

## **THE ECONOMIC IMPACTS OF THE OIL AND GAS RESOURCES IN LEBANON**

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### **Abstract**

*On the verge of locating the oil and gas reserves in the Mediterranean Sea, countries surrounding this area started the exploration "race". While Israel and Cyprus are in the lead with effective and efficient decision making, and with more advanced technology, they started their exploration and extraction of oil and gas. Lebanon on the other hand, is still waiting to reach an agreement with a number of companies that are working in this field. The maritime borders with Israel will cause many problems for Lebanon in extracting oil and gas, but if the government could reach an agreement with a number of companies those problems will become minor because Lebanon will start benefiting from this exploration. Oil will result in an overall economic improvement i.e. covering the public debt, creating new job opportunities, improving the industrial sector, and improving the overall economic welfare. The main goal of this research is*

*to raise awareness regarding the importance of the oil and gas sector to the Lebanese economy; in this regard a questionnaire was used for data collection. The questionnaire reflected a great point of view in the form of professional and expert opinion; Furthermore, it was found that the development of oil and gas resources is mainly slowed down by political disputes, administrative complications and the conflict with the neighboring countries.*

*Keywords: Lebanon, Gas and Oil, Israel, Economic improvement, Public awareness*

## **INTRODUCTION**

Oil and gas reserves in Lebanon are today the subject of politicians, economists and researchers. The question raised is “How would oil and gas exploration affect Lebanon’s economy and development of the country?” The very recent discovery of oil and gas is located in an unexplored area of the Mediterranean Sea between Turkey, Cyprus, Israel, Syria and Lebanon.

The division of oil and gas capital spending into exploration and development is drawn between research and development. Lebanon decided to offshore the service of exploration and the manufacturing of oil due to lack of the right qualifications to perform the operation in-house, in addition to many political restrictions due to its location and basin sharing countries.

The discovery is situated in 1,645m of water in the Levantine Basin, located approximately 130km west of Haifa, Israel. At the time of discovery, the most prominent field ever found in the Leviathan gas field was Levantine Basin. It covers about 83,000 square kilometers of the eastern Mediterranean region. The Leviathan field falls within the precinct of the Rachel and Amit licenses. Production is expected to commence in 2017.

Noble Energy based in Houston has interests in oil and natural gas exploration and production. It is the operator company of the Leviathan gas field. Its share in the project is 39.66%. The Leviathan field is the largest discovery ever for Noble Energy. Delek Group subsidiaries - Drilling and Avner oil exploration have a working interest of 22.67% each in the Leviathan project. Ratio Oil Exploration is the other stakeholder, with 15%.

It is estimated that Levant’s basin contains up to 122 trillion cubic feet tcf of gas and 1.7 billion barrels bbl of oil. For perspective, Saudi Arabia holds 238.1 tcf in proven gas reserves and 264.5 bbl in proven oil reserves. Both nations’ motivations in the border dispute are now based upon the ability of domestic oil and gas fields to change the fate of future generations. As both nations are pioneering shifts away from oil to natural gas, the following will focus the gas aspect.

In 2008, Lebanon possessed 9 trillion cubic feet (tcf) of proven gas reserves. The differential was offset by its linkages to the Arab Gas Pipeline (AGP) which originates in Egypt. Lebanon was operationally linked to the AGP in 2006. Despite consuming and producing very little natural gas, Lebanon is currently in the process of converting its power plants to run on natural gas from petroleum-based products. The site location of the natural gas resources in the area surrounding Lebanon is given by figure 1:

Figure 1. Site location of the Levantine basin



Source: <https://www.google.com.lb/search?q=israel+lebanon+map&biw>

### Geology of the Levantine Basin

As per the US Geological Survey (USGS) estimates, the entire Leviathan Basin holds a mean approximation of 1.7 billion barrels of recoverable oil and a mean of 122 trillion cubic feet of recoverable gas. The Leviathan gas field's natural gas reserves are estimated to be about 17 trillion cubic feet (tcf). Besides natural gas, the field is said to contain 600 million barrels of oil beneath the gas layer.

The Oligo-Miocene reservoir rocks at Leviathan field are deep-water slope and fan sandstones sealed by sedimentary rocks of the mid to late Miocene age and Messinian age salt. Natural gas at the Leviathan field was found in several sub-salt Miocene intervals.

