FiT) program aimed at promoting investments for the deployment of renewable energy technologies, particularly solar and wind (Ministry of Electricity and Renewable Energy, 2014). The FiT program provides long-term contracts and guaranteed payments for electricity generated from renewable sources (Goueli & Eid, 2018). This policy has successfully attracted domestic and international investments, leading to the construction of several large-scale solar and wind power projects (IRENA, 2021).

- **Investments in Renewable Energy Projects:** Egypt has witnessed significant investments in renewable energy projects in recent years and made significant advancements in harnessing solar and wind energy. Notable examples include the Benban Solar Park, completed in 2019, is the largest solar installation in Africa with a total capacity of 1.65 GW (World Bank, 2019) and the Gabal El-Zeit Wind Farm, with a capacity of 580 MW (Ibrahim et al, 2021; REEEP, 2020). These projects have not only contributed to the diversification of Egypt's energy mix but also created new employment opportunities and fostered local economic development.
- **The National Renewable Energy Action Plan (NREAP):** launched in 2015, the NREAP outlines Egypt's roadmap for achieving its renewable energy targets as part of its commitment to decouple GDP growth from carbon emissions. It includes specific actions and initiatives to promote the development of renewable energy projects and the integration of renewable energy into the national grid (NREAP, 2015). As per NREAP, the country aims to generate 20% of its electricity from renewable sources by 2022, increasing to 42% by 2035 (Ministry of Electricity and Renewable Energy, 2015).
- **National Energy Efficiency Action Plan (NEEAP):** The country has also implemented energy efficiency policies and initiatives to reduce energy consumption and promote sustainable energy use. This culminated by launching the National Energy Efficiency Action Plan (2018 – 2022), which aims to reduce energy consumption by 20% by 2022 (Ministry of Electricity & Renewable Energy, 2018b).
- **Green Transportation:** Egypt has also focused on promoting sustainable transportation and reducing carbon emissions from the transportation sector. The country has introduced green transportation policies such as the development of bike lanes, the increase in public

transportation, and the promotion of electric transportation. That is, in 2019, the government launched a project to replace 50,000 traditional tuk-tuks with electric ones. Additionally, the government has launched a mass transit project, which aims to develop a modern and integrated public transportation system in major cities, including Cairo and Alexandria (EBRD, 2022).

- **National Water Resources Plan (NWRP)**: while water scarcity is a significant environmental challenge facing Egypt, the country has nonetheless implemented water management policies and initiatives to conserve water resources. In 2017, the government of Egypt launched the NWRP which aims to reduce water consumption and promote sustainable water use as means of mitigating Egypt's water scarcity issues covering the period 2017 – 2037 (Ministry of Water Resources & Irrigation, 2017).
- **Green Bonds**: in 2020, Egypt became the first country in the Middle East and North Africa to issue a sovereign green bond. The country issued its first-ever green bonds worth \$750 million, aimed at financing various green projects (Reuters, 2020). The green bond was conceived as a financial solution to meet Egypt's pressing need for environmentally sustainable investment. The funds raised will support renewable energy, clean transportation, and sustainable water and wastewater management initiatives, pollution prevention and control, energy efficiency, and climate change adaptation World Bank (World Bank, 2022b).
- **International Cooperation and Partnerships** have played a critical role in Egypt's transition towards a green economy. In this regard, Egypt has formed partnerships with various international organizations to secure financing for green projects. For instance, the European Bank for Reconstruction and Development (EBRD) has invested €1.7 billion in Egypt's green

economy since 2012 including significant financial assistance to renewable energy projects (EBRD, 2019; EBRD, 2021).

- **Egypt's National Climate Change Strategy (NCCS)2050:** which was issued in 2022, ensures the integration and mainstreaming of climate change dimensions and issues into general planning of all sectors in the country (Ministry of Environment, 2022b).
- **The National Initiative for Green Smart Projects** in Governorates has been launched by the Ministry of Planning and Economic Development, the Ministry of Communications and Information Technology (MCIT), the Ministry of Local Development, the Ministry of Environment, the Ministry of International Cooperation, and the National Council for Women. It is a flagship project directed toward attaining sustainable and smart development and addressing the environmental dimension and effects of climate change. (Government of Egypt, 2022).

2) Egypt Environmental Performance Indicators: An Overview

Environmental Performance Index: The Environmental Performance Index (EPI) was developed to benchmark the environmental performance of a country relative to other countries. The 2022 EPI scores serve as a starting point for deeper analyses into a country's sustainability performance. The 2022 EPI leverages 40 performance indicators grouped into 11 issue categories. These issue categories are in turn aggregated into 3 policy objectives: Environmental Health, Ecosystem Vitality, and Climate Change. As a composite index, the 2022 Environmental Performance Index distills country-level data on 40 specific indicators into 11 issue categories, 3 policy objectives, and an overall EPI score (Wolf *et al.*, 2022). Tracking

performance across environmental domains helps decision-makers develop comprehensive sustainability policies.

Table(1): Egypt’s Environmental Performance Index by Component, 2022

Component	Rank	EPI Score	10-Year Change
EPI	127 over 180	35.5 over 100	6.5
Ecosystem Vitality	95	43.7	4.2
Biodiversity	124	42.5	2.4
Terrestrial biomes (national)	100	75.4	0.1
Terrestrial biomes (global)	141	42.4	NA
Marine protected areas	61	10.3	1.3
Protected Areas Rep. Ind.	127	18.9	14.9
Biodiversity Habitat Index	17	63.5	NA
Species Protection Index	98	41.4	1.9
Species Habitat Index	12	97	-2.3
Ecosystem Services	29	55.1	1.5
Tree cover loss	23	48.3	2.5
Grassland loss	1	100	NA
Wetland loss	78	51.3	-2.6
Fisheries	123	10.6	-1.7
Fish Stock Status	81	17.2	-5
Marine Trophic Index	107	8.1	NA
Fish caught by trawling	80	5.2	0.3
Acidification	78	73.8	30.9
SO2 growth rate	79	84.5	49.9
NOx growth rate	94	63.2	11.9
Agriculture	78	38.6	1.3
Pesticide	96	24.2	NA
N Management Index	41	53	2.6
Water Resources	46	42	NA
Wastewater treatment	46	42	NA

Con. Table(1): Egypt's Environmental Performance Index by Component, 2022

Component	Rank	EPI Score	10-Year Change
EPI	127 over 180	35.5 over 100	6.5
Health	111	31.5	6.2
Air Quality	92	34.6	6.5
PM2.5	174	NA	NA
Household solid fuels	33	84.4	17.4
Ozone	161	26.8	2.7
NOx	170	0.9	-4.4
SO2	171	4.6	-2.9
CO	159	15.1	-5.4
VOC	75	39	-1.4
Sanitation Drinking Water	112	36.7	9.3
Sanitation	118	36.7	12.1
Drinking water	108	36.7	7.4
Heavy Metals	177	13.1	3.6
Lead	177	13.1	3.6
Waste Management	121	19.8	-0.8
Solid waste	107	24.2	NA
Recycling	42	26.6	3.8
Ocean Plastics	131	4.3	-6.8
Climate Policy	139	28.5	9
Climate Change	139	28.5	9
CO2 growth rate	96	33.4	13.7
CH4 growth rate	48	53.4	43.3
F-gas growth rate	41	71.6	10.2
N2O growth rate	88	63.8	27.4
Black Carbon growth rate	139	51.9	20.2
Projected GHG Emissions	162	8.2	2.6
CO2 from land cover	152	NA	-71
GHG intensity trend	87	49.9	17.2
GHG per capita	76	59.2	1.7

Source: Egypt | Environmental Performance Index (yale.edu)

The higher the score, the higher the environment performance of the country is achieving environment sustainability. In 2022, Egypt is ranked 127 over 180 countries and has an EPI score

of 35.5 over 100 (Table 1). Although Egypt's air quality and waste management (111 and 121, respectively) rank better than the aggregate score, climate change however ranks 139 with a lower EPI score 28.3.

