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The Relationship between Energy Production and Consumption with Greenhouse Gas Emissions (Case study: Arab countries of OPEC in the Persian Gulf region (the UAE, Iraq, Saudi Arabia, Kuwait, and Qatar))

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Abstract

The Middle East region accounts for the largest quota of the world's energy reserves, which is the reason for the interdependence between the world's largest industrial countries and the governments of this region. Given the known oil reserves of the Arab countries in the Persian Gulf region, the effect of energy consumption with a sample of five Arab countries as members of OPEC and oil producers of the Persian Gulf region on greenhouse gas emissions during 40 years (1980-2020) was investigated in this research. The energy production and consumption and greenhouse gas emissions of the target countries were studied to identify their contribution to energy production and consumption in the world. It was determined that these countries account for a significant share of climate change and global greenhouse gas emissions. The results show that approximately 34% of the global oil reserves and 22% of carbon dioxide (CO2) production belong to the five Arab countries in the Persian Gulf region. The largest and the lowest shares in CO2 production belong to Saudi Arabia and Kuwait among the five countries of the Persian Gulf region.

Keywords: energy, Persian Gulf, greenhouse gases, OPEC, Arab countries.

Introduction

Energy production requires the supplying resources. The use of energy resources is associated with consequences, in addition to its advantages, and this is the reason for paying more attention to the effects of these two on each other and their surroundings (Dong et al., 2018). The Persian Gulf region is always in the attention of the world countries because of the global center of energy suppliers (Kavoosi, 2021).

This area has been the focus of major international disputes in recent decades and years, and this type of energy supply resources has consequences on the surrounding environment, the emission of various greenhouse gases is a major

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problem of fossil fuels. This pollution affects people's lives around the world so that about 80% of the global carbon dioxide (CO2) depends on the production and use of fossil fuels (Shahsavari & Akbari, 2018).

In addition, the position and role of countries possessing energy production resources in energy consumption and their contribution to the production of toxic gases on the planet are of considerable importance (Martin & Meyer Steinberg, 2019). Therefore, the Arab countries of OPEC in the Persian Gulf region were selected for the present research.

Objectives

This article pursues the following goals during the study process:

• Understanding the relationship between energy production and consumption

• Investigating the relationship between production and emission of greenhouse gases

• Examining the relationship between energy consumption and greenhouse gas emissions

Method and Materials

The present research is a descriptive-analytical and applied study in the methodology and targeting, respectively, using library and documentary methods for data collection.

This descriptive research uses the data analysis method, in which the literature review, problem definition, dimensions, and indicators related to the research subject are introduced after hypothesis development. Then, the required data are collected and the research findings are analyzed with software through library resources and using statistics and information from reliable sites.

Global energy production and consumption

The world energy intensity index in 2018 was 0.17/tons of crude oil equivalent per thousand US dollars based on fixed prices in 2015. Among the different regions of the world, the lowest energy intensity belonged to North America, Europe, Eurasia, and Central and South America with 0.12, 0.13, and 0.15/tons, respectively, of crude oil equivalent per thousand US dollars. The highest energy intensity belonged to Africa, the Middle East, and Asia-Pacific with respectively 0.33, 0.31, and 0.21/tons of crude oil equivalent per thousand US dollars. In the world energy balance of 2018, the total supply of primary energy and the total final consumption of the world increased by 2.38% and 2.28%, respectively, and reached 14281.9 and 9937.7 million tons of crude oil equivalent compared to the previous year (Kavoosi, 2019) (Figure 1) shows the relationship between energy production and consumption in the world from 1980 to 2020, indicating an increase in global energy production and consumption.