Noble Energy commenced drilling on the Leviathan-1 well in October 2010 using the Sedco Express deep-water semi-submersible rig, which is owned by Transocean. In the first stage of drilling, the well was drilled to a depth of 5,170m. It encountered a minimum of 67m of

natural gas pay. The gas was discovered in several sub-salt Miocene intervals. In the second stage of drilling, the well is intended to touch an additional depth of 2,030m, where the estimated natural gas reserve is expected to reach 25tcf.

Drilling of Leviathan-1 well, in May 2012 was suspended after reaching a depth of 6,522m, approximately 678m short of the target depth. The suspension took place due to high well pressure and mechanical restrictions of the well-bore design. The work is not expected to restart until the end of 2013.

Drilling of Leviathan-2 well started in March 2011 by the Pride North America rig. The drilling operations, however, had to be stopped after detecting a flow of water in the well hole.

Drilling of the Leviathan-3 well commenced in June and was successfully completed in December 2011. The third well, located approximately five kilometers east of the original Leviathan discovery, was drilled to a total depth of 5,226m and encountered a minimum of 88m of natural gas pay.

### **Need for the Study**

The need for the study is based on the need for a coherent policy and rules for the long exploration process which is an important issue considered by many politicians, experts and economists.

The delay in issuing a signed agreement governing all the steps that the exploration process may pass by is a major problem which is making Lebanon losing day by day the benefit of the oil wealth discovery. The delay may cast unwanted results; many international oil production companies are ready and committed to sign an agreement of production with Lebanon. Thus, within the petroleum administration there should be a fixed time to sign the first implementation agreement. The companies that will begin soon extracting gas on behalf of Israel will probably drain off amounts belonging to Lebanon.

### **Problem Definition**

Lebanon is a politically unstable country, which is influencing the economic situation as a whole. The economy fluctuation couldn't be predicted as fixed results as no one knows what will happen in the near future. The petroleum exploration project is linked to the stability issue in order to encourage the international oil and gas exploration companies to invest in Lebanon. It is also related to the politician's unity in order to agree on the first licensing round but the fall of the Lebanese cabinet last March has delayed the process. Crucially, it means that the two pieces of legislation that need to be passed by the country's Council of Ministers have not yet realized. Without these laws no contracts can be agreed. The first legislation deals with the

demarcation of the 10 offshore exploration blocks, while the second approves the terms of the exploration and the production sharing agreement between the companies and firms. The lack of the former, in particular, is putting off foreign companies as they are unwilling to bid until they know the blocks are confirmed.

### **Scope of the Study**

The goal of this research is to raise the awareness and to answer all the possible questions that Lebanese people are asking about the pending issue of exploration of oil and gas. First, this paper starts by defining crude oil, process of extraction and its benefits. Second, comes the 1st licensing round and within the pre-qualification results there is the evaluation process and methodology. Third, the paper will introduce the petroleum components and its benefits then the political constraints and the delayed take-off and its application. Finally, the paper tackles the case study of Hubbert peak oil and gas.

### **Oil and Gas in Lebanon**

Crude oil is the essential element for different substances and especially petroleum as this oil contains hydrocarbons which are molecules that contain hydrogen, carbon and come in various structures. Hydrocarbons contain a lot of energy from which derives gasoline, diesel fuel, paraffin wax etc. It has a different form that varies from the substance methane which is lighter than the air to a longer chain of a combination of liquid carbon to very long chains solids like wax or tar. When these chains of hydrocarbons are chemically cross-linking, you can get synthetic rubber to nylon to the plastic in Tupperware and many other products (Freudenrich, 2011).

Since ancient times, the oil is known and used. First it was explored underground where abundant quantity was found. The usage of this oil was as a source of heat and light, pharmaceutical product, paving streets cement and caulking of boats. Since the middle Ages, distillation methods were used to transform oil into different products. The oil was explored in Romania in 1857 and in the United States in 1859 in the state of Pennsylvania. In 1920-1970 period, exploration and development took place, the oil production became more advance and developed fuel such as gasoline, diesel and heavy fuel oil, in addition to further production of plastics, textiles and artificial rubber and intermediates for the chemical and pharmaceutical industries. In 1970, the geologist Marion King Hubbert predicted the oil production peak for the United States.

