



*Reality and Future of Unconventional and Renewable Energy Sources in International Energy Markets**

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Introduction:

The conventional energy sources represents a great deal of safety in meeting international energy needs, but with natural depletion of reserves and increasing consumption on an ongoing basis as world population grows and many variables change, doubts are being raised about the adequacy of these sources to meet the world's energy needs at the time. In addition, the world has begun to pay attention to the phenomenon of climate change, which is caused by the polluting emissions of the environment resulting from the end use of conventional energy sources, as well as the concern for the pollution of the environment in general, and in light of the depletion of resources less Energy sources and their effects on the environment necessitated the search for other sources of energy for the purpose of ensuring the supply and continuity of supplies. Consequently, renewable sources of energy have emerged as inexhaustible and widely available sources on the planet, and the energy generated by them is clean energy. In the extraction of oil and natural gas from unconventional sources and in the light of their large proven and technically recoverable reserves, these sources have been exported with renewable sources in the international energy supply mixture to take an active role in the structure of the energy balance.

First: The importance of research

The importance of research is to know the extent of diversity and development in the production of energy sources, especially unconventional energy sources and renewable energy at the present time and the future.

Second: Problem of Research

Fossil energy sources have become dubious that they cannot continue to ensure international supply security "under international economic and population growth, as they are depleted energy sources, as well as the

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uncertain future of renewable energy sources," will lead to increased demand for fossil energy sources Which requires greater changes in the diversification of unconventional and renewable sources of energy to ensure the security of suppliment, so it is necessary to study unconventional and renewable energy sources and their role in the international energy market.

Third: Research Objective

The research aims to identify the reality and future of low energy and unconventional and renewable energy. As well as to identify the level of development and progress in energy sources, as well as to know the extent of the potential of unconventional energy and renewable in ensuring the continuity of securing the world's energy needs and its role in preserving the environment and achieve a sustainable balance.

Fourth: The hypothesis of research

The research is based on the hypothesis that unconventional and renewable energy sources will contribute to the diversification of the international energy mix as well as their ability to ensure supply security in the international energy market.

Structure of research:

The following topics were discussed:

First: International market for unconventional energy sources.

Second: International reserves of unconventional energy sources.

Third: The international market for renewable energy sources.

Fourth: Future outlook for energy sources: supply and demand.

First: The International market for unconventional energy sources

Talking about oil and natural gas from unconventional sources as an energy source has its importance in the balance of international energy is not historically a long-term historically, despite the production of oil and natural gas from unconventional sources in some countries of the world for many years, but the world did not pay attention to the importance of these sources with the exception he success of the United States in increasing the production of oil and natural gas from unconventional sources, especially rock oil and shale gas, even referred to this large and unexpected increase in the production of unconventional energy in the United States, which began at the end of 2005, and the Which has triggered the world energy market as the "unconventional energy revolution" or "rock energy revolution"⁽¹⁾. and that this revolution has made countries with reserves of oil and natural gas unconventional



reconsider their entry into the industry and work on the development of technologies for producing these sources have attracted world attention towards unconventional energy.

1- The reality of international developments in the production of unconventional oil

Oil production is concentrated in unconventional sources in a few countries. The United States is the first to produce large quantities of shale oil and Canada by producing sand oil. The production of heavy oil and oil shale is concentrated in Venezuela, Brazil, Colombia and Ecuador. The development of unconventional production techniques and their spread of other countries began producing unconventional oil, but are still in their early stages. In general, unconventional oil production is concentrated in non-OPEC countries. Non-OPEC oil produced in non-OPEC countries in 2000 About 0.9 million b While unconventional oil production in non-OPEC countries rose to 1.4 million barrels / day in 2005, and in OPEC countries it reached 0.2 million barrels / day for the same OPEC production of unconventional oil has grown to 0.8 million barrels / day in 2015, and has grown significantly in non-OPEC countries to 7.7 million barrels / day for the same year. We can say that international production of unconventional oil is undergoing a continuous growth stage. The production of the world of rock oil has only doubled sevenfold from 2010 to 2009 in the year 2015, rising from 0.8 million barrels / day in 2010 to 5.6 million barrels per day in 2015. Rock oil produced in the United States accounts for more than 80% of the world's oil production, as the production of the United States Of oil is 4.8 million barrels / day in 2015, and the production of the United States of rock oil has increased significantly to 5.7 million barrels / day in 2017, and the production of other unconventional oil continues to increase, The world production of sand oil (bituminous) has been from 1.6 million barrels / day in 2010 to 2.5 million barrels / day In 2015, sand-based oil produced in Canada accounted for more than 90% of the world's sand oil production. Table 1 shows the world's production of unconventional oil and its development for the period 2000-2016:

