



Environmental and Economic Study About Using Natural Gas for Electrical Power Generation In Samawa Station

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ABSTRACT

This paper aims to show that Natural gas is the cheapest fuel for the electrical power generation in electrical stations and show that Natural Gas the less damage on the environment. The paper is studying about natural gas used in electric generation stations in the field of the environment and future plans for the countries of the world in the construction of many electric -gas stations. The paper show environment-economic comparisons and Calculate quantities and prices between Natural Gas and Fuel Oil used in two electrical power stations. The result the ratio natural gas consumption to electrical power generation is 316 m3/MWH and ratio Fuel oil consumption to electrical power generation is 0.197 m3/MWH. The price of Fuel oil or Diesel is higher than Natural gas, therefore Fuel oil consumption cost for electrical power generation very high. The city of Samawa needs to establish electrical plants that run on natural gas because of the economic and environmental benefits for the city.

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الدراسة البيئية والاقتصادية حول استخدام الغاز الطبيعي لتوليد الطاقة الكهربائية في محطة السماوة

الخلاصة

وتهدف هذه الورقة إلى أن تبين أن الغاز الطبيعي هو أرخص وقود لتوليد الطاقة الكهربائية في المحطات الكهربائية وإظهار أن الغاز الطبيعي أقل ضرراً على البيئة. تدرس الورقة حول الغاز الطبيعي المستخدم في محطات توليد الكهرباء في مجال البيئة والخطط المستقبلية لبلدان العالم في بناء العديد من محطات الغاز الكهربائية. وتظهر الورقة مقارنات بيئية-اقتصادية وتحسب الكميات والأسعار بين الغاز الطبيعي وزيت الوقود المستخدم في محطتي طاقة كهربائية. وتبلغ نسبة استهلاك الغاز الطبيعي إلى توليد الطاقة الكهربائية هي 316 متر مكعب\ ميكا واط لكل ساعة ، ونسبة استهلاك زيت الوقود إلى توليد طاقة كهربائية هي 0.197 متر مكعب\ ميكا واط لكل ساعة. إن سعر زيت الوقود أعلى من الغاز الطبيعي، وبالتالي تكلفة استهلاك الديزل أو زيت الوقود لتوليد الطاقة الكهربائية عالية جداً. تحتاج مدينة السماوة إلى إنشاء محطات كهربائية تعمل على الغاز الطبيعي بسبب الفوائد الاقتصادية والبيئية للمدينة.

الكلمات المفتاحية

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Introduction:

Electricity generation in power stations needs to select the best fuel in terms of environmental and economic impact. Natural gas becomes the optimized selection in all countries of the world in terms of future planning to increase the generation of electric power stations that run on natural gas. Internationally, For example in the United States of America, as shown in Figure (1) U.S.A use Natural gas as an important source for electric power generation. In Figure (1) as a comparison between 2007 and 2013, we note increased from 22% to 27% in the expansion of Natural gas stations compared with other fuel sources used in electrical power generation [1].

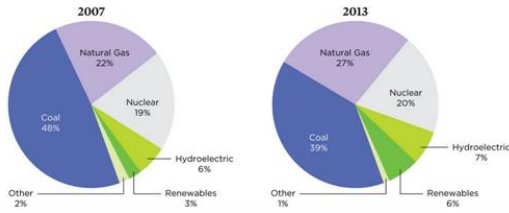


Figure 1: Change in U.S.A electrical generation mix 2007 and 2013 [1]

In all countries in the world, there is an increase in demand for the use of natural gas as a fuel for electric plants levels, especially in economically developed countries such as United States of America and Japan, shown in Figure 2..

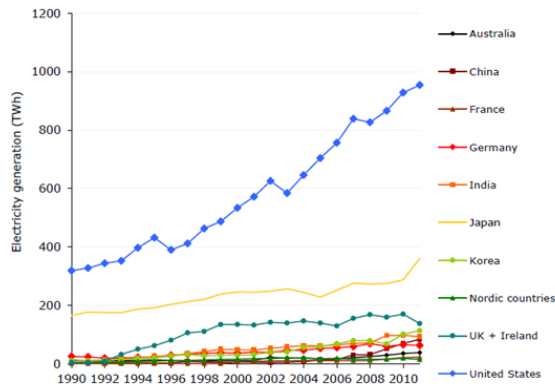


Figure 2 : Gas-fired power generation in some countries of the world for the period 1990 -2010.[2]

For example, In 2012, the electric power industry planned to bring 23.5 GW of new capacity online with 37 percent being natural gas-fired (20 percent wind, 18 percent coal, 12 percent solar, 5 percent nuclear, and 8 percent other).[3]

In the near future, USA expects a significant increase in the generation of electricity by natural gas source because of its advantages in terms of reducing pollution in advanced countries. The United States has always conducted scientifically, as shown in figure (3), to

compare the resources they have and providing the consumer with the most suitable power prices [3].

