Republic of Iraq
Ministry of Higher Education
and Scientific
Al-Mustaqbal University College
Chemical Engineering and Petroleum Industries Department

Subject: Petroleum Economics

Second Class

Lecture Two

2.1:Petroleum Industry Stages:

We have already mentioned that the subject of the oil economy includes all economic activities related to the creation of extraction, production, distribution and consumption of the petroleum commodity, whether it is a primary commodity (crude) or in a variety of different forms, i.e. in the form of petroleum products or in the form of petrochemicals. considered as the oil industry, that complex, differentiated and diverse human productive activity in its stages and fields broad and unlimited. These stages are interrelated and complement each other (in a vertical manner).

in particular and in a general horizontal manner) to form the total oil economy.

Research and exploration stage:

The stage of research and exploration has emerged clearly, since the discovery of the relationship of oil with the types of rocks formed for the earth. Where it has been proven that it is often found in sedimentary rocks, and this phenomenon has weighed throughout history ,the theory of organic origin, and thus explorers link the possibility of its existence with these rocks. So focus research in sedimentary basins at the edges of continents, near mountain ranges, and on the continental shelf.

The most important methods used to search for oil are:

First - Geological survey: where the geologist's task is to draw different maps that show the structures the rocks and their types of the area to be surveyed, after taking samples and models and analyzing them in the laboratory. as it guides researchers on the whereabouts of oil through some natural phenomena, such as the dome structures that attract it the curves are clearly defined, and this method is considered one of the easiest and least expensive.

Second - Geophysical survey: As a result of scientific and technological progress in the field of the oil industry, it has scientists have found more complex methods, but they are more feasible, the most important of which are:

-Seismic survey: This method relies on sending sound waves to the Earth by creating movement on the surface or at suitable depths and the frequencies of the sound waves it transmits are recorded the different layers on the magnetic tapes are already automated and by interpreting this information can learn about rock formations and their types.

-Magnetic scanning: It is the measurement of the magnetic field element in different areas to find out the thickness sedimentary rocks, that is, after the basal (igneous) rocks from the surface of the earth, and this gives a picture to place the rock layers, through which the presence of the reservoir can be inferred or not.

Drilling and Exploration Phase:

This phase is critical to the success of the process of economic exploitation of the natural oil wealth. I. after being done determining the expected oil or gas fisheries The location of the exploration well is determined, to see if it is there oil or not.

The stage of extraction and oil production:

It is the stage aimed at extracting crude oil from the ground and raising it to the surface of the earth to be ready or suitable for transportation, export and manufacture in near or far places, and within the region or country or outside. This stage includes the activity related to the preparation and validity of the oil area for exploitation economic, whether it is from the technical, technological or construction aspects, such as the use of drilling wells successful oil production, determining their number, making them suitable for production or extraction, and constructing various mechanical equipment such as reservoirs, transport and purification pipelines, purification and assembly tanks...etc.

The oil transfer phase:

The phase aimed at transporting crude oil from its production centers or areas to its export areas or regions its refining or consumption. This is done through the formation of facilities with the provision of various means and equipment for transporting oil of all kinds on land (such as pipelines, trucks, etc.) and marine (giant ships).

The stage of oil refining or filtering

It is the stage that aims to manufacture oil in refineries by converting it from its crude form into various forms of petroleum commodity products and processing to fill and meet human needs directly or for industrial processes for several later industrial stages.

These various aforementioned petroleum products, some of them are primary or major, some are secondary, and some are light, such as gasoline and kerosene, some heavy, such as asphalt or wax, for example, and some medium...etc.

This industrial stage is the stage of the manufacturing industry because it is an approved industrial activity and is related to the material crude oil to be converted into manufactured products.

Marketing and distribution stage:

It is the stage aimed at marketing and distributing oil in its raw form or oil products to regions and the places of its use and consumption near and far and on the local, regional or global scale. Be distribution centers are main or subsidiary centers and provide all equipment, tools and places for receiving and storage for crude oil or petroleum products and redistribution.