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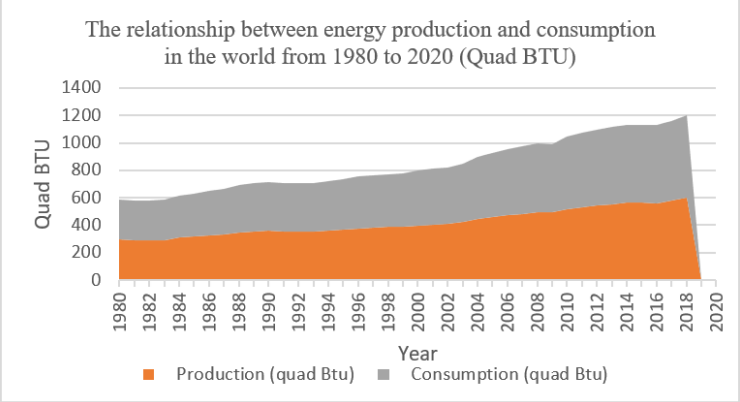

Figure 1. The relationship between energy production and consumption in the world from 1980 to 2020 drawn by the author using the source BP Statistical [2016]

Table (1) represents the consumption trend of fossil fuel resources based on the oil, gas, and coal sources in the world since 1965 and the forecast for using these fuels until 2030.

Table 1. Global consumption trends of fossil fuels based on sources, including the share of oil, gas, and coal drawn by the author using the source BP Statistical [2016]

Year	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
Oil (BTU)	65	95.7	115.1	129.9	125.7	141.1	148	162.9	169.4	181.1	194.4	206.1	216.9	229.3
Gas (BTU)	23.1	35.2	42.3	51.6	59.1	70.4	76.7	87.82	107.4	120.3	134.4	146.9	155.8	164.7
Coal (BTU)	55.6	58.7	62.1	71.8	82.3	88.9	89.1	94.4	122.5	140.2	146.9	171.7	164.7	202.2

OPEC and its members

The Organization of Petroleum Exporting Countries (OPEC) was established in September 1960 by signing an agreement in Baghdad by five countries, Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela. Other countries, namely Qatar (1961), Indonesia (1962), Libya (1962), United Arab Emirates (1967), Algeria (1969), Nigeria (1971), Ecuador (1973), Gabon (1975), and Angola (2007) joined OPEC after its establishment by the founders (Alamdari et al., 2013).

The goal of OPEC

OPEC mainly aims to coordinate and integrate the oil policies of the member

countries and determine the best strategy to secure their collective or individual interests to ensure the stability of oil prices in the international oil market.

Arab countries of OPEC in the Persian Gulf region

These countries include the UAE, Iraq, Arabia, Kuwait, and Qatar. OPEC member countries possess nearly two-thirds of the global oil reserves. The Arab countries of OPEC in the Persian Gulf region are examined in the following.

The oil reserves of the Arab OPEC member countries of the Persian Gulf region compared to global reserves

(Table 2) lists the oil reserves of the Arab OPEC member countries of the Persian Gulf region compared to the global reserve based on oil reserves. The largest and the lowest oil reserves respectively belong to Saudi Arabia and Qatar among other countries.

Table 2. The share of oil reserves of the Arab OPEC member countries in the Persian Gulf region relative to the global reserve (https://wisevoter.com, 2023)

Row	Country	Oil reserves
1	United Arab Emirates	97,800 MMbbl
2	Iraq	145,000 MMbbl
3	Saudi Arabia	297,500 MMbbl
4	Kuwait	101,500 MMbbl
5	Qatar	25,200 MMbbl
6	World	1/977/000 MMbbl

Positive and negative effects of oil

The positive effects of oil and the resulting resources refer to cases such as increasing jobs, payments to workers, tax revenues, more service provision, and providing new economic opportunities for local businesses and resource owners in areas with oil and gas reserves (Measham & FIeming, 2014).

The negative effects of the development of energy resources point out the environment in resource-rich countries. According to this viewpoint, extraction, production, and consumption of oil resources cause the waste of resources and environmental destruction of the regions (Kais & Sami, 2016).

The relationship between energy production and consumption in a 40-year period (1980-2020) for the studied countries

The UAE

(Figure 2) shows the relationship between energy production and consumption in the UAE for a 40-year period (1980-2020), indicating a significant increase in production compared to consumption.