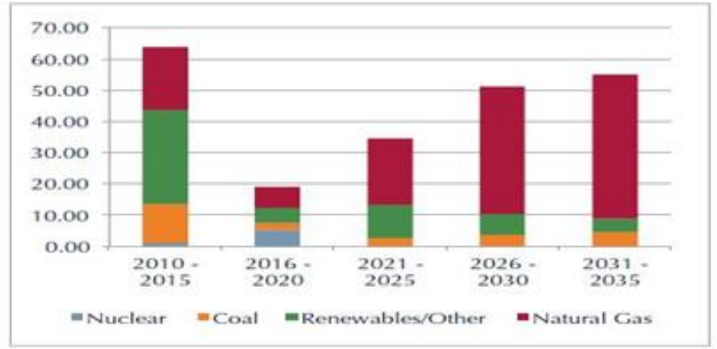


Figure 3 :U.S.A Future Electricity Generation Additions by Fuel Type 2010 - 2035 (GW)[3]

Natural gas associated with oil production considered a problem in Iraq, where the gas emitted with oil production burn and go down the drain every day. Economically, no benefits from natural gas in previous years are achieved in addition to the environmental effects of burning process. It is now the time of economic growth and take advantage of natural gas and increase electrical generating stations that run on natural gas, especially in nearby oil wells regions as a city of Samawa and other Iraqi cities. In this paper, we take two models of fuel used in electrical power plants: fuel oil (diesel), natural gas, and we will hold simple comparison on the amounts of consumption and fuel cost compared with production of electrical power.

As of January 1, 2006, the world proved natural gas reserves estimates are in the range of 6,112 to 7,000 trillion cubic feet. For the Middle East, the natural gas reserves are in the range of 2,542 to 2,590 trillion cubic feet. [4] However, Iraq's natural gas production for the year 2011 was 20 billion cubic meters (706.3 billion cubic feet), of which 12 billion cubic meters (423.7706.3 billion cubic feet) of the natural gas was flared [5] . According to Organization of the Petroleum Exporting Countries, In 2014 Iraq's natural gas production was 771 billion cubic feet, of which 454 billion cubic feet was flared. Iraq was the fourth country in the world of the (natural gas -flaring) after Russia, Iran, and Venezuela.[6] Iraq's natural gas reserves were the twelfth level of world reserves at end 2015. This reserve about 112 trillion cubic feet , About three-quarters of Iraq's natural gas reserves are associated with oil, Most of this reserves are in southern Iraq.[6] With the increasing population growth and increasing demand for electric power, and providing natural gas in huge quantities. Therefore, an increase in this gas investment in the field of production of electrical energy and there are two electrical energy stations in the city of Samawa.

The Negative Effects of Natural Gas in Power Stations on the Environment:

The last studies have shown the size of gases emitted from power plants in the United Kingdom, where these gases (SO₂ , CO₂, NO_x) are toxic and deadly to life on Earth. Gas-Electric stations are less emission of toxic gases, which affect human life ,Because of these gases (SO₂ ,CO₂,NO_x)are the main reason for diseases such as asthma and respiratory. Table 1:shows that the natural gas used in the operation of power stations is the least pollution to the environment and human life, Amounting to the amount of carbon dioxide(CO₂ =0.5) , and increasing (CO₂)in the atmosphere leads to the emergence of the phenomenon of global warming, which leads to rise in temperatures and changing climate and the same thing for nitrogen oxide(NO_x =0.25) and Sulfur dioxide (SO₂ =0).[7] .