The period between 1973 and 1980 the first and second oil shocks took place and oil prices started to decrease but in 2003 the price rises and many companies started to operate as oil and gas production companies such as Petrobras and Petrochina.

## **Benefits**

Lebanon is considered to become one of major producers in energy production in the Middle East. International companies are very interested and are competing over exploiting the large energy reserves detected off its coast.

Every government major concerns are the output growth, unemployment and inflation and deflation rates. The goals of any government policy makers are to increase output growth, lower unemployment and lower inflation. With oil and gas exploration it is expected to create job opportunities and lower unemployment rate.

Chief executive officer of the British Spectrum Geo Inc. David Rowlands said that: "the value of the gas and crude oil reserves in Lebanon is worth \$140 billion". In addition, Spectrum Geo had unveiled in 2012 that Lebanon's oil and gas reserves off its coast are of the richest and best in the Mediterranean.

Rowland revealed that 120 companies expressed interest in drilling for oil and gas reserves in Lebanon including U.S. Marathon Oil and Petroleum Corporation and British Royal Dutch Shell.

Lebanon's energy and water minister estimates that the country will be able to produce around 90,000 barrel of oil daily by the end of the current decade. Meanwhile, Malcolm Graham Wood, the oil and gas adviser for VSA Capital said that: "I think that the gas reserves amount to much more than 25 trillion cubic feet, and all (gas companies) are interested in this wealth," Wood told the UK Times.

## **CASE STUDY**

### **Hubbert Peak Oil Curve**

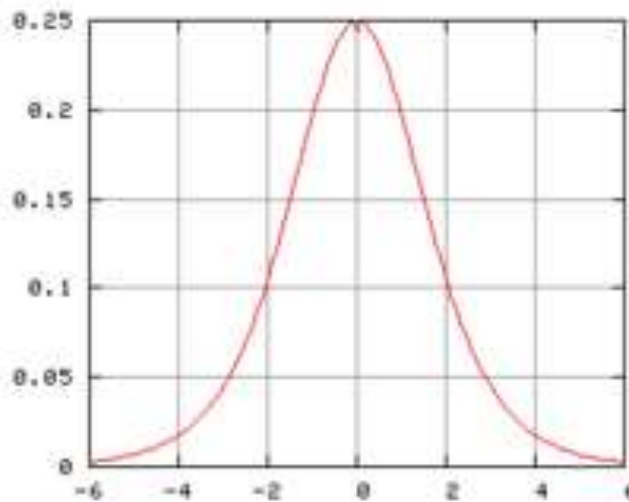
The Hubbert study is to explain the raise in reserves and its relation to technology. Referring to the Hubbert peak oil prediction model for the US, one of the primary theories of peak oil is the Hubbert peak theory which states that for any given geographical area, from an individual oil-producing region to the planet as a whole, the rate of petroleum production tends to follow an inverted U-shape (bell-shaped curve). A post-hoc analysis of peaked oil wells, fields, regions and nations found that Hubbert's model was the "most widely useful" providing the best fit to the data.

Early in the curve (pre-peak), the production rate increases because of the discovery rate and the addition of infrastructure. Late in the curve (post-peak), production declines because of resource depletion. As we all know that petroleum is a non-renewable natural resource, thus The Hubbert peak theory is based on the observation that the amount of oil under the ground in any region is finite.

In the US, oil extraction followed the discovery curve after a time lag of 32 to 35 years. The Hubbert curve satisfies these constraints. Furthermore, it is roughly symmetrical, with the peak of production reached when about half of the fossil fuel that will ultimately be produced has been produced. It also has a single peak.

Given past oil discovery and production data, a Hubbert curve that attempts to approximate past discovery data may be constructed and used to provide estimates for future production. In particular, the date of peak oil production or the total amount of oil ultimately produced can be estimated that way (figure 2).