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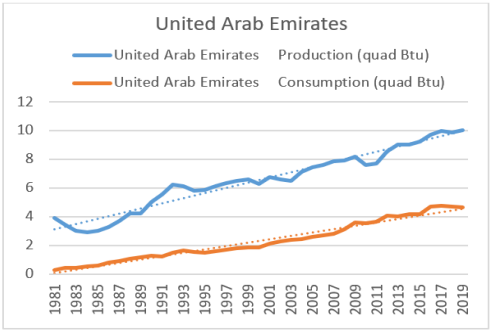

Figure 2. The relationship between energy production and consumption in the UAE from 1980 to 2020, drawn by the author using the source BP Statistics [2020]

The comparison of the energy production and consumption graph in the UAE suggests an increase in production with fluctuations, especially from 2011 to 2013 compared to other years. Energy production and consumption show a significant increasing trend in the studied period.

Iraq

In (Figure 3), the comparison of the energy production and consumption graph in Iraq reveals considerable fluctuations in production, especially from 1991 to 1997 and 2003 compared to other years. Energy consumption has a significant increasing trend in the studied period, and the production chart with this trend shows that the production is not proportional to consumption in Iraq, which is currently an energy importer.

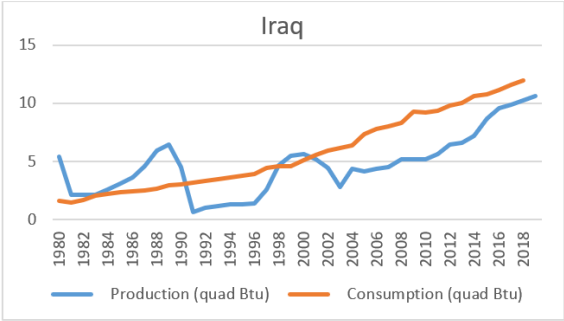

Figure 3. The relationship between energy production and consumption in Iraq from 1980 to 2020 drawn by the author using the source BP Statistical [2020]

Iraq is the second largest producer of oil, but a large fraction of Iraq's gas resources cannot be exploitable, and the country needs to import gas to use its generators.

Saudi Arabia

Saudi Arabia is known as the largest producer of crude oil in OPEC and the second largest producer of petroleum liquids in the world after the United States. (Figure 4) shows the comparison of the relationship between energy production and

consumption in Saudi Arabia for a 40-year period (1980-2020). The high production versus the consumption rate suggests the high volume of oil exports from this country

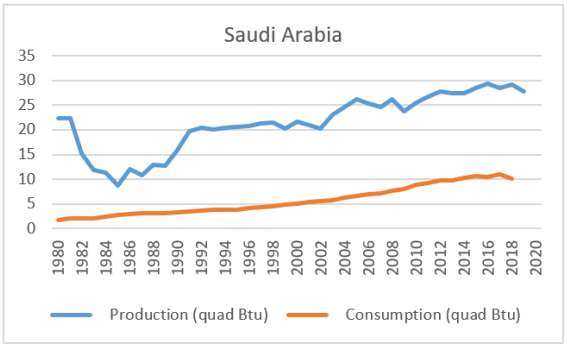

Figure 4. The relationship between energy production and consumption in Saudi Arabia from 1980 to 2020 drawn by the author using the source BP Statistical [2020]

The comparison of the energy production and consumption graph in Saudi Arabia shows an increase in the production trend with fluctuations, especially from 1982 to 1986 compared to other years. Energy consumption shows an increasing trend in the studied period. With this production rate, the increasing trend, and the reduction rate of reserve resources, Saudi Arabia will turn from an energy exporter into an energy importer in the future.

Qatar

(Figure 5) depicts the relationship between energy production and consumption in Qatar for a 40-year period (1980-2020), showing a significant increase in production relative to consumption, especially in the last decade.