Table1: Relative Power Plant Emissions per Unit of Electricity Generated in U.K[7]

Fuel Source	SO ₂	NO _x	CO ₂
Coal (Average Uk)	1.00	1.00	1.00
Coal (typically imported)	0.55	1.00	1.00
Coal(incorporating fuel emission control)	0.10	0.60	1.05
Heavy Fuel -Oil	1.20	0.75	0.85
Natural Gas	0.00	0.25	0.50

While in the case of petroleum products resulting from oil refining operations, Figure 4 shows petroleum products in the oil refinery, the crude oil is causing pollution to the environment, starting from extraction and transport and then refining processes, which cause both air pollution and water pollution. The most important air pollutants are sulfur oxides SO, nitrogen oxides NO_x, carbon monoxide CO , aldehydes, ammonia, particles, and hydrocarbons . Water pollution Discharging effluents into the environment can contaminate surface waters, soil and underground water due to leak or oozing of raw materials or products, Such a condition could be occurred due to tanks' or pipelines' leak [8] .

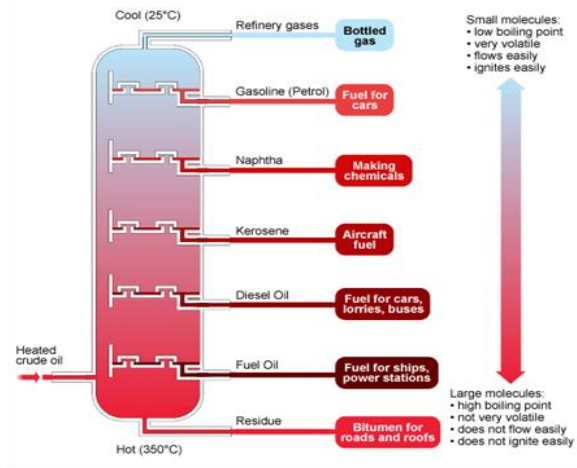


Figure 4: petroleum products in the oil refinery and their uses[9].

Combustion engines internal (power station):

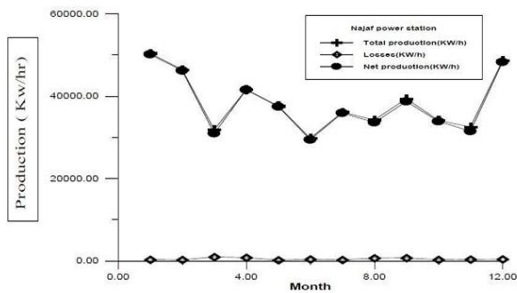
1- Diesel power stations:

This type of power stations working on Fuel Oil or DIESEL . The Fuel Oil expensive it depending on International Petroleum prices . The Fuel Oil producing operations cost a lot of money and design difficult for that type electrical power station . The diesel-electric power station in the city of Samawa has the capacity of 60 MW and four units. We have a comparison between the production of electrical energy and the Fuel Oil consumption process for the year 2010 .Table (2) showing diesel -electric station ,electric power production , consumption of fuel oil , and the cost of fuel oil for the year 2010 .Note that the fuel consumption ratio of electric power generated is 0.197M3/MW*120,000=23640 Iraqi dinars and the cost of one cubic meter of fuel oil is 120,000 Iraqi dinars(\$94).

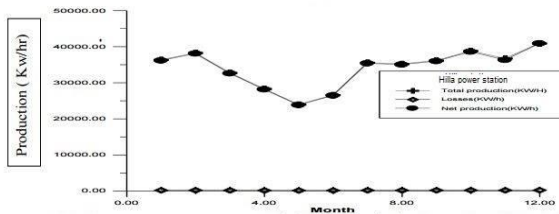
2- Gas turbine power station:.

There is Gas – Electric power station in the city of Samawa Consisting of production units with designed capacity of 40 MW is Characterized by cheap price and ease of maintenance, as well as the electrical losses in the electric gas station be very small compared to other stations . Figure 4:The relationship between the actual production(kw/h) and the final (kw/h) and the value of the electrical power losses(kw/h)[10] .The Figure 4 A , shows losses in Najaf gas station and Figure 4 B shows electrical losses in Hilla gas station. Through Table 3 we note increased electricity production by gas stations. The economic cost of electric gas station production is calculated through the consumption of Natural Gas rate to calculate the electric power generated:((Cubic meters)m³)/((Megawatts)MW). The cost of the one

cubic meter of natural gas is 50 Iraqi dinars=\$ 0.039 cost subsidised by the government: IN 2010 (316 m³/MWh)* 50=15800 Iraqi dinars. Table 3 shows gas-electric Samawa station, electric power production ,consumption of gas and the cost of gas for the year 2010. Through Tables (4 ,5) define the overall ratio of natural gas consumption to the production of electrical energy is (317-320) m³/MWh, Tables (4 5) : shows gas-electric Samawa station, electric power production ,consumption of gas and the cost of gas for the year 2014-2015..