Petrochemical manufacturing stage:

It is the stage aimed at converting and manufacturing petroleum commodity products into commodity products there are hundreds of different petrochemicals, such as agricultural fertilizers, detergents, pesticides and dyes plastic materials, synthetic fabrics....etc. This stage includes a wide and unlimited number one of the important and vital economic and industrial activities in the national or global economic sphere (It did not begin to appear until the thirties of the twentieth century and in some countries such as the States USA and Germany...).

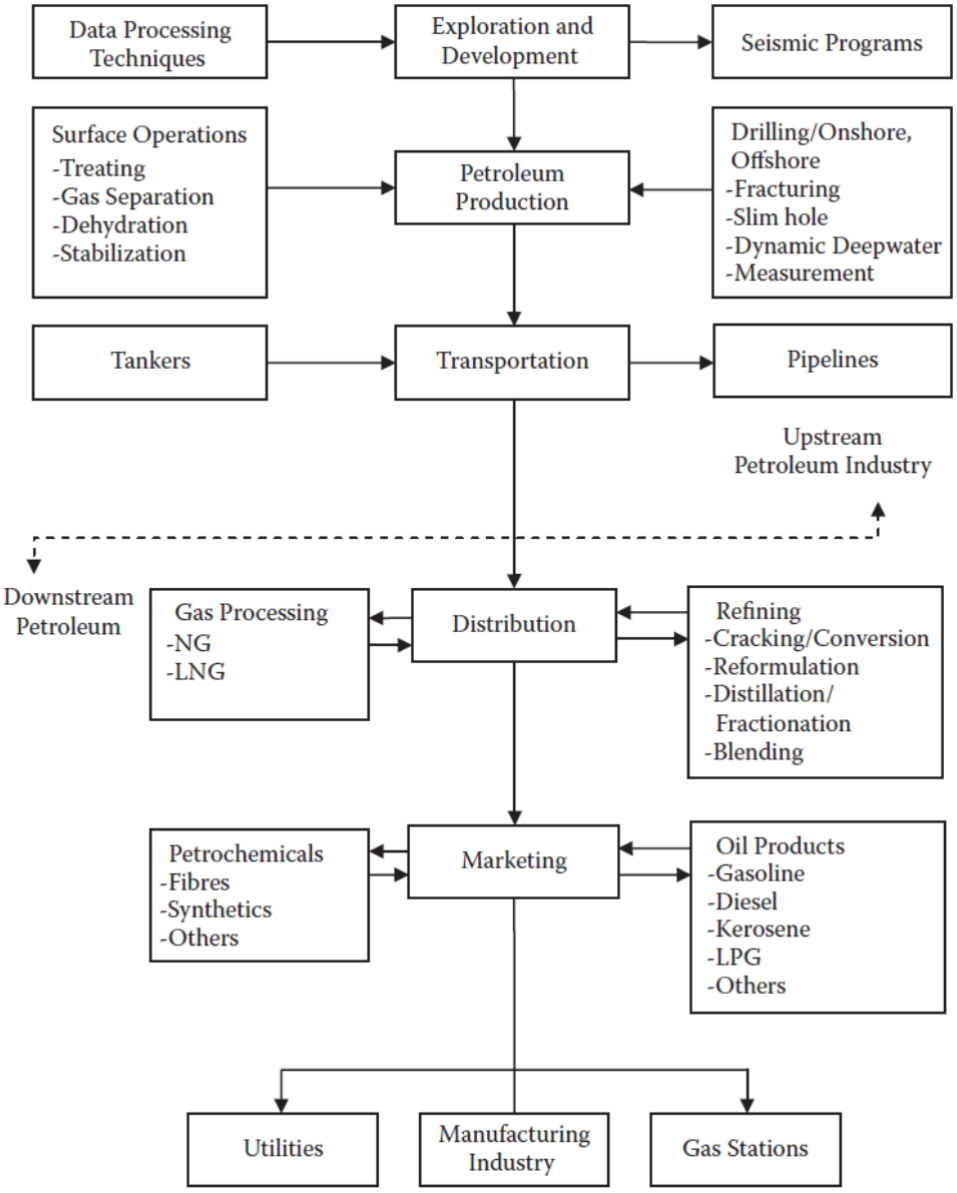


Fig.1 Petroleum industry stages from exploration to marketing

2.2:World Oil Supply (Crude oil production)