Figure 2. Hubert peak oil curve

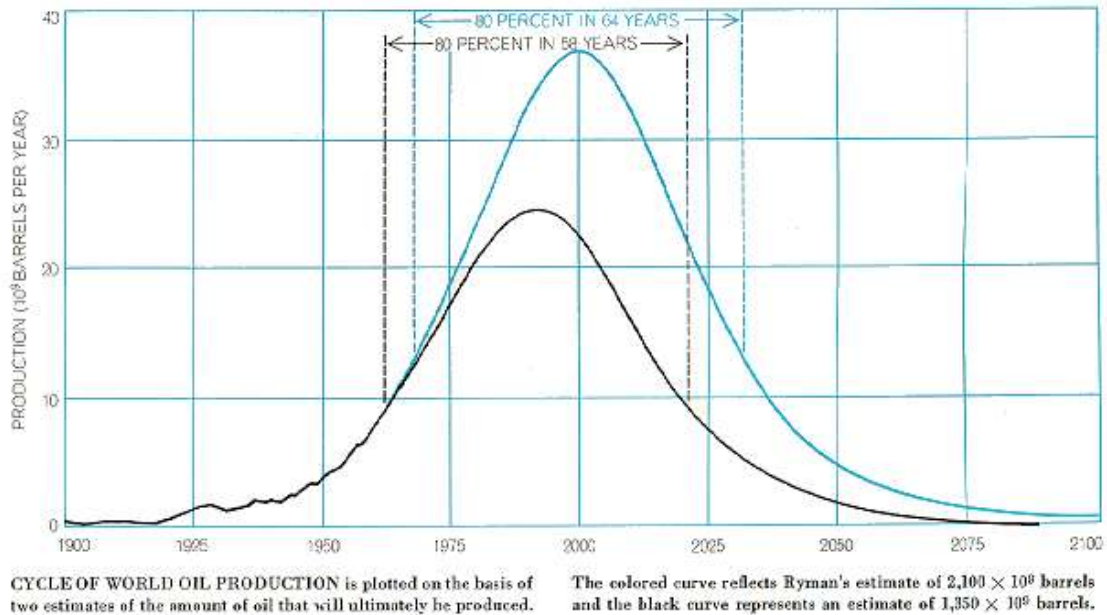


Source: <http://en.m.wikipedia.org/wiki/File:Hubbert-curve.png>

Early in the curve (pre-peak), the production rate increases because of the discovery rate and the addition of infrastructure. Late in the curve (post-peak), production declines because of resource depletion.

As an example we can take the case of the US where the oil production met more than the expected Hubbert estimation. Figure 3 shows the curve of both Hubbert estimated curve and the Observed one.

Figure 3. Hubbert peak oil curve estimated and actual data curve



Source: <http://www.hubbertpeak.com/hubbert/>

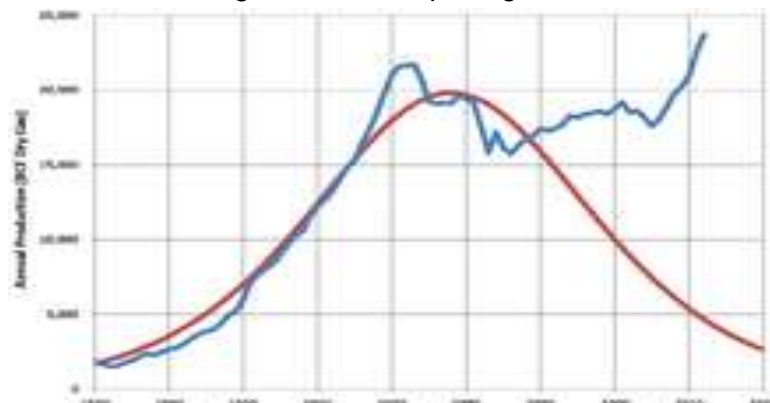
Hubbert's upper-bound estimate, accurately predicted that the US oil production would peak in 1970. Forty years later, the upper-bound estimate has also proven to be very accurate in terms of cumulative production, less so in terms of annual production.

The upper-bound Hubbert model predicts a percentage of cumulative crude oil and condensate of 1% higher than the upper bound estimate, with annual production of 32% lower than the upper bound estimate.

### Natural Gas

Hubbert peak theory has been also applied to other natural resources as peak oil theory received most attention. Hubbert also predicted that natural gas production would follow a logistic curve similar to that of oil (Figure 4 Hubbert, 1989).

Figure 4. Hubbert peak gas curve





## RESEARCH METHODOLOGY

Interview and a questionnaire design were used in the data collection. The interview reflected a great point of view in form of professional and expert discussed information, individual information gained from the interviewee experience, that added value to the study.