Sustainable Development Goal Index: In 2015, United Nations member countries including Egypt adopted the United Nations Resolution A/RES/70/1 as an intergovernmental set of 17 aspiration Goals with 169 targets also known as the 2030 Agenda for Sustainable Development. The Sustainable Development Goals (SDGs) objective is to end poverty, protect the planet, and ensure prosperity for all to be achieved over the next 15 years. The Sustainable Development Goal Index (SDGI) was developed to benchmark the SDG performance of a country relative to other countries. The higher the score over 100 the higher the performance. Egypt ranks 87 over 163 countries with a score of 68.7 in 2022. The SDGI is disaggregated into current assessment and trend in achieving the 17 SDGs (Figure 1). Major challenges remain although the trend is moderately improving for SDG 8 Decent Work and Economic Growth. Conversely, challenges remains while the trend is on track for SDG 13 Climate Action.

Figure(1): Egypt Sustainable Development Goal Index Dashboard, 2022



Source: Sustainable Development Report 2022 (sdgindex.org)

3) Egypt and Regional Strategic Fit: An Overview: All Arab countries have ratified the United Nations Framework Convention on Climate Change (UNFCCC) before 2000. Moreover, all of them have published their Intended National Determined Contribution (INDC) and few countries such as Egypt still need to publish their National Determined Contribution (NDC). Under the 2015 Conference of Parties (COP) or Paris Accord, the reduction of 25% in GHG emissions for the year 2030, relative to the 2019 Business as Usual (BAU) scenario, is consistent with provisions stipulated in the said Accord (UNFCCC website). Concomitantly, most Arab countries have embarked on a transitional economy stance and formulated development strategies to comply with or exceed the Paris Accord and even the 2021 Glasgow Accord targets such as the United Arab Emirates (UAE) that has committed to achieving net-zero carbon emissions by 2050 (Table 2). Moreover, most of these strategies are being implemented in line with the worldwide United Nations 17 Sustainable Development Goals (SDGs) to be reached by 2030 (UN SDG website) and, for Arab-African countries, the regional

African Union's African Agenda 2063's inclusive and sustainable development (AU AA website).

Table (2): Selected Arab NDC and Transitional Economy Strategies

Country	Latest NDC	Selected Transitional Economy Strategies, Plans and Programs
Bahrain	NDC 2021	Vision 2030
Egypt	NDC 2022	Vision 2030; Egypt Takes Off; and Egypt National Climate Change Strategy 2050
Kuwait	NDC 2021	Vision 2030; and Vision 2035 (New Kuwait)
Oman	NDC 2021	Vision 2040
Qatar	NDC 2021	Vision 2030; and National Development Strategy of 2011-2016 &2018-2022
Saudi Arabia	NDC 2021	Vision 2030; and National Transformation Program 2020
United Arab Emirates	NDC 2020	National Climate Change Plan of the UAE 2017-2050 that was complemented by the UAE Net Zero by 2050 Strategic Initiative in 2020; National Green Growth Strategy in 2012; and Abu Dhabi Economic Vision 2030

Source: UNFCCC website: All NDCs (unfccc.int); and various national official websites available in the list of References.

4) Egypt, Arab World, and Gulf Cooperation Council (GCC) Countries GDP Growth and GHG Emissions Trends: Irrespective of the moral imperative of swiftly decarbonizing worldwide economies, there is still an ongoing global debate whether curbing greenhouse gases (GHG) could help drive or impede economic growth. Depending on the GHG emissions reduction policies in place, worldwide experience provides a palette of examples ranging from countries driving or impeding economic growth. The right mix of policies adopted in most European countries (Aden, 2016) in the last decades have contributed towards the gradual decoupling process whereas countries such as India and its firm stand on fossil fuels during the

November 2021 COP 26 in Glasgow, are still gauging the GDP growth vs. GHG emissions reduction trade-offs before putting the decarbonization of their economies on an accelerated pace.

With a total population almost reaching the 450-million mark in 2021 (Figure 4), most Arab countries are embracing the decarbonization stance at different paces. Yet, the past two-decades of Gross Domestic Product (GDP) growth and GHG emissions trends display different spectrums as shown in Table 3; Figures 2, 3 and 4 (WDI 2021 data was used for the analysis):

- In absolute terms, Arab countries' GDP growth exceeds GHG emission increase in 2018 as compared to 2000: 97% vs. 85%.
- Conversely, and still in absolute terms, Gulf Cooperation Council (GCC) countries' GDP growth balances GHG emission increase in 2018 as compared to 2000. However, across countries: (i) Qatar and Saudi Arabia have higher GDP than GHG emissions growth as they are 3.5-fold higher and 1.1-fold higher respectively; (ii) Bahrain has a balanced GDP and GHG emission growth; whereas (iii) Kuwait, Oman and the UAE have significant higher GHG emissions increase than GDP growth ranging between 1.1 to 2.8-fold and Egypt belongs to this category.
- When considering the trends based on annual averages, Arab countries' GHG emissions increase at a slower pace (2.2%) than the annual GDP in 2010 constant US dollar (3.3%). However, GCC countries' GDP growth matched the GHG emissions increase (3.5%) although countries fair differently: (i) Kuwait, Oman and Qatar annual growth trend shows higher GHG emissions than GDP increase; (ii) Saudi Arabia evens out; whereas (iii) Bahrain and UAE show higher GDP than emission increase, as is the case for Egypt.

- The annual average GHG emissions per capita increased at a much slower pace (0.1%) than the annual GDP per capita in 2010 constant US dollar (3%).
- Yet, GDP growth and GHG emission trends are positively and strongly correlated for all Arab and GCC countries alike with a correlation coefficient (R) greater than 0.979 over the 2000-18 period. When GDP growth per capita and GHG emissions per capita trends are considered, the relationship between the two remains positive and strong for all Arab countries with an R equal to 0.969 while GCC countries show a positive but moderate relationship with an R greater than 0.694.
- Two countries, i.e., Oman and Qatar, are tilting the GCC country balance where the GDP and GHG relationship becomes negative for both as well as weak for the former and moderate for the latter. In the case of Oman (R=-0.313), the highest population growth (6.1% annually over the period) among the considered countries (Table 2) and the GDP growth fluctuation could explain the negative correlation as Oman has gradually increased its GHG intensity per GDP to rank first among the countries considered in 2018 (0.97 kg of GHG per GDP in 2010 constant terms). Conversely, Qatar's negative but moderate correlation (R=-0.565) could not only be explained by the second highest population growth (5.1% annually over the period) but also by a GDP growth decoupled from GHG emissions. The latter could be validated by the GHG intensity trend where Qatar has made sensible efforts since 2005 to reduce its GHG intensity per GDP. Indeed, Qatar is the less GHG intensive per GDP country among the countries considered (0.51 kg of GHG per GDP in 2010 constant terms in 2018 after reaching a 0.77 peak in 2005--Figure 4). While Egypt is showing a commendable effort at reducing GHG intensity per GDP (0.86 in 2018 after reaching a peak at 0.98 in 2005), all the other countries

show different trends with an increase for GCC countries (0.62 to 0.66 for the same period) and a perfect balance for Arab countries (0.68 to 0.68) with however fluctuations within the period and across countries (Figure 4).