Since the 1850s, oil has been produced in different parts of the world. The United States was the major producer; it produced over 90 percent of world production until 1875. Over the years and with the increasing importance of oil, new regions have emerged as key oil producers. The Middle East share of world's oil production has increased from 4.8 percent in 1940 to more than 25 percent in 2000, while the United States share reduced to around 10 percent in 2000 from 62 percent in 1940. Table 1 shows the share of crude oil production by region.

Table1: **Share of World Crude Oil Production (mbd) by Region from 1960 to 2010**

Share of World Crude Oil Production by Region from (mbd) 1960 to 2010

	Year						2010 Share
Region	1960	1970	1980	1990	2000	2010	of Total
North America	9.20	13.26	14.10	13.85	13.90	13.88	16.6%
Latin America	2.90	4.83	3.75	4.51	6.81	6.91	8.9%
Western Europe	0.30	0.46	2.6	3.70	4.10	4.2	21.8%
Eastern Europe	3.20	7.60	12.31	12.4	10.5	13.81	21.8%
Middle East	5.30	13.90	22.02	17.54	23.55	25.18	30.2%
Africa	0.28	6.11	6.79	6.72	7.80	10.10	12.2%
Asia and Pacific	0.60	1.99	5.11	6.73	7.87	8.35	10.2%
Total	21.78	48.09	66.05	65.46	74.89	82.10	

Source: BP Statistical Review of World Energy, London, 2011. With permission.

Fig 2: Forecasted World oil refining capacity (mbd), 2000–2020. From Alsahlawi M., Global Refining Industry Outlook, 2nd Annual Global Refining Technology Forum, 19 March 2012, Doha, Qatar

The share of oil in world energy production reached its maximum in 1970 with more than 60 percent. This was caused by the decrease in coal produc- tion in major parts of the world. In the 1990s, however, the share of oil pro- duction declined to less than 40 percent as a result of its replacement by other forms of energy such as coal.

World Primary Energy Production in Percent Share (Energy Mix in Production), 1960–2010

	Year					
Energy Source	1960	1970	1980	1990	2000	2010
Oil	54.53	60.19	46.45	39.40	39.00	38.50
Natural gas	22.28	25.62	18.41	20.51	21.50	21.70
Coal[a]	20.36	11.56	26.18	28.07	28.1	28.20
Hydroelectric power	02.82	02.46	06.35	06.58	06.00	06.50
Nuclear power	0.01	00.17	02.60	05.43	05.40	05.10
Total	100	100	100	100	100	100

Table 2 World Primary Energy Production in Percent Share (Energy Mix in Production), 1960–2010