The questionnaire, addressed ten questions to different age range, educational background (major) and professional people. Such data collection evaluates the audience, citizens and people opinion about the gas and oil issue. Thus, this data added the level of knowledge each person shared and the percentage of each individual's pinion. Moreover, every person had an equal chance to be selected from the targeted population of the study (random sampling) to instill the highest possible level of accurate representation.

### Survey and Interview Techniques

The covered issues of oil and gas exploration and results in Lebanon consisted of the following results:

- the maritime borders problem with neighboring countries
- the development stages and opportunities and promising revenues
- the economic benefits from the revenues

### Forecasting for Ten Years

Given the statistical information and estimated data by the Ministry of Energy, it could be assumed that Lebanon's total net revenues from gas extraction will exceed \$600 billion, to reach \$1000 billion.

The forecast is for ten years,  $600/10 = 60$  billion/year reserves of crude oil.

If total expected revenues are \$60 billion per year, then how much would Lebanon's share be of net profits?

Consider the following three scenarios:

First, the optimistic scenario:  $\$60 \text{ billion} \times 60\% = \$36 \text{ billion}$  profits per year.

By taking a look at the Lebanese budget in 2015, we get the following numbers in USD:

Government Revenues	\$9,442,666,667
Government Expenditures	\$13,387,333,334
Government Overall Deficit	(\$3,944,666,667)

After adding the estimated optimistic profits to the Government Revenues, the expected Total Government Revenues will be \$45,442,666,667. If government expectation remain constant the government surplus will be equal to  $\$45,442,666,667 - \$13,387,333,334 = \$32,055,333,333$ .

The current public debt is \$63.5 billion, so if Lebanon pays \$10 billion annually to cover the public debt it will take us exactly 6.35 years. ( $\$63.5 \text{ bln} / \$10 \text{ bln} = 6.35 \text{ years}$ )

The rest will be  $\$32,055,333,333 - \$10,000,000,000 = \$22,055,333,333$  can be used to enhance the development of the country.

Moreover, the average scenario:  $\$60 \text{ billion} \times 45\% = \$27 \text{ billion}$  profits per year.

By taking a look at the Lebanese budget in 2015, we get the following numbers in USD:

Government Revenues	\$9,442,666,667
Government Expenditures	\$13,387,333,334
Government Overall Deficit	(\$3,944,666,667)

After adding the estimated average profits to the Government Revenues, the expected Total Government Revenues will be \$36,442,666,667. If government expectation remain constant the government surplus will be equal to  $\$36,442,666,667 - \$13,387,333,334 = \$23,055,333,333$ .

The current public debt is \$63.5 billion, so if only \$ 8 billion are paid annually to cover the public debt it will take us exactly 7.9375 years. ( $\$63.5 \text{ bln} / \$8 \text{ bln} = 7.9375 \text{ years}$ )

The rest will be  $\$23,055,333,333 - \$8,000,000,000 = \$15,055,333,333$  can be used to enhance the development of the country.

Third, the pessimistic scenario:  $\$60 \text{ billion} \times 30\% = \$18 \text{ billion}$  profits per year.

By taking a look at the Lebanese budget in 2015, we get the following numbers in USD:

Government Revenues	\$9,442,666,667
Government Expenditures	\$13,387,333,334
Government Overall Deficit	(\$3,944,666,667)

After adding the estimated average profits to the Government Revenues, the Total expected Government Revenues will be \$27,442,666,667. If government expectation remain constant the government surplus will be equal to  $\$27,442,666,667 - \$13,387,333,334 = \$14,055,333,333$ .

The current public debt is \$63.5 billion, so if we annually pay \$ 7 billion to cover the public debt it will take us exactly 9.071 years. ( $\$63.5 \text{ bln} / \$7 \text{ bln} = 9.071 \text{ years}$ )

The rest will be  $\$14,055,333,333 - \$7,000,000,000 = \$7,055,333,333$  can be used to enhance the development of the country.