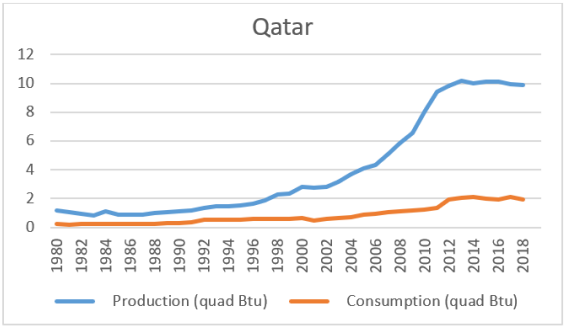

Figure 5. The relationship between energy production and consumption in Qatar from 1980 to 2020 drawn by the author using the source BP Statistical [2020]

A comparison of the energy production and consumption graph in Qatar shows considerable fluctuations in production compared to consumption. Production fluctuations in Qatar have a very sharp slope from 2000 onwards until 2004. In this studied period, energy consumption has an increasing trend and the production graph is not proportional to the consumption with this trend.

Kuwait

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(Figure 6) shows the relationship between energy production and consumption in Kuwait for a 40-year period (1980-2020), indicating a lower consumption rate than the production rate.

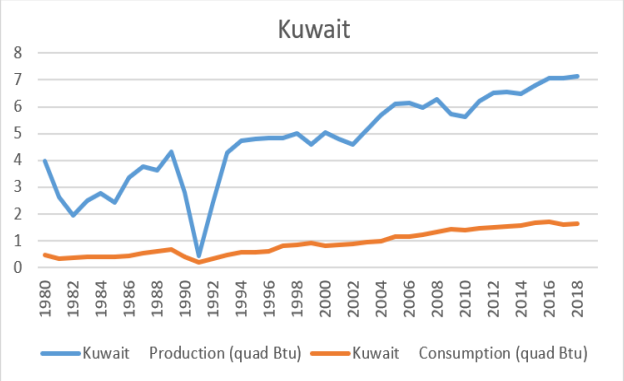

Figure 6. The relationship between energy production and consumption in Kuwait from 1980 to 2020 drawn by the author using the source BP Statistical [2020]

A comparison of the energy production and consumption graph in Kuwait shows considerable fluctuations in the reduced production, especially from 1990 to 1992 (Iraq and Kuwait war) compared to other years. In the studied period, energy consumption has an increasing trend, and the production graph has two completely different slopes and speeds compared to the consumption graph. With this trend, Kuwait is also a major exporter of energy, and this increasing trend and the reduction rate of reserves will turn Kuwait from an energy exporter into an importer of non-renewable energy in the future.

Climate changes and greenhouse gas emissions

The increase in global demand for energy from fossil fuels, such as oil and gas, plays a major role in increasing the emission of greenhouse gases, such as CO2, and the resulting air pollution. A major reason for this increase in demand is the huge growth of the world population, technological advancements, and related problems such as poverty and environmental problems caused by greenhouse gas emissions (Shahsavari & Akbari, 2018).

In the initial stages of economic growth, which is accompanied by the expansion of economic activities, environmental pollution increases and continues until the maximum point. After that, pollution decreases by improving the efficiency of economic activities, using standard technology, and imposing restrictive laws and regulations (Dong et al., 2018).

In 2019, a climate change alert signed by 11,000 scientists in more than 150 countries suggests that economic growth drives "the over-extraction of materials and over-exploitation of ecosystems" and that this "should be reduced rapidly until the long-term sustainability of the biosphere. They add that "our goals require a shift from growing GDP and pursuing wealth to

ecosystem preservation and human well-being improvement by the prioritization of basic needs and reduction of inequality" (Vijayalakshmi, 2018).

Global production of CO2

The ecosystem is heavily polluted due to greenhouse gas emissions and various pollutants produced by burning fossil fuels, which are easily available and commonly used to meet the global energy demand (Khorasanizadeh et al., 2014).
The Paris Agreement was signed by more than 160 countries to prevent the increase in greenhouse gas emissions and the resulting increase in temperature. According to this agreement, the increase in the average global temperature should be limited to less than 2 °C compared to the pre-industrial level, and the global warming level should be limited to 1.5 °C (Dong et al., 2018).
With industrial development, population growth, development of urbanization, and demand-affected increase in gross production, greenhouse gases are redoubled in the world and cause an increase in the earth's environmental pollution. (Figure 7) shows the rate of CO2 emissions caused by fuel consumption in the world, which shows a steep upward trend in emission rates, despite the commitments and strict rules of international organizations.