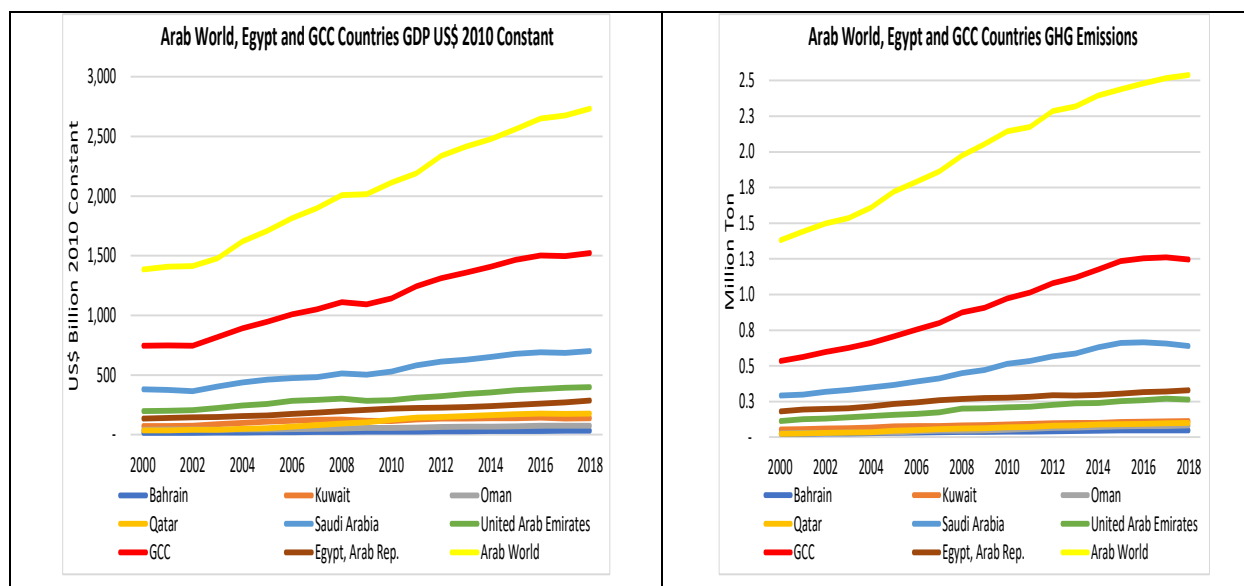
Table(3): Various Ways at Looking at the Arab World GDP Growth and GHG Emissions Decoupling, 2000-2018

Country	GDP 2010 US\$ constant /Capita Annual Increase	GHG Emission/ Capita Annual Increase	GDP / Capita - GHG / Capita Correlation	GDP 2010 US\$ constant Annual Increase	GHG Emissions Annual Increase	GDP growth – GHG Emissions Trend Correlation	GDP 2010 US\$ constant 2018 over 2000 Increase	GHG Emissions 2018 over 2000 Increase
	±% 2000-2018	±% 2000-2018	R	±% 2000-2018	±% 2000-2018	R	±% 2018/2000	±% 2018/2000
Bahrain	3.3%	0.3%	0.8217	3.7%	3.1%	0.9966	121%	121%
Kuwait	4.0%	-1.2%	0.9187	1.7%	3.0%	0.9375	86%	104%
Oman	-3.7%	-0.7%	-0.3134	3.8%	5.4%	0.9897	78%	86%
Qatar	7.6%	-0.3%	-0.5650	4.3%	4.7%	0.9892	393%	111%
Saudi Arabia	1.8%	0.6%	0.9064	3.3%	3.2%	0.9891	85%	78%
United Arab Emirates	4.9%	2.1%	0.9750	4.1%	3.3%	0.9786	101%	204%
GCC Total	2.8%	0.6%	0.6939	3.5%	3.5%	0.9947	105%	393%
Egypt	2.5%	-0.1%	0.8874	3.4%	2.1%	0.9817	110%	312%
Arab World Total	3.0%	0.1%	0.9695	3.3%	2.2%	0.9951	97%	85%

Note: red color means greater, yellow means equal or quasi equal, and green means lower GHG emissions than GDP growth. Annual increase is obtained by averaging the logarithms of the year-to-year growth ratios. For correlations, GDP growth is considered the dependent variable and GHG emission the independent variable.

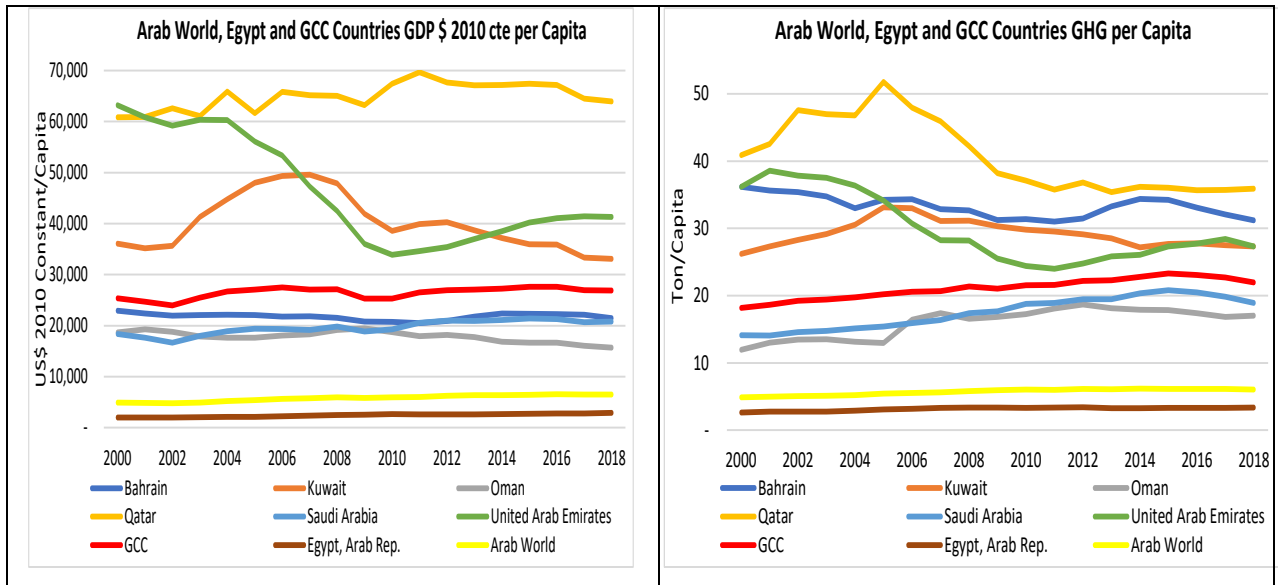
Source: analysis based on data reported in WDI (2021).

Figure(2): GDP and GHG Growth Trend in the Arab World, GCC Countries and Egypt



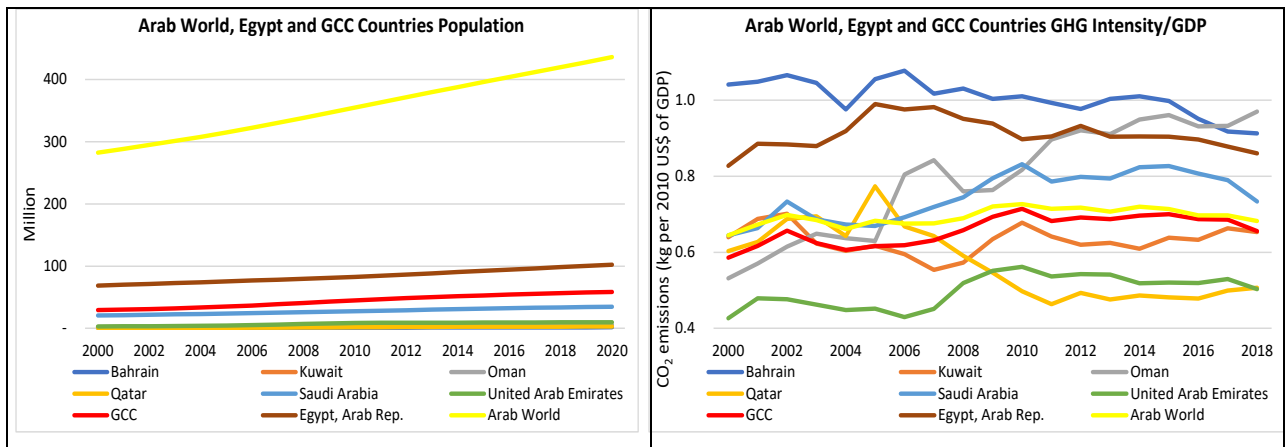
Source: analysis based on data reported in WDI (2021).