Table (1) Evolution in world production of unconventional oil for the period 2000-2016 million barrels /day

year	World oil production*	World production of non-conventional oil	Rate of nonconventional oil out of total oil produced in the world
2000	74.8	1.1	1.4%
2005	81.7	1.6	1.9%
2006	82.4	1.5	1.8%
2007	84.3	1.6	1.8%
2008	83.8	1.8	2.1%
2009	83.3	2.3	2.7%



2010	85.7	2.6	3.0%
2011	86.6	3.9	4.5%
2012	87.1	5.0	5.7%
2013	88.2	6.2	7.0%
2014	89.5	7.5	8.3%
2015	92.3	8.5	9.2%
2016	94.2	9.1	9.7%

Table is prepared by researcher based on the information contained in:

International Energy Agency, world energy outlook, 2006-2017

* International oil production includes conventional and unconventional oil.

** The percentages were calculated by the researcher according to the table data.

Table (1) appears that international production of unconventional oil has increased substantially for the period 2000-2016, reaching 9.1 million barrels / day in 2016, while it was 1.1 million barrels / day in 2000, unconventional oil out of the total oil produced in the world, if the world production of unconventional oil accounted for 1.4% of the total oil produced in the world, while in the form of 9.2% in 2015 and about 10% in 2016, due to this large growth in oil production Mainly due to the continuous increase in the production of these oils in the North American region, particularly the increase in production of the United States of America shale Oil , and which contributed to these developments for the growth of the production of unconventional oil is the entry of many countries outside OPEC to invest its unconventional sources to promote diversity in their economies.

2- Reality of international developments in unconventional gas production

The international production of unconventional natural gas is concentrated in North America, mainly in the United States, which is the engine of growth for the production of unconventional natural gas, especially rock gas, followed by Canada. Unconventional natural gas is produced outside North America and is very modest and concentrated in China which has the largest technically recoverable reserves of shale gas. According to the International Energy Agency (IEA), world production of unconventional natural gas in 2000 was about 169 billion cubic meters⁽²⁾. International production of unconventional natural gas Reached 460 billion cubic meters, equivalent to 14% of the world's natural gas production for 2010 (3284 billion cubic meters)⁽³⁾. With modern technologies and the great success of natural gas exploitation from its unconventional sources, the world production of unconventional natural gas The world's production of shale gas in 2013 reached about 331 billion cubic meters, and the kerosene gas about 232 billion cubic meters and methane gas has been applied about 67 billion cubic meters of coal and the production of 3 billion cubic meters of coal-to-gas conversion, Conventional to total world production of non-natural gas To 633 billion



cubic meters in 2013. Methane gas, according to current technologies, cannot produce an economically viable amount, but the IEA expects to play a significant role in international energy supply in the following years⁽⁴⁾. The year 2016 has seen significant growth in the production of unconventional natural gas, as illustrated in the following table:

Table (2) Evolution of international production of unconventional natural gas for the period 2000-2016 billion cubic meters

years	Global production of natural gas *	Global production of non-conventional natural gas	Rate of non-conventional natural gas out of total gas production in the world
2000	2506	169	7%
2010	3284	460	14%
2013	3513	633	18%
2016	3621	780	21.5%

Table is prepared by researcher based on the information contained in:

International Energy Agency, world energy outlook, 2012, p136

International Energy Agency, world energy outlook, 2015, p206, p233

International Energy Agency, world energy outlook, 2017, p346

* International production of natural gas includes conventional and unconventional.

* Percentages were calculated by the researcher according to the table data.

Table (2) shows that international production of unconventional natural gas has grown significantly over the period 2000-2016, reached 780 billion cubic meters in 2016, equivalent to 21.5% of the total world natural gas produced in the year 3621 Billion cubic meters, while it was 169 billion cubic meters in 2000, equivalent to 7% of the total natural gas produced in the world for the same year of 2506, and that this significant development in the production of natural gas is unconventional due to the large increase in extraction in America And to the United States production of shale gas.

In general, the production of oil and natural gas from their sources of unconventional is increasing in most countries that have these resources in its territory, and that this increase is significant effects, which reflected positively on the leading countries in the exploitation of these sources, the development of ways to exploit these energies of Which will enhance the security of their supplies and provide them with a measure of safety in achieving energy security. It will also reduce or reduce economic dependency (dependency of energy-consuming countries of energy producing countries), prolong the life of conventional oil and natural gas reserves and many other positive impacts, There This increase is reflected in the non-leading countries in producing these resources. Imports and profits will be reduced due to the reduction of imports of oil and natural gas in countries producing unconventional sources. Economic forces will also be distributed with the ownership of energy sources. Ultimately, however, these developments are increasing oil production Natural gas



from unconventional sources is boosting energy supplies in international markets and diversifying the international energy balance blend.