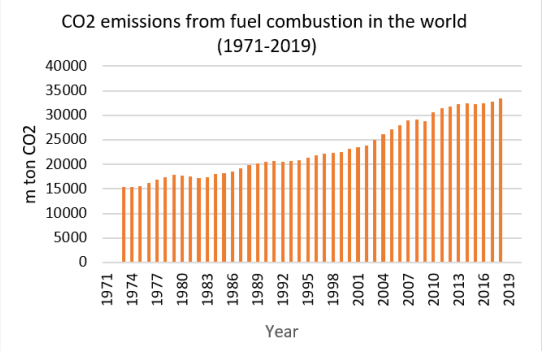

Figure 7. CO2 emissions caused by fossil fuel consumption in the world from 1971 to 2019, drawn by the author using the source IEA [2020]

Energy consumption and CO2 production
This entails the need to develop energy consumption and greenhouse gas production, which becomes more important given the contribution of non-renewable resources to energy supply. Accordingly, the relationship between energy consumption and greenhouse gas production in the Arab OPEC member countries of the Persian Gulf region is discussed in the following.

In recent years, issues such as sustainable development, environmental protection and greenhouse gas emission control have led many countries to pursue renewable energy development policies (Matzenberger, 2015).

Energy consumption and CO2 production in Iraq

Based on (Figure 8), energy consumption and CO2 production in Iraq during about 50

years (1971-2019) shows that the country's share has largely grown in gas production compared to energy consumption, which can be a serious threat to the health of society.

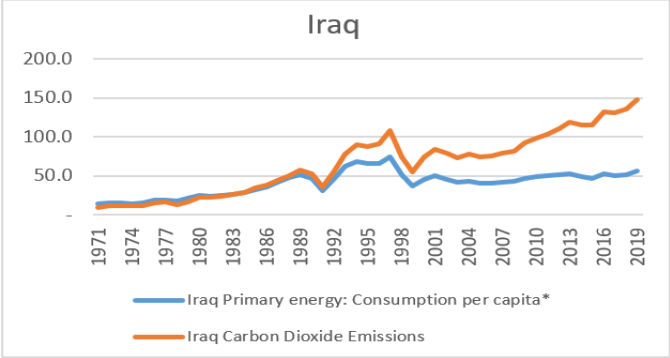

Figure 8. CO2 emissions caused by fossil fuel consumption in Iraq from 1971 to 2019, drawn by the author using the source IEA [2020]

Energy consumption and CO2 production in Kuwait

Based on (Figure 9), energy consumption and CO2 production in Kuwait during about 50 years (1971-2019) indicate a lower growth in the country's contribution to gas production than energy consumption.

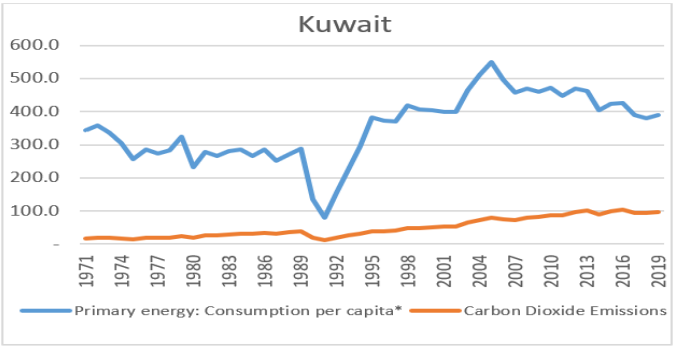

Figure 9. Energy consumption and CO2 production in Kuwait during about 50 years (1971-2019), drawn by the author using the source IEA [2020]

Energy consumption and CO2 production in Saudi Arabia

Based on (Figure 10), the energy consumption and CO2 production of Saudi Arabia during about 50 years (1971-2019) shows a lower growth of the country's share in gas production than energy consumption.