Figure(3): Per Capita GDP & GHG Growth Trend in the Arab World, GCC Countries and Egypt



Source: analysis based on data reported in WDI (2021).

Figure(4): Population & GHG Intensity per GDP Trend in Arab World, GCC Countries & Egypt

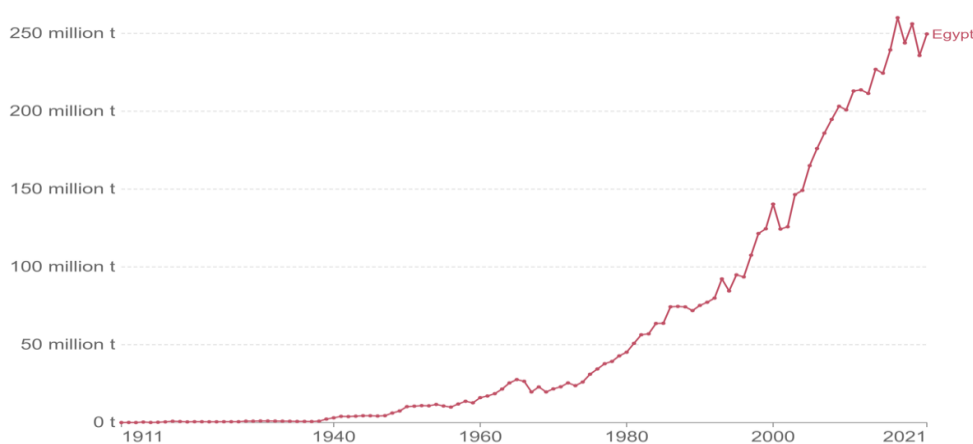


Source: analysis based on data reported in WDI (2021).

The Case of Egypt: This section will focus on Egypt's GHG profile and presents an analysis of the major trends with carbon and GHG emissions in relation to growth in GDP.

Trends in Carbon/GHG Emissions: Figure 5, below, shows how much CO₂ is produced in Egypt in a given year. The same Figure indicates that the annual CO₂ emissions in Egypt have been growing steadily over the years to reach around 250 million tons in 2021 which represents an increase of around 80% from 2000 level (140 million tons).

Figure(5): Annual CO₂ Emissions in Egypt, 1910 – 2021

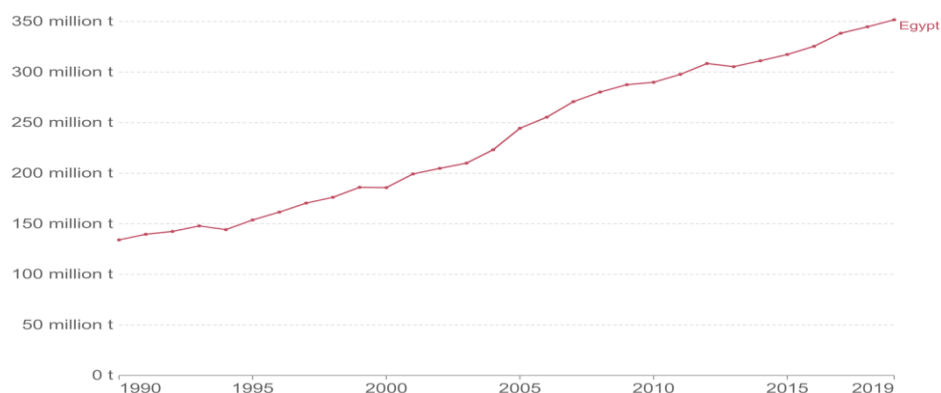


Note: the data pertains to carbon dioxide (CO₂) emissions from fossil fuels and industry only and does not include land use change

Source: Hannah Ritchie *et al* (2020) and Our World in Data website: <https://ourworldindata.org/>

With regard to total GHG emissions, Figure 6 below indicates a steady increase since 1990. The same figure shows that total GHG emissions in Egypt have increased from 186 million tons in 2000 to reach 352 million tons in 2019 representing an increase of almost 90% during this period.

Figure(6): Total GHG Emissions in Egypt, 1990 – 2019



Note: emissions are measured in carbon dioxide-equivalents. Emissions from land-use change and forestry are not included.

Source: Hannah Ritchie *et al* (2020) and Our World in Data website: <https://ourworldindata.org/>

However, in order to be able to reflect the increase in population on emissions and understand the ‘footprint’ of the average person in the country, Figure 7 below shows CO₂ per capita emissions in Egypt. The figure indicates that the per capita CO₂ emissions increased from 1.97 ton in 2000 to 2.28 tons in 2021 representing a growth rate of only 16% over this period whereas Figure 5 above indicates that the increase in the total CO₂ emissions during the same period was 80%. This striking variance can be attributed to the high increase in total CO₂ emissions which outpaced the population growth rates during that period.

Figure(7): Per capitaCO₂ Emissions in Egypt, 1910 – 2021

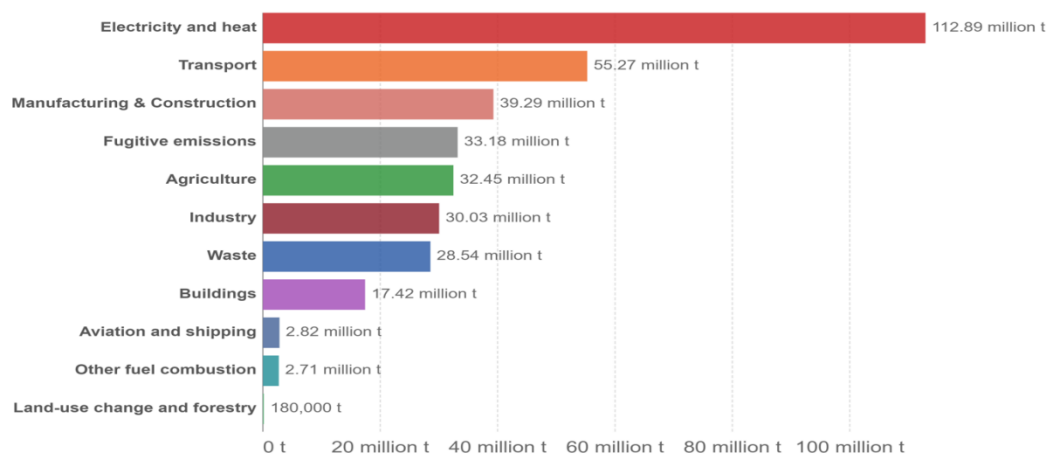


Note: Carbon dioxide (CO₂) emissions from fossil fuels and industry. Land use change is not included.