2.3:Production of Refined Oil Products

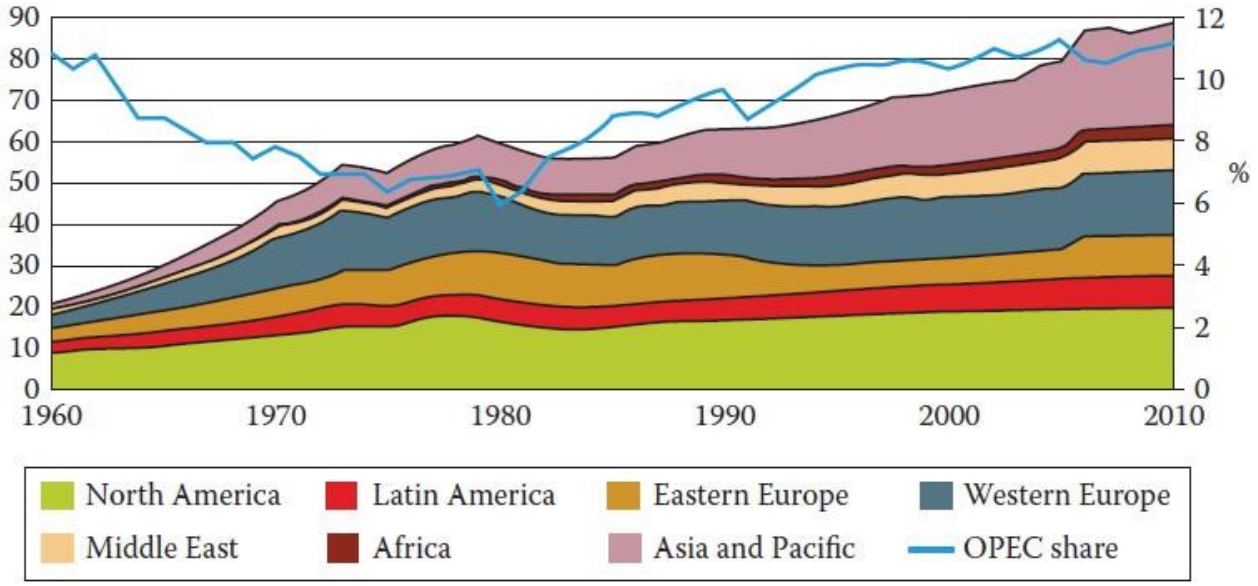
Production of refined oil products is determined by several factors, mainly the supply of crude oil, refining capacity, oil prices, environmental regulations, and world economic growth. However, adequate supplies of oil products depend on the optimal allocation between types of crude oils and an increasing supply of natural gas, which affect the sources of refinery feedstock.

The type of crude oil with respect to its density and sulfur contents determines refining yields and refining processes. For example, light crude with lesser density will yield a higher proportion of more valuable final oil products such as gasoline and will require a less complex refining process.

In 2010 world production of refined oil products was estimated to be around 82.3 mbd with an average annual increase of 6 percent from 1960 to 2010. Figure 4 presents world production of refined products by regions over the period 1960 to 2010 compared to OPEC's share. The United States and Western Europe produce almost half of the world total. On the other hand, Latin America, Eastern Europe, and mainly Russia produced around 10 percent each of world production in 2010 over the same period. The

Middle East, which is the largest producer of crude oil, however, produces almost 8 percent of world production of refined products. This indicates that refineries were located near the consuming areas rather than producing areas, except in the case of the United States and Europe which are both major producers and consumers. Refineries located near the markets are known as market refineries, in contrast to resource refineries which are located near producing oil fields. Refinery locations can be determined by certain factors including product types and transport costs as well as political considerations.

Table 3 gives the distribution of world refining capacity by regions for the period 1965 to 2010. Before 1965 the United States led the world in refining capacity with a share of 67 percent of total world refining capacity.



Figre 4: Production of refined products (mb/d), 1960–2010. (From *OPEC Annual Statistical Bulletin,* Vienna, 2010

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Table 3 World refining capacity by regions for the period 1965 to 2010

World Oil Refinery Capacity by Region (1000 b/d)[a], 1965–2010

Regions	Year						Change 2010 over 2009	2010 Share of Total
	1965	1970	1980	1990	2000	2010		
North America	11,896	14,818	21,982	19,195	19,937	20,971	–0.7%	22.8%
South and Central America	3562	4808	7251	6009	6271	6707	0.3%	7.3%
Europe and Eurasia	13,194	21,968	32,136	27,909	25,399	24,516	–1.0%	26.7%
Middle East	1702	2466	3528	5260	6491	7911	1.2%	8.6%
Africa	560	697	2102	2804	2897	3292	8.9%	3.6%
Asia Pacific	3600	6588	12,364	13,470	21,478	28,394	2.7%	30.9%
World	34,514	51,344	79,363	74,647	82,473	91,791	0.8%	100.0%
Of which:								
OECD	22,852	34,591	49,833	40,542	44,761	45,124	–1.3%	49.2%
Non-OECD	11,662	16,754	29,530	34,105	37,712	46,667	3.0%	50.8%
European Union[b]	8413	15,119	20,669	15,239	15,456	15,240	–2.0%	16.6%
Former Soviet Union	4518	6105	10,190	11,217	8574	8033	0.9%	8.8%

[a] Atmospheric distillation capacity on a calendar-day basis.