Second: International reserves of unconventional energy sources

The estimation way reserves of unconventional energy sources differs from the known methods of estimating the reserves of conventional sources of energy for the different characteristics of unconventional sources and how they are discovered and their productive potential. The method of calculating unconventional oil reserves or unconventional gas is very complex and requires much Geological and geological data. Unconventional energy reserves are continuously changing according to the variables surrounding them, so their estimates are reviewed every 2-3 years or at least unconventional energy reserves are estimated once every ten years⁽⁵⁾.

The amount of unconventional oil found in the world of shale oil, oil rock, and heavy oil and oil sands in very large quantities, and its recoverable reserves according to the technology known now estimated at 3297 billion barrels by the end of 2012, and that the large amount of unconventional oil reserves More than double the proven conventional oil reserves in the world, and that very heavy oil and oil sands constitute the largest proportion of unconventional oil reserves, when the world reserves are technically recovered from the very heavy oil and oil sands 1879 (Kerogen) with a technically recoverable reserve of 1073 billion barrels at the end of 2012, and finally, rock oil with a technically recoverable reserve of 345 billion barrels by the end of 2012. It is worth mentioning that the quantities of oil is very heavy and oil sands (bitumen) concentrated in four countries of the world is the main dominant on its reserves, concentrated heavy oil in Venezuela and the oil sands of Canada. These two countries have more than 68% of the world's very heavy oil reserves and technical recoverable oil sands, Come and m Followed by Russia with 18.4% and Kazakhstan with 10.5%. Thus, these four countries have 97% of the world's very heavy oil reserves and technically recoverable oil sands, and the remaining fraction is distributed to the rest of the world. Oil Rock (Kerogen) is concentrated in North America, especially in the United States, which owns 93% of the total recoverable oil reserves in the world and the rest is distributed to different countries of the world⁽⁶⁾, and with regard to the existence of the world's rock oil reserves according to the report of management US Energy Information (EIA) issued in 2013, the technically recoverable oil reserves of 345 billion barrels at the end of 2012 distributed in different countries of the world, but ten countries acquire more than 81% of them, Russia comes first with 21.7% The United States, 16.8%, followed by China 9.3%, Argentina 7.8%, Libya 7.5%, Australia 5.2%, Venezuela and Mexico, as well as Pakistan and Canada 12.7%⁽⁷⁾. The estimates of



unconventional oil reserves in the world have changed according to new discoveries, The latest estimates from the Energy Information Administration On November 24, 2015, showed that the world's total technically recoverable oil reserves amounted to 418.9 billion barrels by the end of 2014, so that the recoverable rock oil reserves have increased by more than 21% compared with previous estimates issued in 2013, The changes in the amount of oil reserves have led to changes in the scale of the largest countries to own these reserves⁽⁸⁾. According to the latest report on the unconventional oil reserves issued by the International Energy Agency, the oil reserves of rock amounted to 420 billion barrels by the end of 2015, a The world's technically recoverable oil has reached 1073 billion barrels by the end of 2015 and has not changed from the previous estimates for 2012. The reserves of the world's very heavy oil and technically recoverable oil sands have changed only very little, The table below shows that the very heavy oil reserves and the oil sands formed 55.7% of the world total. The rock form constituted 31.8% of the world total and the rock oil finally reached 12.5%. Table (3) shows these facts:

Table (3) Unconventional oil reserves recoverable technically in the world as at the end of 2015

Non-conventional oil types	Quantity (billion barrels)	%
Very heavy oil and oil sands	1876	55.7
Oil rock (kerogen)	1073	31.8
Oil shale	420	12.5
Total world	3369	100

Table is prepared by researcher based on the information contained in:

International Energy Agency, world energy outlook, 2016, p128

* Percentages were calculated by the researcher according to the table data.

According to the latest international studies and reports, the world's recoverable reserves, using currently known unconventional natural gas technologies, reached 343 trillion cubic meters at the end of 2012 , And rock gas accounted for the bulk of these reserves, reaching 212 trillion cubic meters technically recoverable, followed by rock gas impermeable reserve of 81 trillion cubic meters and finally the gas coal layers with a international reserve of 50 trillion meters As of the end of 2012, unconventional natural gas is found in every continent of the world. The bulk of unconventional natural gas reserves are located in the Asia-Basque region. This region has 42% of the world's technically recoverable gas reserves Coal deposits followed by Eastern Europe and Eurasia with 40% of the coal gas reserves and the remaining 18% owned by the OECD and European countries. The technically recoverable international reserve of impermeable rock gas has an Asia-Basque region



of 25.9% of the world total with 18.5%, Eastern Europe and Eurasia 13.6%, Africa 12.3%, Middle East 11.1%, OECD 18.5%, and technically recoverable Rock Gas Reserves, 25% in Asia-Basque region, 25%. , Followed by the OECD and the European countries (28.7%), Latin America (18.9%), Africa (18.4%), Eastern Europe and Eurasia (7.1%) and the Middle East (1.9%) respectively. , Followed by Argentina with 11% , Followed by the United States of America (9.1%), Canada (7.8%), Mexico (7.5%), and the rest distributed to different countries.⁽⁹⁾ (according to the IEA report in 2015) Unconventional natural gas, up slightly from the 2012 estimate of 344 trillion cubic meters by the end of 2014,⁽¹⁰⁾ but unconventional natural gas reserves have risen significantly, according to the latest report by the International Energy Agency (IEA), as shown in Table (4) below:

Table (4) Unconventional natural gas reserves technically recoverable at the end of 2016 trillion cubic meters

Region	Shale gas	impermeable gas	Coal gas layers	total
North America	61	11	7	79
Central and South America	41	15	-	56
Europe	18	5	5	28
Africa	40	10	0	50
Middle east	11	9	-	20
Eurasia	10	10	17	37
Asia-Pacific	53	21	21	95
Total	234	81	50	365

Source: International Energy Agency, outlook for natural gas, 2017, p345

Table (4) shows that shale gas is dominant in the world's reserves of unconventional natural gas that can be extracted technically, accounting for 64% of the total, followed by the reserve of clogged rock gas at 22.1% of the total, and coal gas at 13.6%, and the above table shows that the amount of unconventional natural gas reserves that can be extracted technically as at the end of 2016 increased by 21 trillion cubic meters when compared with the estimates of 2014. This increase in unconventional natural gas reserves is resulted from the increase of rock gas reserves to include new countries as well as the expansion and development of research and exploration techniques for shale gas, especially in North America. Methane hydrates, one of the most important types of unconventional natural gas, are still in their experimental stages and despite their huge quantities in the world, which is technically recoverable due to the lack of sufficient technological capabilities at present to calculate it but whose reserves are expected to be calculated and produced in large quantities in the next few years.

Third: The international market of renewable energy sources

The controversy over oil's arrival and the issues of many studies and reports warning of the depletion of known reserves of fossil fuels,



especially oil, created a tense atmosphere and increased concern about the adequacy of the growing energy needs, the world's fluctuations in oil prices and the environmental considerations advocated by Reducing the consumption of fossil fuels and resorting to clean and environmentally friendly sources, has led to increasing international interest in renewable energies and is seen as necessary to ensure energy security in the future. Renewable energy sources play an important role in the use of renewable energies.⁽¹¹⁾ is now the first and best choice for clean energy at a competitive price. It is worth mentioning that more than 170 countries have adopted renewable energy targets. Some 150 countries have developed their energy policies including Stimulates investment in its renewable energy technology.⁽¹²⁾ and that each renewable energy source has its own developments in the international energy market as follows:

1- International Solar and Wind Energy Market

The continuous improvements in technology and technologies for solar energy use have added a great deal of reliability to the use of solar energy, especially for the provision of electricity. In general, all solar technologies have been developed, including solar cell technology. Wind energy is also developing solar energy and wind energy are an inherent source of energy as well as reducing environmental pollution. Clearly, development can be seen in the world production of photovoltaic and wind power as shown in the following table:

Table (5) Total international production of solar photovoltaic and wind energy for the period 2005-2017

years	Global production of solar PV Giga watts	Solar Additive Giga watts	World production of wind energy Giga watts	Wind power added Giga watts
2005	5	1+	59	12+
2006	6	1+	74	15+
2007	8	2+	94	20+
2008	15	7+	121	27+
2009	23	8+	159	38+
2010	40	17+	198	39+
2011	70	30+	238	40+
2012	100	30+	283	45+
2013	137	37+	319	36+
2014	177	40+	370	51+
2015	228	51+	433	63+
2016	303	75+	487	54+
2017	402	99+	539	52+

Table is prepared by researcher based on the information contained in:

Renewable Energy Policy Network for the 21 st Century (REN21), Renewables International Status Report, 2018, p38, p42

and Renewable Energy Policy Network for the 21 st Century (REN21), Renewables International Status Report, 2017, p66, p77

Table (5) shows that international solar photovoltaic production reached 5 gig watts in 2005 and grew to 40 gig watts in 2010 and was



slowly increasing for the period 2005 to 2010 and that the energy added during The international solar PV production has increased significantly beyond 2010 to 402 gig watts in 2017 by the adding significant energy over previous years, and these developments in solar energy production have made an important location in the energy markets. As for wind energy, it is noted from Table (5) that international production is from Wind energy and the amount of added energy has developed significantly for the period (2005-2017), when the world production of wind power 59 GW in 2005 and increasing to 539 GW in 2017, and also notes the increasing quantities of wind energy in the world, The largest increase in wind energy, and the largest increase in 2015 is due to the development of wind power production in China.