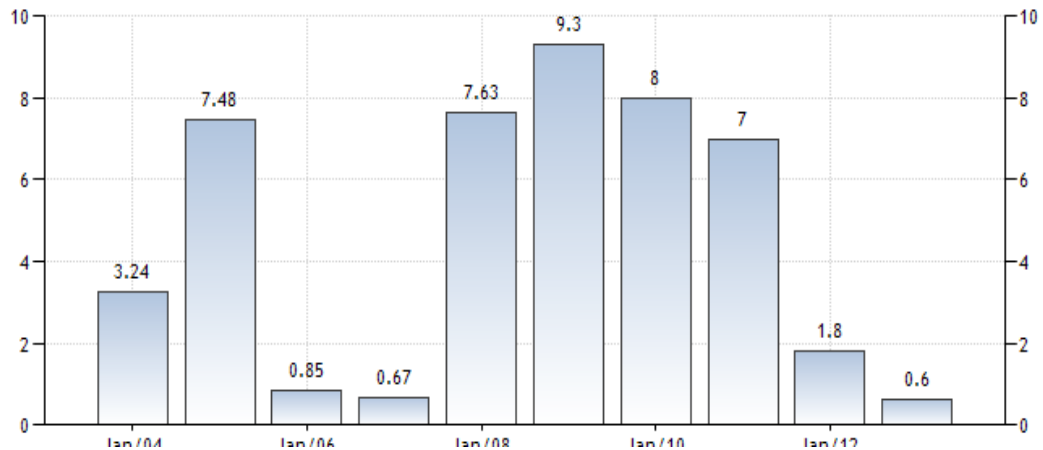
### Lebanon's Public Debt

"The public debt in Lebanon will reach \$76 billion by the end of the current year and is estimated to increase to reach \$80 billion at the end of 2016" according to the minister of finance.

### Gross Domestic Product (GDP)

Gross Domestic Product is the total market value of a country’s output, the market value of all goods and services produced within a given period by the factors of production available within the country. There are three basic factors of production: land, labor and capital. It is the measure of total production of an economy (Figure 5. Shows Lebanon’s economic growth rate).

Figure 5. Lebanon growth rate



Source: tradingeconomics.com

### ANALYSIS AND FINDINGS

The questionnaire is designed to collect information about a sample of people whom the majority majoring in the business field. Table 1, presents the sample of the study as follows:

Table 1. Sample of 110 people

Options	A	B	C	D
Question				
1	5	29	54	22
2	69	41	–	–
3	80	30	–	–
4	90	20	–	–
5	82	28	–	–
6	59	51	–	–
7	57	53	–	–
8	29	81	–	–
9	88	22	–	–

Table 2 indicates the answers of the sampled individuals by percentages as follows:

Table 2. Respondents opinion by percentage

Opinion (by %)	A	B	C	D
Question				
1	4.54%	26.36	49.1	20
2	62.72	37.28	–	–
3	72.73	27.27	–	–
4	81.82	18.18	–	–
5	74.55	25.45	–	–
6	53.64	46.36	–	–
7	51.82	48.18	–	–
8	26.37	73.63	–	–
9	80	20	–	–

**Q 1-** In your opinion how long it will take Lebanon to extract Crude Oil?

- 4.54% answered 2 years
- 26.36% answered 5 years
- 49.1% answered 10 years and above
- 20% answered “never”

The majority answered 10 years and above and that is due to that Lebanon appears to be falling behind its neighbors Israel and Cyprus, who are both closer to extracting their resources and have significantly increased cooperation in recent months. In addition, this delay is likely to increase if the country's politicians cannot sort out the current political dispute.

**Q 2-** After the oil and gas is found in Lebanon will the unemployment rate decrease?

- 62.73% answered yes
- 37.28% answered no

It was expected that the majority of people would answer yes; taking into consideration the fact that many job opportunities will be available as a result of the exploration of oil and gas.

**Q 3-** Do you think that exploration of oil and gas will have a negative impact on political stability?

- 72.73% answered yes
- 27.27% answered no

The majority answered yes, because the Lebanese citizens do not trust the political situation in Lebanon.

**Q 4-** Do you believe that oil and gas products will be monopolized?

- 81.82% answered yes
- 18.18% answered no

More than  $\frac{3}{4}$  of people answered yes. It is normal that the majority of people would say that because according to them, this sector will be monopolized due to the fact that the crucial sectors in Lebanon are dominated by a single producer.