[b] Excludes Lithuania prior to 1985 and Slovenia prior to 1991.

Note: Annual changes and shares of total are calculated using thousand barrels daily figures.

Source: BP Statistical Review of World Energy, London, 2011. With permission.

- Asia pacific= China, Japan, South Korea, Australia, India, Singapore, Taiwan, New Zealand

This trend has continued with a decreasing rate as the refining industry has been directed toward markets of refined oil products. Supporting this argument, refining capacity in Western Europe and Asia has increased substantially, and their shares in world refining capacity have increased to 27 percent and 30 percent in 2010, respectively. Over the last four decades the world refining capacity rose to reach more than 91 mbd in 2010 from 51 mb/d in 1970. The major contributors to this rise were Europe and the Far East. The Middle East as a major crude oil producer has increased its refining capacity from 1.7 mbd in 1965 to 7.9 mbd in 2010. However, against expectations, its share in world refining capacity has not increased substantially. As a matter of fact, it did not exceed 8.6 percent in 2010.

In forecasting refined oil products supply, it is assumed that world eco- nomic growth rates would be 2 percent per year from 2010 to 2015 and 3 percent from 2015 to 2020. Oil prices, however, would be around $180 over the period 2010 to 2015 and would be in the range of $100 to $110 during the years 2015 to 2020. Figure 5 shows the future projections of world oil refining capacity for the years 2000 through 2020.

Surplus and deficit in the global oil supply

The different stage of the oil industry characterized maybe by norm or the shortage of crude oil production, where each stage suffer certain times of shortage or excessive production capacity.

The oil projects in all stages often take a long period of time starting from the planning process and until the start of the first stage of the production process which is known as (the period of pregnancy) as meaning that when he turns the decision to invest into energy productivity actual perhaps the world and prices will be changed.

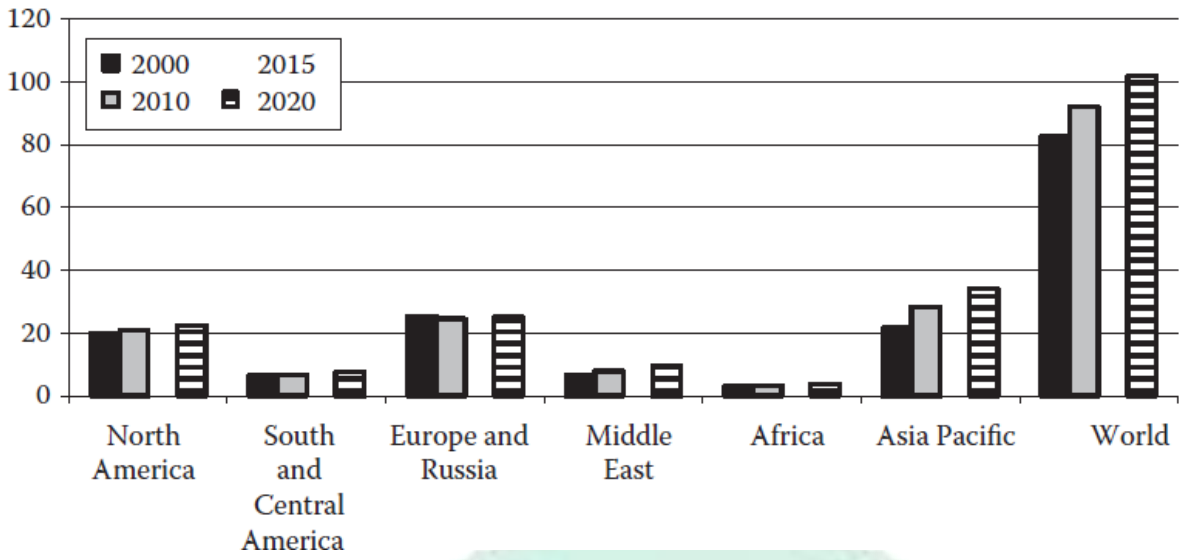


Fig 5: Forecaste d World oil refining capacity (mbd), 2000–2020. From Alsahlawi M., Global Refining Industry Outlook, 2nd Annual Global Refining Technology Forum, 19 March 2012, Doha, Qatar