It is noteworthy that the solar energy markets and the added quantities of solar PV are concentrated in China, the United States, Japan, Germany, Italy, India, United Kingdom, France, Australia, Spain, respectively, which is the top ten countries in that.⁽¹³⁾ The year 2017 saw an increasing interest in the construction of solar projects in several Arab countries. The projects of the State of Kuwait, Dubai, Egypt, Saudi Arabia and Morocco were also highlighted. This plant is operational by the end of 2018. The project is one of the most important production projects the wind energy markets are concentrated in China, which is the largest producer of wind power, followed by the United States, Germany and India. Wind turbines are mainly concentrated in China, the European Union, India and the United States. Morocco, Morocco, Tunisia, Jordan, Algeria, Bahrain, Syria, Kuwait and Lebanon, and the Arab countries are striving to develop wind power production.⁽¹⁴⁾

2- International Markets of Water Power

Hydropower is one of the most reliable sources of electricity in the world. China, Brazil, the United States, Russia and Canada are the largest producers of energy from water sources, followed by India, Norway, Japan, France, and Turkey some countries generate more than half of their electricity using hydropower, including Brazil, Iceland, Nepal and Mozambique.⁽¹⁵⁾ The hydroelectric market is booming worldwide and is expanding in Asia, Europe, North and South America, Africa, and that's why The world's installed capacity of hydroelectric power has grown from 723 GW in 2001 to 857 GW in 2007⁽¹⁶⁾, and the production of energy from water sources has increased from 2008 to the present, as can be seen from the following table:



Table (6) Total international production of hydropower for the period 2008-2017

years	World production Giga watts	Power added Giga watts
2008	874	
2209	900	26+
2010	936	36+
2011	970	34+
2012	990	20+
2013	1000	10+
2014	1055	55+
2015	1064	9+
2016	1096	32+
2017	1114	18+

Table is prepared by researcher based on the information contained in:
Renewable Energy Policy Network for the 21st Century (REN21), Renewables International Status Report, 2011- 2018

Table (6) shows that international hydroelectric production reached 874 GW in 2008, and despite the fluctuations in the amount of energy added between international increase and decrease, international hydroelectric production has grown to 1114 GW In 2017, it is worth mentioning that the production of energy from water sources is directly related to the quantities of available water (water abundance, water scarcity) in the countries producing this energy.

Hydroelectric power is produced in many Arab countries, including Algeria, Egypt, Tunisia, Iraq, Syria, Morocco, Sudan, Lebanon and Jordan. Production is very modest compared with the rest of the world. 2016 of 12079 MW/year, accounting for 1% of the world's total hydroelectric production for the same year.⁽¹⁷⁾

3- International Markets of Geothermal Energy

The geothermal energy grows modestly when compared with the growth of other renewable energies. Their markets are regular. Despite their slow growth, the world's total installed geothermal energy has increased from 10.3 GW in 2008 to 14.1 GW in 2017. The energy added from geothermal 2017 is the largest addition for the period (2008-2017), as shown in Table (7):

Table (7) Total combined geothermal energy "Produced" in the world for the period 2008-2017

years	Total world Giga watts	Power added Giga watts
2008	10.3	0.3
2009	10.7	0.4
2010	10.9	0.2
2011	11.0	0.1
2012	11.3	0.3
2013	11.9	0.6
2014	12.5	0.6



2015	12.8	0.3
2016	13.4	0.6
2017	14.1	0.7

Table is prepared by researcher based on the information contained in:

Organization of Arab Petroleum Exporting Countries (OAPEC), Annual Report of the Secretary-General (various issues), 2010-2017

Renewable Energy Policy Network for the 21st Century (REN21), Renewables International Status Report, 2018, p36

Geothermal energy use and markets are concentrated in the USA, the Philippines, Indonesia, New Zealand, Italy, Mexico, Iceland, Kenya, Japan and Turkey. These countries highlight the production of geothermal energy from the rest of the world. Some countries rely heavily on geothermal energy, including Kenya, which has a geothermal capacity of 27% of its energy mixture.⁽¹⁸⁾ In the Arab countries, the utilization of geothermal energy is still in its infancy. Some Arab countries are developing and establishing production projects The Electric power of geothermal energy.

4- International Markets of Biomass energy

Biomass energy differs from other renewable energies in the variety of uses. In addition to the use of cooking and heating in buildings and the production of energy in factories and the production of electricity, biomass is becoming a fuel of great importance in the international energy balance blend.