Source: Hannah Ritchie *et al* (2020) and Our World in Data website: <https://ourworldindata.org/>

Egypt GHG Profile by Sector and by Fuel: As indicated by Figure 8, Egypt's electricity sector is by far the major GHG emitter followed by the combined industry, manufacturing and construction sectors and the transportation sector while the other sectors are being responsible for the residual emissions. By fuel type and as shown in Figure 9, Egypt's major GHG emissions stem from gas (50%) that has just outpaced oil (40%) since 2020. The same Figure also indicates that Egypt is gradually phasing out the use of coal (-7%).

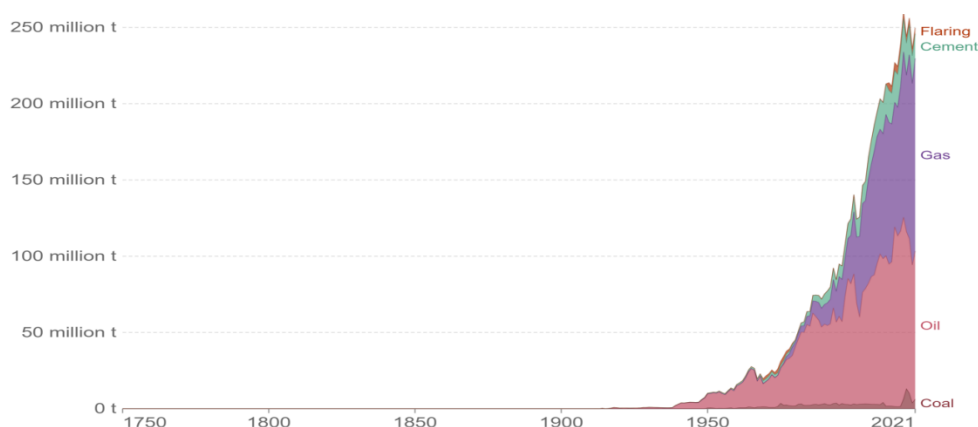
Figure(8): GHG Emissions by Sector in Egypt, 2019



Note: emissions are measured in carbon dioxide equivalents (CO₂eq)

Source: Hannah Ritchie *et al* (2020) and Our World in Data website: <https://ourworldindata.org/>

Figure(9): GHG Emissions by Fuel or Industry Type in Egypt



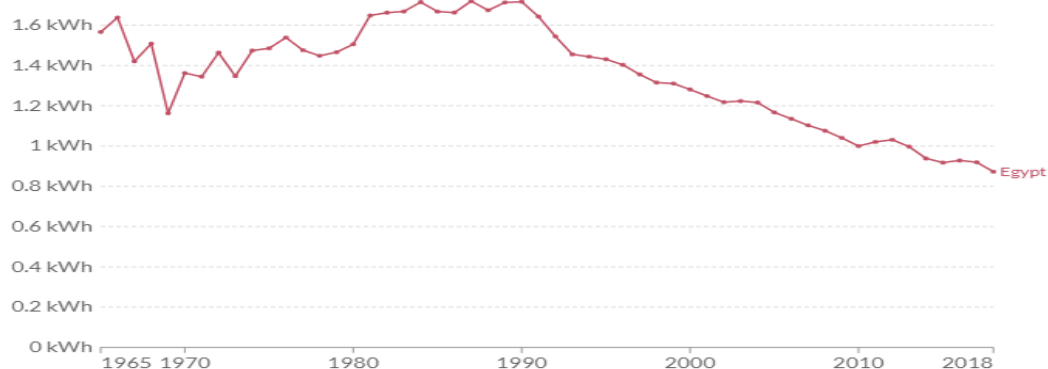
Source: Hannah Ritchie *et al* (2020) and Our World in Data website: <https://ourworldindata.org/>

Trends in Energy Efficiency and GDP Decoupling

Since energy is such a large contributor to CO₂, reducing energy consumption can inevitably help to reduce emissions. Energy intensity can therefore be a useful metric to monitor. Another way to measure decoupling is through carbon intensity which measures the amount of energy consumed per unit of gross domestic product. It effectively measures how efficiently a country uses energy to produce a given amount of economic output. A lower energy intensity means it needs less energy per unit of GDP.

Figure 10, below, shows that Egypt's carbon intensity has steadily decreased over the past few decades, indicating progress towards decoupling. This can be attributed to the government's efforts to promote energy efficiency and renewable energy.

Figure(10):Trends in Egypt's Energy Intensity

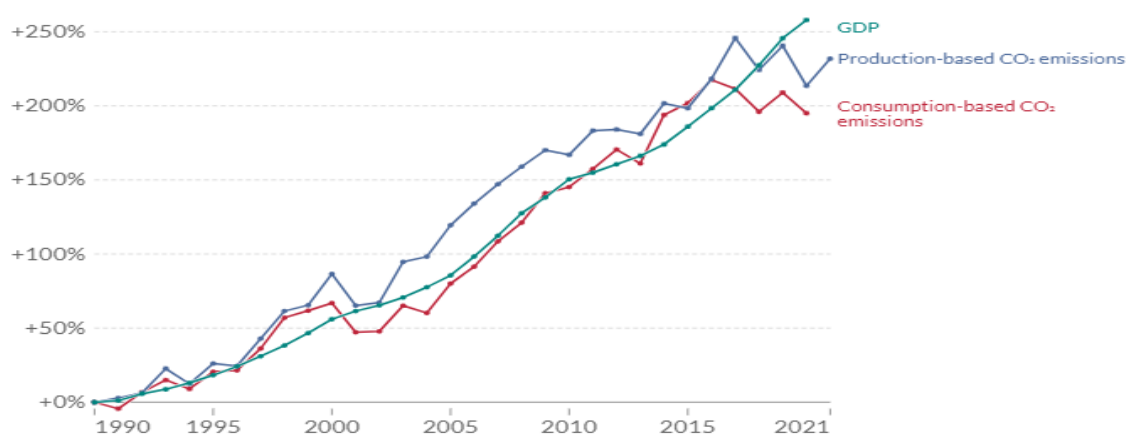


Note: Energy intensity is measured as primary energy consumption per unit of gross domestic product. This is measured in kilowatt-hours per 2011\$ (PPP).

Source: Hannah Ritchie *et al* (2020) and Our World in Data website: <https://ourworldindata.org/>

As shown in Figure 11, below, Egypt's carbon emissions have steadily increased alongside its GDP growth over the past few decades. This indicates a lack of decoupling between the two variables. However, there have been recent signs of progress towards decoupling since 2018 when Egypt's GDP was growing its associated carbon emissions were on a decreasing trend. This relative decoupling between the two variables is shown in Figure 11 below.

Figure(11):Change in CO₂ Emissions and GDP in Egypt



Note: Gross Domestic Product (GDP) figures are adjusted for inflation

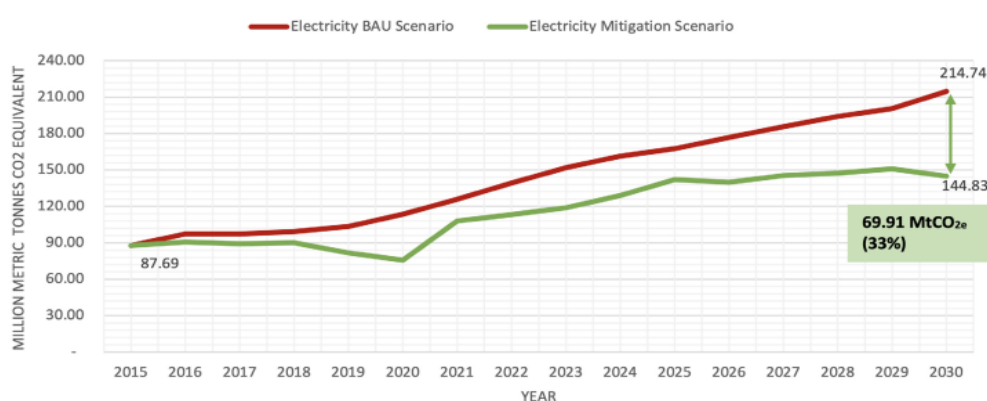
Source: Hannah Ritchie *et al* (2020) and Our World in Data website: <https://ourworldindata.org/>

Egypt's Updated NDC and GHG Emission Targets: Egypt's 2022 updated NDC provides a roadmap for reducing the country's carbon and GHG emissions by 2030. It sets more ambitious targets for reducing greenhouse gas (GHG) emissions. To achieve these targets, the country has developed mitigation and adaptation measures across various sectors, including energy, transport, industry, forestry, agriculture, and waste. The updated NDC includes several strategies that will be implemented to achieve Egypt's 2030 targets. In the following, we will present the

targets in the three major sectors that are generating the majority of GHG emissions in Egypt: electricity generation, oil and gas, and transport sectors.