For example:

The period (1974-1975) there appeared an oil surplus as a result of oversupply and lack of demand and the time period (1975-1980) was characterized by a lack of supply and

increased demand, which led to higher spot price, compared with the official price. Where it was a public official price for the year 1980 is $ 29 a barrel / day while the spot price of $ 36 a barrel / day.

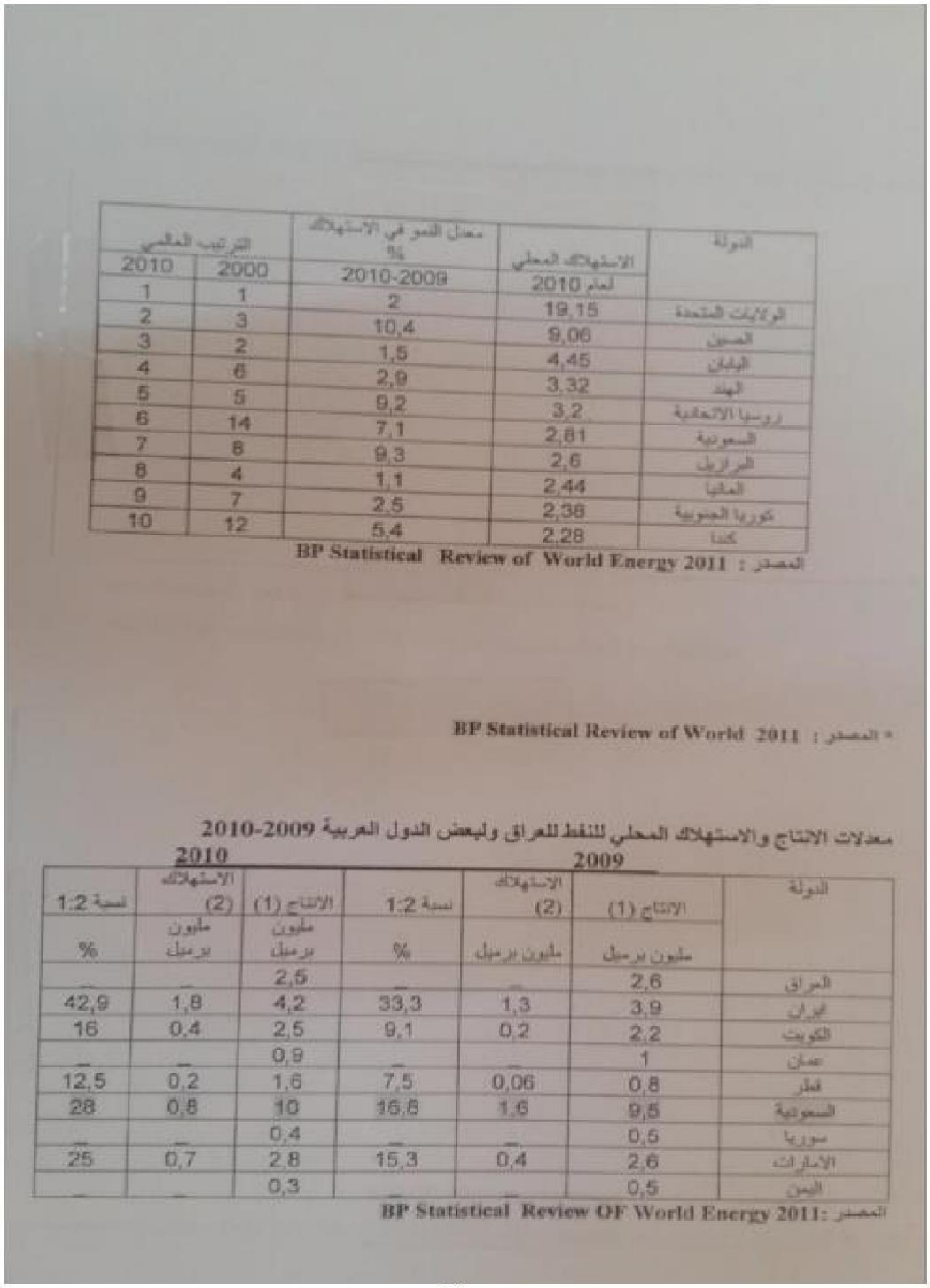
The time period (1982-1988) increased crude oil production and increase supply, bringing the spot price for the year 1986 was (13 $) barrels / day, while the official price (25 $) barrels / day, during the same year.