The amount of electricity produced from biomass in the world in 2016 is about 112 gig watts, which represents about 504 terawatt hours. The United States topped the world by generating electricity from biomass, followed by China, Germany, Japan, India, and energy from biomass in some Arab countries, led by Qatar, followed by Jordan, Lebanon and the United Arab Emirates (UAE)⁽¹⁹⁾. The production capacity of biomass in 2017 increased by only 1 terawatt-hour 2016, to 555 TW / h in 2017. But about biofuels, international production increased from 19651 thousand tons of oil equivalent in 2005 to 84121 thousand tons of oil equivalent in 2017⁽²⁰⁾ and at fluctuating annual growth rates between increase and decrease. This fluctuation is due to competition other types of fuel as well as the costs, prices and conditions needed by fuel The table below shows these facts and developments in the international production of biofuels for the period 2005-2017, as shown in Table 8:



Table (8) Evolution of international production of biofuels for the period 2005-2017

years	Biofuels Thousand tons of oil equivalent	Annual growth rate
2005	19651	
2006	25666	30.6
2007	37429	45.8
2008	50109	33.8
2009	55894	11.5
2010	63906	14.3
2011	65680	2.7
2012	66848	1.7
2013	72415	8.3
2014	80009	10.4
2015	79866	-0.1
2016	81483	2.0
2017	84121	3.2

Table is prepared by researcher based on the information contained in:

BP Statistical Review of world energy, June 2018, p45

BP Statistical Review of world energy, June 2016, p39

5- International Markets of hydrogen energy

International hydrogen energy is seen as a renewable energy component of the future international energy balance mixture and is seen as a complement to conventional international energy supplement. However, advances in hydrogen energy use need long periods of time. The work done by some countries such as the United States of America to develop the use of hydrogen energy in many areas, especially in transportation, the use of hydrogen as a source of energy production in its beginnings, which is very modest, as some countries see that hydrogen will become the main source of energy in the transportation sector ⁽²¹⁾. In general, the exploitation of hydrogen as a source of energy requires a lot of investment and technological development as well as the development of the hydrogen storage system. The focus on the safety of the use of hydrogen with high degree of safety is one of the most important concerns and that all this increases costs and creates obstacles to achieving the goal of producing hydrogen energy economically. With the success of many experiments and the development of ways to exploit hydrogen as a source of energy came the issue of saying markets for products that D hydrogen in power generation, which promised obstacles that, need more time to overcome. ⁽²²⁾

In general, increasing energy production from renewable sources will be at the expense of conventional energy sources, reducing international demand for conventional energy sources as well as reducing their contribution to international energy supplies. In return, international demand for renewable energies will increase and contribute to international energy supply. That the leading countries in the exploitation



of renewable energy sources achieve advantages in the energy sector, which reduces the environmental pollution and emissions that will change the climate as well as to achieve some assurance in the supply security.

Fourth: - Future expectations of energy sources: supply and demand

Developments in the nature of the structure of the international energy market like modern production methods from unconventional sources and expansion of the exploitation of renewable energy sources as well as the international calls to reduce environmental pollution from fossil fuels all change the nature of international energy consumption and are impacting the energy outlook. In the future, in general, the expectations of international energy vary from one institution to another and they differ for the same institution according to the scenarios adopted by the institution, and there are many expectations issued by international and non-international institutions and some of the company T interested in the affairs of international energy, but come the International Energy Agency and the Organization of Arab Petroleum Exporting expectations (OPEC) as the most important and most reliable forecasts in the field of energy.

The international energy demand and supply outlook of the international energy agency (IEA) and the organization of petroleum exporting countries (OPEC) depend on many of its assumptions in the future, namely the growth of economic activity represented by GDP and changes in the world population, taking into consideration international energy prices and the development of technologies Energy sources, and interest in trying to increase reliance on alternative sources of fossil fuels and environmental concerns takes a large part in the numbers of their forecasts⁽²³⁾, as well as many variables and factors that are considered when preparing future expectations.

In general, the IEA forecast that the international economy will continue to achieve an average annual GDP growth rate that is strong and that the population will increase. The economic growth rate is expected to be measured by 3.7% GDP during the period 2020-2030, Economic growth in the next few years beyond 2030 will be modestly reduced to achieve an average annual growth rate of 3.1% in the period 2030-2040. Emerging economies such as China and India are expected to grow faster than the rest of the world. The IEA expects its arrival to be over (9 million in 2040 and currently 7.5 million)⁽²⁴⁾, and that such an increase in the world's population and the continued growth of the international economy is an effective factor in influencing international energy demand and supply and reflects these expectations on international energy markets.