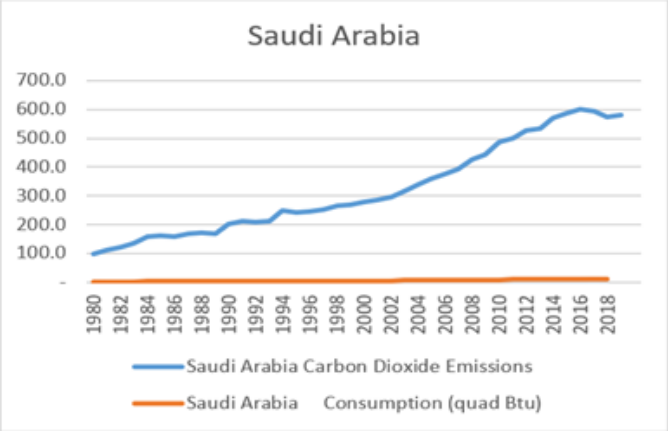

Figure 10. Energy consumption and CO2 production in Saudi Arabia during about 50 years (1971-2019) drawn by the author using the source IEA [2020]

Energy consumption and CO2 production in the UAE

As shown in (Figure 11), the energy consumption and CO2 production of the UAE during about 50 years (1971-2019) indicate a lower growth of the country's share in gas production than in energy consumption**.**

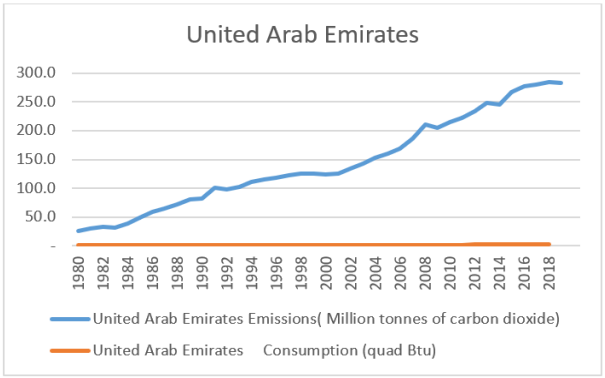

Figure 11. Energy consumption and CO2 production in the UAE during about 50 years (1971-2019). Drawn by the author using the source IEA [2020]

Energy consumption and CO2 production in Qatar

According to (Figure 12), the energy consumption and CO2 production of Qatar during about 50 years (1971-2019) shows that the share of this country is lower in gas production growth than in energy consumption.

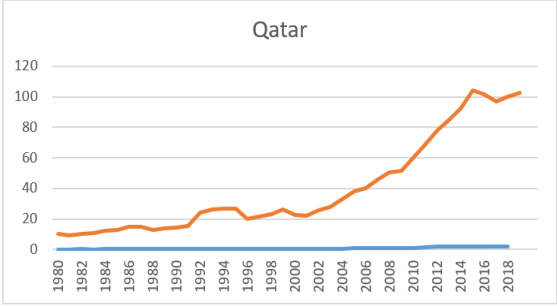

Figure 12. Energy consumption and CO2 production in Qatar during about 50 years (1971-2019). Drawn by the author using the source IEA [2020]

Primary energy consumption of Arab countries of OPEC in the Persian Gulf region

Figure (13) shows the primary energy supply graph of Arab OPEC member countries of the Persian Gulf region within about 50 years (1971-2019).

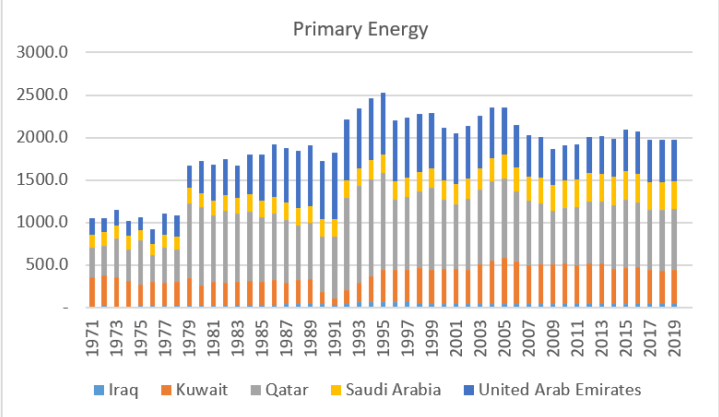

Figure 13. The primary energy supply graph of Arab countries of OPEC within about 50 years (1971-2019). Drawn by the author using the source IEA [2020]