A: electrical power losses (kw/h)in Najaf gas station[10]



B : electrical power losses(kw/h) in Hilla gas station [10].

Figure 4 :A and B:The relationship between the actual production(kw/h) and the final (kw/h) and the value of the electrical power losses(kw/h) [10]

To calculate the rate of Natural Gas or Fuel Oil consumption for the production of electric power m³/MWh:

$$\frac{\text{RECIPIENT NATURAL GAS : } m^3}{\frac{\text{ELECTRICAL POWER GENERATED PER HOUR : MWH}}{\text{FUEL OIL : } m^3}} = \text{ELECTRICAL POWER GENERATED PER HOUR : MWH}$$

Result and Discussions:

we study and compare the environmental and economic impacts of Natural Gas and Fuel Oil used to run power plants. for the problem treatment of power shortage in Iraq . Especially in the city of Samawa, where the city suffers from a shortage of electric power because of the high temperatures during the summer and we have the following observations:

1. **Environment Protection:** Natural gas used in power stations is less pollution on the environment and human life. There are two types of pollution:

***Air pollution:** From Table 1, Three major emissions (SO₂ ,CO₂ ,NO_x)related to global warming were lower in quantities for power stations which depend on natural gas compared to those depending coal or fuel oil.

***Water and Soil Pollution:** In this case Diesel is polluted on the environment because maybe leakage in pipelines or tanks.

2. **Economically:**

A . Natural gas associated with oil production is located in the south of Iraq, which it was formerly wasted by the state, but now there is a good plan for use natural gas associated oil in the electrical sector in the city of Samawa , which is near to natural gas sources.

B. Through the comparison between the power stations that run on Natural Gas and electric power stations in the city of Samawa ,and through the data and readings of the two stations and natural gas consumption rate of the consumer, it is found that , the Gas costs are less than Diesel Fuel in the production of electric energy. The cost of natural gas per electrical power 316M³/MWH*50 Iraqi Dinar=15800 Iraqi dinars while costing diesel per electrical power 0.197M³/MWH*1200 Iraqi Dinar=23640 Iraqi dinars. Table 6 and Figure 6 : Shows a comparison between the electrical power generation, cost diesel fuel consumption and electrical power generation, cost natural gas consumption for the year 2010. That the price of diesel fuel is influenced by the price of oil globally.consumption, and costs. That the price of diesel fuel is influenced by the price of oil globally .

Table2: Diesel-electric Samawa station power in the city , electric power production, consumption of Fuel Oil, and the cost of fuel oil for the year 2010

Month	Received Fuel oil	consumption Fuel oil m ³	electrical power MWH	MAX: MW	Average: MW	Consumption rateM3/MWH	The cost of the Iraqi dinar :fuel oil M3/MWH
January	6607	6393	35716	60	50	0.179	21480
February	5980	6665	32322	60	45	0.206	24720
March	4895	4996	26460	60	37	0.189	22680
April	6266	6551	33872	60	47	0.193	23160
May	5492	5434	29686	56	41	0.183	21960
june	3764	3558	20348	56	28	0.175	21000
July	5803	5191	31368	50	44	0.165	19800
August	3876	3662	22148	47	31	0.165	19800
September	2637	3151	14255	37	20	0.221	26520
October	2089	2856	11293	38	16	0.253	30360
November	2328	3090	12584	42	17	0.246	29520
December	5280	4489	23427	46	33	0.192	23040
Total		56036	293479			0.191	22920
consumption rate m3/MWH						0.197	23640

Table3: Gas-electric Samawa station electric power production in Samawa city and consumption of Gas and the cost of gas for the year 2010