**Q5-** Will the corruption in the country affect the oil and gas sector?

- 74.55% answered yes
- 25.45% answered no

The majority answered yes

Lebanon's Offshore Petroleum Resources Law declares that any contract with energy companies will be based on a production sharing agreement. Under such an agreement, the companies will pay for infrastructure and take the money from the initial sales called 'cost oil'. After the company has recouped its expenses further resources will be split between the government and the company at a fixed rate to be negotiated between the parties.

**Q6-** Do you think that Lebanon will be able to export oil and gas?

- 53.82% answered yes
- 46.18% answered no

Half of people answered yes and the other half no, the Lebanese people are not well informed about the forecast of reserves .i.e., whether this quantity will satisfy Lebanon needs only or it will have an excess that we could be exported.

**Q7-** Will the revenues of oil and gas cover the debt?

- 51.82% answered yes
- 48.18% answered no

Half of people answered yes and the other half no. Lebanon ranked 127<sup>th</sup> based on the corruption perception index, this had led that people not to trust the politicians to use the revenues of this sector in an efficient way.

**Q8-**Will the world price of oil and gas decrease?

- 26.37% answered yes
- 73.63% answered no

The  $\frac{3}{4}$  of people answered no, because petroleum is a non-renewable resource and it is decreasing day after day.

**Q9-**Can Israel steal Lebanon oil and gas?

- 80% answered yes
- 20% answered no

More than  $\frac{3}{4}$  answered yes

In July the energy and water minister made the claim that Israel's development near the disputed maritime border meant that they could steal Lebanon's gas. "Israel could lay a pipeline horizontally to siphon off Lebanese gas, which is sitting only four kilometers away from the new discovered Israeli field,"

**Q 10-**What is your opinion about the dispute between Lebanon and Israel regarding the share / borders of each country? And will this dispute be resolved?

12 didn't answer; 15 answered no; 5 people discussed solutions to make peace with Israel

22 didn't answer; 23 answered no; 19 discussed solutions

2 didn't answer; 3 answered no; 3 said there will be a war; 6 discussed solution

36 didn't answer; 41 answered no; 3 said there will be a war; 30 discussed solution

## **CONCLUSION**

The history background of Lebanon's resources has been used inefficiently up to the current time. The government should use these resources efficiently and try to protect it for not deteriorating. Moreover, the development of the sector of oil and gas is mainly slowed down by political disputes, administrative complications and the conflict of neighboring countries, namely Israel. These factors are negatively affecting the Lebanese economy, thus addressing and managing the Lebanese national gift (oil and gas) in the very near future will save Lebanon from digging in unwanted troubles.

## **RECOMMENDATIONS**

The road towards Lebanon becoming a gas producer is very long and it is still very early for the government and politicians to start planning on how to spend the gas resources in Lebanon, the

balance between the use of gas to meet domestic demand and for export purposes will ultimately determine the companies' profitability, together with their incentive to develop the reserve base. Meeting domestic demand, especially in the power sector, should be a top priority in any government policy. But this requires that Lebanon to have a clear policy regarding the pricing of gas for the domestic market, which is potentially a contentious issue in negotiations between government and companies. Furthermore, since gas demand is strongly interlinked with the evolution of electricity demand, it is essential that the government embark on the reform of the power sector and electricity prices.

Should Lebanon aim at directing its exports towards regional markets by pipelines, or should it invest in the more expensive liquefaction facilities? Ultimately, the complex geopolitical landscape will impact Lebanon's choices over possible monetization options and hence will be pivotal in determining the future direction of gas trade flows. The long-term border conflicts across the region serve as impediments to the realization of synergies and the optimization of resource development. However, Lebanon is in a better position than its neighbors as it has more options – such as pipeline gas exports either to Turkey through Syria or to Jordan and Egypt through the Arab Gas Pipeline – to monetize its reserves in the long term.

## LIMITATIONS

The main limitation of this study is the lack of any data on the accurate stocks of gas and oil in Lebanon. Lebanon has not yet located any land or sea sites to quantify the precise stocks of gas and oil. Moreover, even the solicited opinions of the Lebanese oil and gas experts are hypothetical and limited by the governmental studies that were conducted few years ago. The true economic benefits will depend on a larger array of factors i.e. the true amount of gas and oil extracted, the future market price, and the quality of the gas and oil resources compared to those on the world market.

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