CO2 production in Arab OPEC member countries of the Persian Gulf region

As shown in (Figure 14), CO2 production by the OPEC member countries of the Persian Gulf region within about 50 years (1971-2019) shows that the share of this country in gas production has a lower growth than energy consumption. The largest and the lowest shares in CO2 production belong to Saudi Arabia and Qatar, respectively.

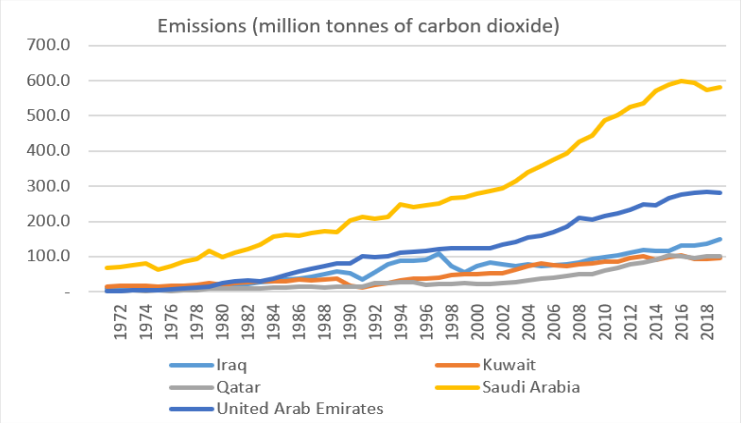

Figure 14. Comparison of CO2 production in Arab OPEC member countries of the Persian Gulf region within about 50 years (from 1971 to 2019). Drawn by the author using the source IEA [2020]

Anthropologist Eduardo S. Brundizio states: "We need to change our narratives". Both our individual narratives linking overconsumption with life quality and status, and narratives of economic systems that still consider environmental degradation and social inequality to be the inevitable outcomes of economic growth. Economic growth is a means and not a goal. We need to seek the quality of life on the planet (Steamers, 2017).

The International Atomic Energy Agency considers the carbon sequestration and storage mechanism an important part of global efforts to limit global warming by reducing greenhouse gas emissions. The agency estimates that CO2 emissions could be reduced to levels that would limit long-term global warming to below C × 2. This will be achieved through the widespread establishment of low-carbon technologies (Solaymani, 2021).

Among the 10 major global challenges in the next 50 years, the shortage and supply of energy are one of the most fundamental and foremost issues of the future, which has become of paramount importance due to exhaustible fossil energy sources in the future (Mirhabibi et al., 2015).

Conclusion

The Middle East and many of its countries are major oil and gas producers in the world, making the study of the issue of paramount importance, especially for the Arab countries of the Persian Gulf region. This research aimed to investigate the relationship between energy consumption and its future and the relationship between energy consumption and greenhouse gas production based on the data obtained on the energy production and consumption of five Arab OPEC member countries of the Persian Gulf region within about 40 years. These countries account for approximately 34% and 22% of the global oil reserves and CO2 production, respectively. The maximum and the minimum shares in CO2 production belong to Saudi Arabia and Kuwait among other countries. The UAE is the second largest consumer of oil and other hydrocarbon resources due to industrialization among Arab oil-exporting countries after Saudi Arabia. The research

findings using data and statistics from reliable sources demonstrate a significant relationship between energy production and consumption with greenhouse gas emissions, and greenhouse gases increase with increasing energy production and consumption. Additionally, the comparison of energy production and consumption in countries of the Persian Gulf region indicates a high export and energy waste compared to the other studied countries. This energy waste mostly in refineries, power plants, and transmission networks is not appropriate compared to international standards. The current energy waste process and the large volume of oil exports will turn the Arab countries of the Persian Gulf region from energy exporters into energy importers in the near future.

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