As regards electricity production (including transmission and distribution), the updated NDC indicates that Egypt commits to reducing GHG emissions in this sector by 33% by 2030 relative to BAU (that is, 2015). This can be shown in Figure 12 below. This can be achieved primarily by investing in renewable energy sources and transition to low carbon pathway in the electricity sector. In this regard, Egypt plans to increase the use of clean energy sources to 42% of the total energy mix by 2035.

Figure(12): Egypt GHG Emissions in Electricity Sector: BAU Vs. Mitigation Scenario

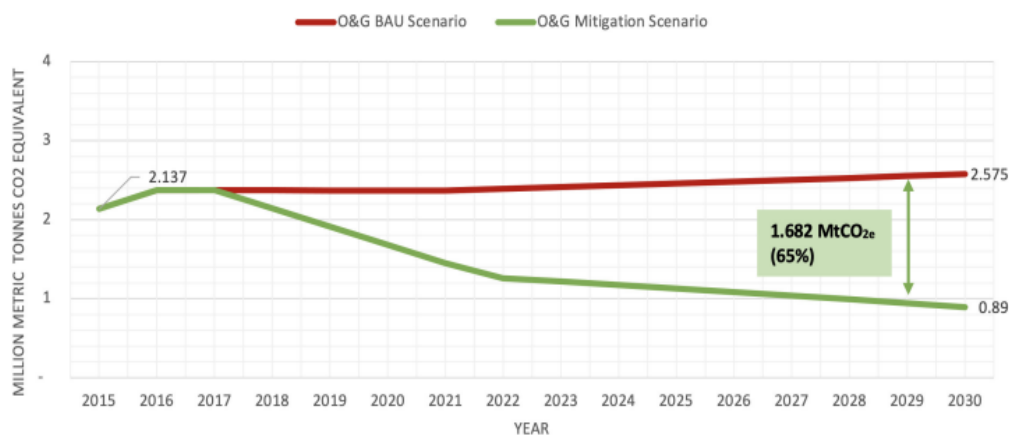


Source: Egypt’s updated NDC (2022)

With regard to the oil and gas sector, Figure 13 below indicates that Egypt is committing to reducing its GHG emissions in this sector by 65% by 2030 relative to BAU (that is, 2015). This can be achieved by implementing an integrated transformative program to modernize the oil and gas sector. More specifically, the transformative program includes the adoption of energy

efficiency and low carbon technologies in the upstream and downstream activities, primarily through capturing of associated gas and other gas flaring projects.

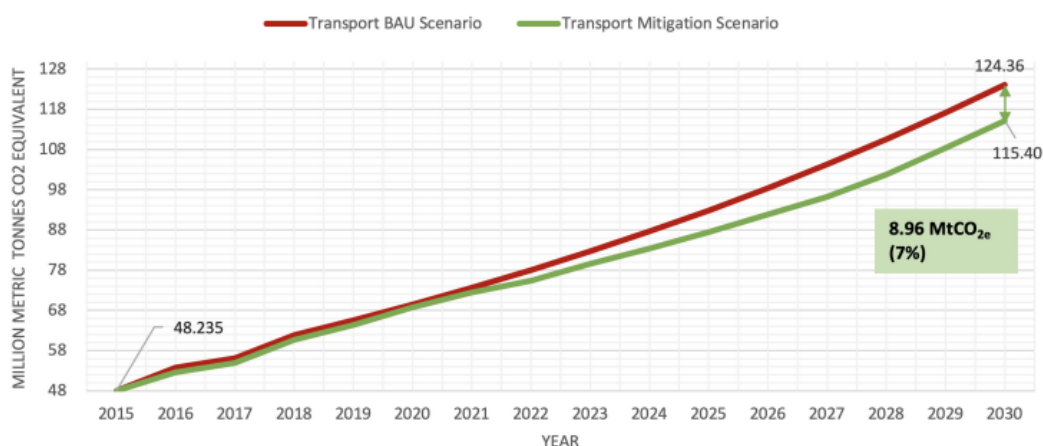
Figure (13): Egypt GHG Emissions in Oil & Gas Sector: BAU Vs. Mitigation Scenario



Source: Egypt's updated NDC (2022)

The transportation sector is another significant contributor to carbon emissions, accounting for almost 32% of Egypt's emissions. Figure 14 below shows that Egypt is also committing to reducing its GHG emissions in the transport sector by 65% by 2030 relative to BAU. Since road transport is the largest GHGs contributor in the transport sector in Egypt, achieving this target will require increasing the use of public transport, promoting sustainable transport options, and encouraging the use of electric and hybrid vehicles. Egypt also plans to increase the use of biofuels and natural gas in the transportation sector, among other measures.

Figure(14): Egypt GHG Emissions in Transport Sector:BAU Vs. Mitigation Scenario



Source: Egypt's updated NDC (2022)

Egypt and the Green Economy: Benefits The pursuit of a green economy path and the decoupling of GHG emissions from economic growth has numerous benefits that could improve the quality of life in Egypt. Some of these benefits include the following:

- **Health improvement:** Reducing air pollution from fossil fuels results in a healthier population. Fossil fuel combustion releases pollutants such as particulate matter and nitrogen oxide, which have been linked to respiratory diseases. Thus, the reduction in the use of fossil fuel leads ultimately to improved air quality and subsequently, improved health conditions of the population.
- **Economic benefits:** The deployment of renewable energy and energy-efficient measures presents opportunities for innovation and new industries. This will, in turn, create employment opportunities, and promote economic growth in the long term. Also, the improvement in the health of the population entails several economic benefits.

- **Environmental protection:** With decoupling of economic growth and GHG emissions, Egypt will be on a path towards sustainable development. The protection of natural resources and the adoption of renewable energy sources will minimize the country's environmental impact and footprint.
- **Climate resilience:** Development projects that enhance climate resilience and adaptation will mitigate the potential risks and impacts of climate change on the country's economy.

Egypt and the Green Economy: Challenges: While Egypt has made progress in decoupling GDP growth from carbon emissions, the pace of decoupling has, nonetheless, been slow. This is essentially due to the presence of several challenges that need to be addressed to accelerate the transition towards a green economy in Egypt. These challenges include:

- **Limited financial resources and access to finance:** Financing remains a significant barrier to the development and deployment of renewable energy projects in Egypt. The government has limited financial resources to invest in renewable energy and energy efficiency projects. That is, high upfront costs and perceived risks associated with renewable energy investments have limited the availability of funds from domestic and international sources (AfDB, 2020). Insufficient funding and limited resources hinder the implementation of green growth policies by placing limits on the scale and speed of the transition (El-Abbadi *et al.*, 2020).
- **Regulatory and institutional barriers:** Egypt's regulatory and institutional framework for renewable energy development is still evolving. Inefficient and complex bureaucracy and a lack of coordination among different government agencies have hindered the implementation and effectiveness of policies and initiatives, and the growth of the renewable energy sector

(AfDB, 2020). Furthermore, inadequate legal frameworks and enforcement mechanisms have resulted in weak regulation of polluting industries (El-Abbadi *et al.*, 2020).