1998, there were overkill in the supply of oil and this led to a collapse in prices, reaching $ 10 a barrel / day.

The table below shows the total world oil (supply and demand) and the excess oil as well as the ratio of the Organization of Petroleum Exporting global supply.

Table 4 Total world oil supply and demand

Year	The total worlds crude oil		Oil Surplus	OPEC Supply	% OPEC from the world's supply
	Demand	Supply			
2001	76.6	84.6	8	30.5	36.1
2002	76.8	84.1	7.3	29.1	34.6
2003	79.3	79.7	0.4	28.3	35.5
2004	82.3	83.1	0.8	30.6	36.8
2005	83.7	84.2	0.5	31.6	37.4
2006	84.6	84.4	0.2	31.4	37.2
2007	85.8	84.8	1	31.0	36.5
2008	87	86.1	0.9	30.6	35.5



الترتيب العالمي 2010	الترتيب العالمي 2000	معدل النمو في الاستهلاك % 2010-2009	الاستهلاك المحلي لعام 2010	الدولة
1	1	2	19,15	الولايات المتحدة
2	3	10,4	9,06	الصين
3	2	1,5	4,45	اليابان
4	6	2,9	3,32	الهند
5	5	9,2	3,2	روسيا الاتحادية
6	14	7,1	2,81	السعودية
7	8	9,3	2,6	البرازيل
8	4	1,1	2,44	المانيا
9	7	2,5	2,38	كوريا الجنوبية
10	12	5,4	2,28	كندا

المصدر : BP Statistical Review of World Energy 2011

* المصدر : BP Statistical Review of World 2011

معدلات الانتاج والاستهلاك المحلي للنفط للعراق وبعض الدول العربية 2010-2009

2010 نسبة 1:2 %	2010 الاستهلاك (2) مليون برميل	2010 الانتاج (1) مليون برميل	2009 نسبة 1:2 %	2009 الاستهلاك (2) مليون برميل	2009 الانتاج (1) مليون برميل	الدولة
_	_	2,5	_	_	2,6	العراق
42,9	1,8	4,2	33,3	1,3	3,9	ايران
16	0,4	2,5	9,1	0,2	2,2	الكويت
_	_	0,9	_	_	1	عمان
12,5	0,2	1,6	7,5	0,06	0,8	قطر
28	0,8	10	16,6	1,6	9,5	السعودية
_	_	0,4	_	_	0,5	سوريا
25	0,7	2,8	15,3	0,4	2,6	الامارات
_	_	0,3	_	_	0,5	اليمن

المصدر: BP Statistical Review OF World Energy 2011

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Fig 6: The rate of production and supply in Iraq and some Arab countries

**The relationship between the three variables (the rate of explorer and production and reserves) with time:

1- Changes in production volume / time. (dQ_P / dt)

2- Change in the rate of explorers / time. (dQ_D / dt)

3- The change in the reserve / time. (dQ_R / dt)

The possible relationship between the three variables above can be seen through the figur 7 below:

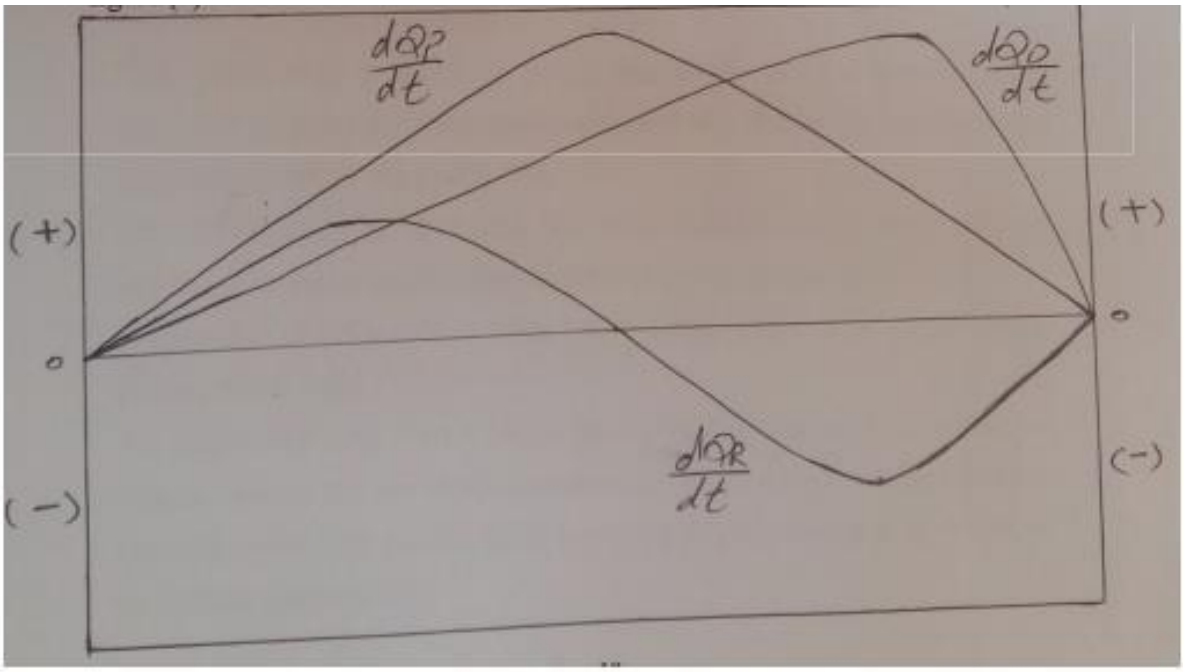

Fig 7: The rate of production, explorer and reserves with tim

Conclusions form figur as follows:

1- That the volume in the amounts of new oil discoveries (exploration) that add to the new reserve must be greater than the volume of oil production as a function of the time element. $(dQ_D / dt) > (dQ_P / dt)$.

2- The new additions to the reserve for the original supplier base beginning countdown in the new stage. Where possible additions to be negative in some cases, because of:

A- The depleted cycle supplier has been ended (the oil well will be turned into a dry well).

B- The cost of extraction per barrel, of oil high compared with the global prices of oil.

3- The relationships between the three variables shown in the above Figure with time can be illustrate that the extent of the economic balances of oil, which, if made possible to elongation the cycle depleted supplier to the longest possible period.

4- The process of oil production is greater than the size of the discoveries, which mean that the process of the original resource of oil is limited and the relationship is as follows: $(dQ_P / dt) \leq (dQ_R / dt)$.

5- The relationship $(dQ_D / dt) = (dQ_P / dt)$, which indicates that the rate of additions and new discoveries are of course accelerate supplier depleted cycle.

6- Relationship of $(dQ_P / dt) > (dQ_D / dt) > (dQ_R / dt)$ it produces fast drying process for oil wells.

7- The relationship $(dQ_P / dt) < (dQ_D / dt) < (dQ_R / dt)$which reflects the correct balance between the size of oil discoveries and additions size and the volume of production with time and this leads to prolong this relationship in the period of the resource depleted cycle.

We note that Iraq has reserves that make it the owner of the longest lifespan of the oil reserves in the world where as much as 165 years, according to statistics for 2006 which is the longest lifespan in the world.