1- Future outlook for international energy demand



The International Energy Agency (IEA) agrees with OPEC in its forecasts of international energy demand, both of which assume a significant increase in international energy demand over the coming decades. These assumptions are the result of the assumption of population growth and the continued growth of economic activity with an improvement in living standards. Individual energy consumption is expected to increase in international energy supplies enough to meet energy needs adequately, and much of this increase in supply will come from unconventional sources and alternative energies. Despite the continued dominance of fossil fuels in beside demand and supply, as shown in the following table, this shows the international energy demand forecasts according to the scenarios of the international energy agency:

Table (9) Forecasting international energy demand up to 2040 according to IEA scenarios Million tons of oil equivalents

Different energy sources	New Policy Scenario		Current Policy Scenario (Reference)		Scenario 450	
	2025	2040	2025	2040	2025	2040
Oil*	4577	4775	4751	5402	4169	3326
Natural gas*	3390	4313	3508	4718	3292	3301
Coal	3955	4140	4361	5327	3175	2000
Nuclear Energy	888	1181	865	1032	960	1590
Hydropower	420	536	414	515	429	593
Bioenergy	1633	1883	1619	1834	1733	2310
rest of renewable energy	478	1037	420	809	596	1759
Total	15341	17865	15938	19637	14354	14879
Percentage of fossil fuels	77.9%	74%	79.1%	78.7%	74.2%	58.1%
Percentage of nuclear energy	5.7%	6.6%	5.5%	5.2%	6.6%	10.6%
Percentage of renewable energy	16.4%	19.4%	15.4%	16.1%	19.2%	31.3%

Source: International Energy Agency, world energy outlook, 2016, p64

* Includes conventional and unconventional.

** percentages were extracted by the researcher according to the table data

Table 9 shows the different estimates of international demand for energy sources in the International Energy Agency (IEA) scenarios. Each scenario assumes specific policies that will be reflected in the number of projections and from the current policy scenario known as the IEA reference status scenario, which has been strongly enshrined in international legislation to lead the energy sector, shows that international energy demand will rise from 15,938 million tons of oil equivalent in 2025 to 19637 million tons of oil equivalent in 2040.

It is assumed that demand for oil will constitute the highest proportion of energy demand compared to With the rest of the sources, estimated international demand for oil in 2025 by 4751 million tons of oil equivalent and expected to rise to 5402 million tons of oil equivalent, and coal is supposed to be the largest proportion of demand after the oil



comes natural gas after them, Fossil fuels will continue to dominate international demand despite the decline in total energy demand for 2025-2040 from 79.1% to 78.7%. Nuclear power assumes demand for 865 million tons of oil equivalent in 2025, accounting for 5.5% of the overall demand for the same year, its environmental problems and the caution of its exploitation in non-peaceful ways the international demand for renewable energy sources is estimated to decrease by 2040 to 5.2 percent of total world demand.

In terms of demand for renewable energy sources, this scenario assumes demand for all types of humbleness continues until 2040, Most of the increase in the demand for renewable sources will come from the demand for solar, wind, geothermal and hydrogen. Its of demand has doubled in the period 2025-2040 from 420 million tons of oil equivalent to 809 million tons of oil equivalent. Driven by technological improvements and dwindling The demand for hydroelectric power is expected to increase slightly or modestly for the period studied.

This moderation is due to the problem of water scarcity in most of the world. The demand for bioenergy is estimated at 1619 million tons of oil equivalent in 2025 and is supposed to increase. To 1834 million tons of oil equivalents in 2040. In general, the demand for renewable energies will constitute 16.1% of the total energy demand in 2040. In terms of the demand for unconventional energy sources, the demand for them as an important part of fossil fuels as well as their status In the main economy OECD countries, especially in the United States.

Also the international energy agency (IEA) expects that the increase in international energy demand will occur mostly in countries outside the Organization for Economic Co-operation and Development (OECD). China and India will constitute the largest increase in international demand and the Middle East will contribute effectively to increasing energy demand. The international energy agency (IEA) expects demand in their countries to decrease in order to rationalize its energy consumption pattern⁽²⁵⁾. As for the new policy scenario, which assumes the current policies, taking into account the measures and measures announced by various countries to reduce environmental pollution resulting from fossil fuel consumption, this scenario assumes a decline in international demand for fossil fuels, estimated at 77.9% in 2025 To 74% in 2040. This decrease is due to the policies adopted by countries to maintain environmental balance by reducing environmental pollution. These policies stimulate investment in alternative sources to develop their technologies and efficiently use them to meet the needs of the world. Energy is expected to increase demand for alternative sources. The proportion of nuclear energy is expected to reach 6.6% of the total world



energy demand in 2040, and the proportion of renewable energy of all types to about 19.4% of demand Total demand for energy sources in 2040. And about scenario 450, which is supposed to follow stricter policies and reduce emissions with a probability of approximately 50% to reduce the international increase in temperatures resulting from the continuous increase in fossil fuel consumption, it is therefore expected that the dependence on oil, coal and natural gas as demand for nuclear energy increases as alternative energy. The international demand for fossil fuels is expected to decline from 74.2% in 2025 to 58.1% in 2040 of the total demand for energy. Nuclear energy supposedly reaching about 10.6% of Starved energy demand in 2040 and with respect to the demand for renewable energy is expected to demand ratio reaches total types to 31.3% of the total international energy demand in 2040.