- **Technological constraints:** Egypt faces technological constraints in adopting and integrating renewable energy sources into its energy mix. For instance, the country's grid infrastructure needs significant upgrades to accommodate the increased penetration of intermittent renewable energy sources, such as solar and wind (IRENA, 2021). There is also a shortage of technical expertise in the renewable energy and energy efficiency sectors. This limits the implementation of projects and the development of the industry.
- **Investment constraints:** One of the main challenges facing Egypt in its transition to a green economy is improving its renewable energy infrastructure. Currently, the country relies heavily on fossil fuels, particularly natural gas, for its electricity production. Although the government has set a target of generating 42% of its electricity from renewable sources by 2035, progress has been slow due to various factors, including a lack of investment and outdated regulations (IEA, 2021). Nonetheless, continued investment in renewable energy and a shift towards more sustainable consumption patterns could help Egypt reduce its dependence on fossil fuels and decrease greenhouse gas emissions.
- **High carbon footprint:** Another challenge Egypt faces is reducing its carbon footprint from transportation. The country's transportation sector is a significant emitter of carbon dioxide, particularly due to the large number of private vehicles on the road (UNDP, 2020). Encouraging the use of public transportation, promoting the development of electric and hybrid vehicles, and investing in cleaner fuels are some of the measures Egypt could take to promote sustainable transportation and reduce carbon emissions.

In addition to the aforementioned challenges, decoupling GDP growth from carbon emissions is also a significant obstacle for Egypt. The country's focus on economic development has resulted in a rapid increase in carbon emissions, with GDP growth and emissions closely linked (UNDP, 2020). However, as the government seeks to transition to a green economy, decoupling GDP growth from carbon emissions will be necessary to ensure sustainable development.

Despite the challenges, the Egyptian government is committed to adopting a green economy. The government believes that a green economy is essential for Egypt's long-term economic and environmental sustainability. The government is confident that the efforts that it is making will help to reduce Egypt's carbon emissions and promote sustainable development.

Egypt and the Green Economy: Moving Forward: The analysis presented in this paper has demonstrated that Egypt has been able to make some strides to pursue a green economy path by decoupling carbon emissions and GDP growth. Despite the progress achieved to-date, more work is needed nonetheless to achieve Egypt's green economy goals. To this end, the following measures and strategies for decoupling GDP and carbon emissions are recommended as means of expediting and strengthening the impact of Egypt's transition to a green economy:

- **Strengthening the regulatory framework:** The Egyptian government should implement more stringent regulations and standards for industries with high emissions, such as cement and steel production (El-Din, 2017). The government can streamline regulations for renewable energy systems, making it easier and faster for businesses and individuals to install and operate renewable energy systems. This can reduce the barriers to entry for renewable energy and encourage more people to adopt it.

- **Improving energy efficiency:** Energy efficiency is the practice of using less energy to accomplish the same task. This is achieved by implementing energy-efficient technologies, processes, and practices that require less energy to produce goods and services. In the context of reducing carbon emissions in Egypt, improving energy efficiency in industries and buildings is a crucial strategy. Improving energy efficiency not only reduces carbon emissions but also results in cost savings for businesses and individuals. By reducing the demand for energy, energy-efficient practices can reduce the need for new energy infrastructure, which can save money and reduce the environmental impact of energy production.

Overall, improving energy efficiency is a crucial strategy for decoupling GDP growth from carbon emissions in Egypt. Improving energy efficiency can have significant results in the following two sectors:

- a. **Industries:** improving energy efficiency in industries is a crucial strategy to reduce carbon emissions while maintaining economic growth. This can be achieved through the use of energy-efficient technologies such as high-efficiency motors, boilers, and lighting. Energy management systems can also be implemented, which optimize energy use by monitoring and controlling energy consumption. These systems can identify areas where energy is being wasted and suggest ways to reduce energy consumption. The adoption of renewable energy sources such as solar and wind can also improve energy efficiency in industries. The government can provide incentives for companies that adopt such practices, and regulations can be put in place to encourage energy efficiency.
- b. **Buildings:**improving energy efficiency in buildings can be achieved through the use of insulation, energy-efficient lighting, and heating and cooling systems. Energy-efficient

windows and doors can also reduce energy consumption by minimizing heat loss and gain. Smart building systems can optimize energy use by automatically adjusting heating, cooling, and lighting based on occupancy and weather conditions.

As for encouraging more energy efficiency practices, the government should promote energy efficiency in both the residential and industrial sectors through incentives, awareness campaigns, and capacity-building programs (IEA, 2020). The Egyptian government can play a crucial role in improving energy efficiency by providing incentives for companies that adopt energy-efficient practices and regulations that require companies to improve energy efficiency. The government can also fund research and development of energy-efficient technologies and provide education and training programs for businesses and individuals to promote energy-efficient practices.

- **Promoting renewable energy:** Promoting renewable energy is a crucial strategy for decoupling Egypt's GDP growth from carbon emissions. Renewable energy sources such as solar, wind, and hydropower are clean and sustainable sources of energy that can significantly reduce carbon emissions while maintaining economic growth. In this regard, engaging the private sector in green projects by facilitating their involvement will be crucial to achieving Egypt's green economy goals. The government should create an enabling environment for private investment in renewable energy and other green sectors (UNCTAD, 2020).

Egypt has significant potential for renewable energy sources such as solar and wind. The government can promote the use of renewable energy by providing subsidies, tax incentives, and other benefits to companies that adopt renewable energy sources. This will not only reduce

carbon emissions but also create new job opportunities and stimulate economic growth. The following provide the important ways that renewable energy can be promoted in Egypt:

- a. Providing incentives: the government can provide incentives for companies and individuals that adopt renewable energy sources. These incentives can include tax credits, grants, and subsidies for the installation of renewable energy systems. This can encourage more businesses and individuals to invest in renewable energy and reduce their reliance on fossil fuels. To this end, the Government needs to create an enabling environment for businesses to invest in renewable energy and green technologies more generally.
- b. Promoting research and development: the government needs to invest more in research and development to fund research and development of renewable energy technologies. This can help to improve the efficiency and cost-effectiveness of renewable energy systems, making them more competitive with traditional energy sources. This can also create new job opportunities in the renewable energy industry.
- c. Developing infrastructure: developing infrastructure for renewable energy can make it more accessible to businesses and individuals. This can include building new solar and wind farms, installing charging stations for electric vehicles, and improving the grid to accommodate renewable energy sources.
- d. Streamlining regulations: the government can streamline regulations for renewable energy systems, making it easier and faster for businesses and individuals to install and operate renewable energy systems. This can reduce the barriers to entry for renewable energy and encourage more people to adopt it.

e. Providing education and awareness: the government can provide education and awareness programs that focus on the benefits of renewable energy and how to adopt it. This can include workshops, training programs, and campaigns that promote renewable energy and sustainable practices.

Promoting renewable energy in Egypt not only reduces carbon emissions but also creates new job opportunities and stimulates economic growth. Egypt has significant potential for renewable energy sources such as solar and wind, and with the right incentives, infrastructure, and regulations, it can become a leader in the renewable energy industry.

- **Enhancing sustainable transport:** Expanding public transportation by developing a comprehensive, low-emission public transportation system will help reduce traffic congestion and carbon emissions (EIB, 2021).

The transportation sector is a significant contributor to carbon emissions in Egypt. Promoting sustainable transport, such as electric vehicles, public transportation, and non-motorized transport, can significantly reduce carbon emissions. The government can invest in infrastructure for sustainable transport, such as charging stations for electric vehicles and bicycle lanes.

Promoting sustainable transport is a crucial strategy for decoupling Egypt's GDP growth from carbon emissions. The transportation sector is a significant contributor to carbon emissions in Egypt, and promoting sustainable transport can help to reduce carbon emissions while maintaining economic growth. Sustainable transport can be promoted in Egypt by adopting some of the following measures:

- a. Encouraging the use of public transportation, such as buses and trains, can significantly reduce carbon emissions. The government can invest in infrastructure for public transportation, such as building new bus and train stations and improving the quality and frequency of service. The government can also provide incentives for businesses and individuals that use public transportation, such as tax credits and subsidies.
- b. Promoting non-motorized transport, such as walking and cycling, can also significantly reduce carbon emissions. The government can invest in infrastructure for non-motorized transport, such as building new bicycle lanes and pedestrian paths. The government can also provide incentives for businesses and individuals that use non-motorized transport, such as tax credits and subsidies.
- c. Promoting electric vehicles given that they are a clean and sustainable mode of transport that can significantly reduce carbon emissions. The Egyptian government has already granted an exemption on custom duties for new imported electric vehicles. However, they can expand this by providing incentives for businesses and individuals that adopt electric vehicles, such as tax credits and subsidies. The government can also invest in infrastructure for electric vehicles, such as building new charging stations.
- d. Encouraging carpooling, where multiple people share a car to travel to work or school, can significantly reduce carbon emissions. The government can provide incentives for businesses and individuals that carpool, such as tax credits and subsidies. The government can also invest in infrastructure for carpooling, such as building new carpool lanes.
- e. Improving the fuel efficiency of vehicles can also significantly reduce carbon emissions. The government can implement regulations that require vehicles to meet minimum fuel efficiency

standards. The government can also provide incentives for businesses and individuals that adopt fuel-efficient vehicles, such as tax credits and subsidies.

Promoting sustainable transport not only reduces carbon emissions but also creates new job opportunities and stimulates economic growth. By investing in sustainable transport infrastructure and providing incentives for businesses and individuals to adopt sustainable transport practices, Egypt can become a leader in sustainable transport and contribute to global efforts to combat climate change.

- **Introducing carbon pricing:** Implementing a carbon pricing mechanism, such as a carbon tax or cap-and-trade system, can incentivize companies to reduce their carbon emissions. This mechanism will create a financial incentive for companies to adopt sustainable practices and reduce their carbon emissions. The revenue generated from the carbon pricing mechanism can be used to fund research and development of sustainable technologies. In 2022, the Egyptian Financial Regulatory Authority (FRA) proposed to make changes to the Capital Market Law No. 95 of 1992 establishing a legal framework for carbon trading (Salah, 2022a). Subsequently, this will enable firms and organizations engaged in emission reduction activities, to obtain Certified Emissions Reduction (CER) credits.
- **Waste management practices:** Proper waste management practices can significantly reduce carbon emissions. The government can promote waste reduction, reuse, and recycling programs to reduce the amount of waste that ends up in landfills. Waste-to-energy programs can also be implemented, which can generate energy from waste while reducing carbon emissions.

- **Promoting sustainable agriculture:** The agriculture sector is a significant contributor to carbon emissions in Egypt. Promoting sustainable agriculture practices such as organic farming, using eco-friendly fertilizers and pesticides, and reducing food waste can significantly reduce carbon emissions in this sector. The government can provide incentives for farmers that adopt sustainable practices and promote sustainable agriculture policies.
- **Strengthening education and awareness:** Education and awareness programs can play a crucial role in reducing carbon emissions. The government can promote education and awareness programs that focus on the importance of reducing carbon emissions and the benefits of sustainable practices. This can include campaigns, workshops, and training programs for businesses and individuals.
- **Enhancing international cooperation:** International cooperation can also play a significant role in decoupling GDP and carbon emissions in Egypt. The government can collaborate with international organizations, such as the United Nations and the World Bank, to access funding, expertise, and technology for implementing sustainable development strategies. Egypt can also learn from other countries that have successfully decoupled their GDP growth from carbon emissions and implement similar strategies.

SUMMARY AND CONCLUDING REMARKS

This paper examined Egypt's pursuit of green economy goals in light of global efforts to reduce carbon emissions and promote sustainable development. The paper reviewed Egypt's strategies, policy framework, and investment initiatives, which aim to decouple carbon emissions and GDP growth. In this regard, Egypt has made significant efforts to achieve its green

economy goals and decouple carbon emissions from GDP growth. The country has implemented various policies and initiatives, such as increasing the use of renewable energy sources, promoting sustainable agriculture, and improving waste management practices. Furthermore, Egypt has enhanced its international cooperation and participation in climate agreements, indicating its commitment to global efforts to combat climate change. Despite these efforts, Egypt still faces several challenges in transforming its economy into a green one, such as limited financial and technical resources, and institutional weaknesses.

However, the paper finds that Egypt's green economy agenda does hold significant potential for enhancing its economic competitiveness, reducing its reliance on fossil fuels, and improving its environmental outcomes. To achieve these goals, the study recommends that Egypt adopt a complementary strategy that integrates climate action into its broader development objectives. This approach would require concerted efforts from various stakeholders, including the government, private sector, and civil society. To this end, Egypt needs to continue implementing sustainable policies and innovative solutions to reduce its carbon footprint while promoting economic growth. Moreover, there is a need to enhance public awareness and strengthen international cooperation to mobilize financial resources and investments for sustainable development. Overall, Egypt's efforts towards a green economy and decoupling carbon emissions from GDP growth are commendable steps towards achieving sustainable development goals. While the road ahead may be challenging, it is also an opportunity for Egypt to position itself as a regional leader in the green economy movement and contribute to the global efforts to combat climate change.

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نمو اقتصاد أخضر في مصر: الفصل بين النمو الاقتصادي وانبعاثات الكربون

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المستخلص

واجهت مصر، كدولة نامية، تحديات كبيرة في معالجة آثار تغير المناخ وضمان التنمية المستدامة. علاوة على ذلك، تواجه الدولة التحدي المتمثل في الحد من انبعاثات الكربون مع تنمية اقتصادها في نفس الوقت. لمواجهة هذا التحدي، بدأت الحكومة المصرية مؤخرًا سياسات تهدف إلى التحول نحو الاقتصاد الأخضر. تهدف هذه الورقة إلى استكشاف جهود مصر للانتقال نحو الاقتصاد الأخضر بشكل أساسي من خلال فصل نمو الناتج المحلي الإجمالي عن انبعاثات الكربون، وتسهيل الضوء على التقدم المحرز حتى الآن والتحديات المقبلة. تقدم الورقة نظرة عامة على مختلف مبادرات السياسات، واستراتيجيات الاستثمار، والتطورات التكنولوجية التي استخدمتها مصر للحد من انبعاثات الكربون وتعزيز التنمية المستدامة. توصي الورقة بأن تتبنى مصر استراتيجية تكاملية تدمج العمل المناخي في أهدافها الإنمائية الأوسع، الأمر الذي يتطلب جهودًا متضافرة من مختلف أصحاب المصلحة. علاوة على ذلك، تحتاج مصر إلى مواصلة تنفيذ سياسات مستدامة وحلول مبتكرة لتقليل انبعاثات الكربون مع تعزيز النمو الاقتصادي.

الكلمات المفتاحية: اقتصاد مصر الأخضر ، الفصل ، كثافة الطاقة ، كفاءة الطاقة ، الطاقة المتجددة