2- Future outlook for international energy supply

The international energy agency (IEA) predicts that fossil fuels will account for the largest share of international energy supplies and over 70% of the world's total energy supply by 2040, with the rest coming from renewable energy, especially solar and wind. Especially in Japan, this will rely heavily on nuclear energy for its energy needs. Shale gas and shale gas will contribute significantly and significantly to the international energy supply as the costs of unconventional sources of energy which strengthens their economies and their position in the international energy balance⁽²⁶⁾. On the other hand, OPEC expects the growth of world energy supplies to continue with the dominance of fossil fuels over most of the supply, as shown in table (10):

Table (10) The international supply of energy according to OPEC forecasts "reference scenario" for the period 2020-2040 Million tons of oil equivalent *

Different energy sources	2020	2035	2040
Oil**	4496	4830	5043
Natural gas**	3514	4435	5616
Coal	4425	5064	5631
Nuclear Energy	704	881	1175
Hydropower	375	445	507
rest of the renewable energies, including biomass	1691	2137	2797
Total	15205	17792	20769
Percentage of fossil fuels	81.7%	80.5%	78.4%
Percentage of nuclear energy	4.7%	5.0%	5.6%
Percentage of renewable energy	13.6%	14.5%	16.0%

Table is prepared by researcher based on the information contained in:

Organization of the Petroleum Exporting Countries (OPEC), world oil outlook, 2014, p8

* Conversion from one barrel of oil / day to one tons of oil equivalent with one ton of oil equivalent to 7.11 barrels of oil and the adoption of the year 360 days, and percentages extracted by the researcher according to the data of the table.

** Includes conventional and unconventional.



Table (10) shows that OPEC expects international energy supply to grow from 15205 million tons of oil equivalent in 2020 to about 20769 million TEU in 2040. It also expects fossil fuels to contribute about 81.7% 2020. Despite its declining contribution to environmental and political considerations, it will remain dominant in the largest share of suppliment, which is expected to account for 78.4% of the world's energy supply in 2040. OPEC also expects the Nuclear Power Conservancy to account for up to 5% until 2040. As regards renewables, it is noted from Table (10) its contribution to international energy supply increased from 13.6% in 2020 to 16% in 2040. OPEC's expectations are clearly in line with the international energy agency's expectations regarding the international supply of energy, both of which see fossil fuels as the biggest contributor to the international energy supply. International energy supplies as oil and natural gas contribute more from unconventional sources of supply, no significant change in nuclear power is expected until the near future, and they agree on the increasing share of renewable energy in supplies significantly.

Conclusions and recommendations:

Conclusions:

1. Fossil fuels represent the largest share of global energy demand, as well as supply, it is the largest contributor to the global energy supply, at the moment, and in the near future, despite the expectation that the proportion of fossil fuels will gradually decline but remain dominant in the energy sector. On the other hand, the natural depletion of fossil fuels and environmental damage are important factors that have pushed many countries to look for energy alternatives that are inexhaustible and meet the human needs of energy, so that non-conventional and renewable energy sources have emerged to take the role of complementary sources, for the time being fuels for Fossil and in the near future.
2. The global reserves discovered from non-conventional and economically viable sources of energy are very large and outweigh the proven reserves of traditional sources, giving great importance to these sources, as well as complementing the traditional oil and natural gas reserves. and prolong her life.
3. Access to clean energy, which will reduce environmental pollution by generating energy from renewable sources, has become the use of renewable sources in the generation and exploitation of electric power, with highly efficient technologies, and is become an important place in the global energy markets.



4. Non-conventional and renewable energy sources are important energies, to diversify of the global energy supply mixture at the moment, and are expected to play an effective and important role in supplying the world with energy in the future.

Recommendations:

1. Necessity, diffusion and awareness of the fact that fossil fuels are prone to depletion, which necessitates reducing dependence on it, and taking energy saving measures in the future.
2. Expand scientific research in the field of non-conventional energy sources in order to know their reserves more accurately and to increase research and exploration in this field.
3. Work on the creation of markets for renewable energy technologies, To make it simplifies Access and deployment it.
4. The need to develop the non-conventional oil and natural gas industry in the Arab countries for what these sources will represent in the future.
5. Necessity for international cooperation in the field of scientific research, and the transfer of technologies, in relation to non-conventional and renewable energy sources, and work on the formation of a special international agency in the field of alternative sources in order to support and strengthen efforts aimed at enhancing the efficiency of the investment of these sources.

Margins

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