Month	Received Natural gas:m3	Natural gas consumption:m3	electrical power MWH	MAX: MW	Average MW	Consumption gas rate:M3/MWH	The cost of the Iraqi dinar :Natural gasM3/MWH
January	7427542	7427542	18837	30	25	394	19700
February	5226493	5226493	16557	32	29	316	15800
March	5856528	5856528	18246	31	27	321	16050
April	6360672	6360672	19618	31	27	324	16200
May	6913440	6913440	21492	31	29	322	16100
june	6225324	6225324	18648	32	27	334	16700
July	6246802	6246802	18431	31	27	339	16950
August	5552602	5552602	15934	31	22	348	17400
September	6547195	6547195	19135	31	28	342	17100
October	5721017	5721017	14874	31	22	385	19250
November	215064	215064	582	30	24	370	18500
December	0	0	0	0	0	0	0
Total	62292679	62292679	182354			342	17100
Natural gas consumption rate m3/MWH						316	15800

Table4: Gas-electric Samawa station electric power production and consumption of gas and the cost of Gas for the year 2014.

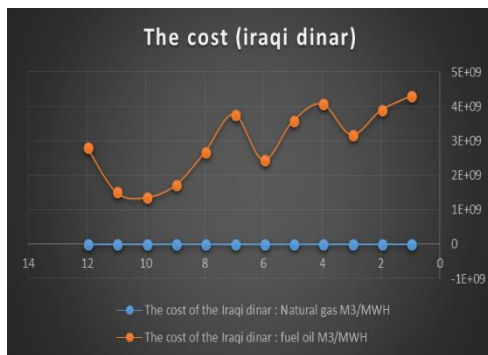
Month	Received Natural gas:m3	Natural gas consumption :m3	electrical power MWH	MAX: MW	Average: MW	Consumption gas rate:M3/MWH	The cost of the Iraqi dinar :Natural gasM3/MWH
January	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-
May	160320	160320	501	8	6	320	16000
june	1612800	1612800	5041	30	17	320	16000
July	477760	477760	1493	29	20	320	16000
August	-	-	-	-	-	-	-
September	1001280	1001280	3129	25	10	320	16000
October	1664640	1664640	5202	34	20	320	16000
November	3828488	3828488	12448	36	23	308	15400
December	6216880	6216880	19459	36	27	319	15950
Total	14962168	14962168	47273			317	15850

Table5: Gas-electric Samawa station electric power production and consumption of gas and the cost of Gas for the year 2015.

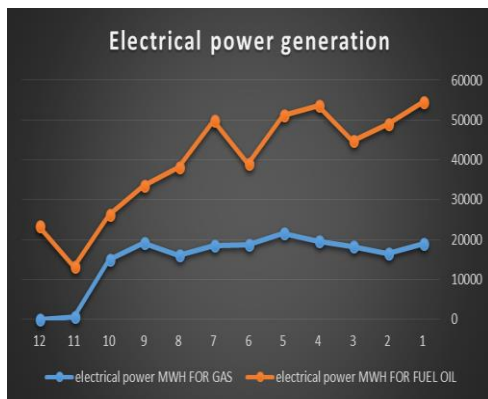
Month	Received Natural gas:m3	Natural gas consumption :m3	electrical power MWH	MAX: MW	Average: MW	Consumption gas rate:M3/MWH	The cost of the Iraqi dinar :Natural gasM3/MWH
January	3856960	3856960	12053	33	19	320	16000
February	5429440	5429440	16967	36	28	320	16000
March	4870080	4870080	15219	36	29	320	16000
April	538580	538580	1683	30	21	320	16000
May	3996800	3996800	12490	30	24	320	16000
june	2750080	2750080	8594	29	20	320	16000
July	2255680	2255680	7051	31	14	320	16000
August	3320000	3320000	10375	26	16	320	16000
September	1660560	1660560	5158	30	23	322	16100
October	3833280	3833280	11979	30	18	320	16000
November	6417280	6417280	20054	35	30	320	16000
December	5040320	5040320	15751	35	30	320	16000
Total	43969060	43969060	137374			320	16000

Table 6: A comparison between the electrical power generation, cost diesel fuel consumption and electrical power generation , cost natural gas consumption for the year 2010.

Month	electrical power MWH for fuel oil	The cost of the Iraqi dinar : fuel oil M3/MWH	electrical power MWH for gas	The cost of the Iraqi dinar : Natural gas M3/MWH
January	35716	4285920000	18837	941850
February	32322	3878640000	16557	827850
March	26460	3175200000	18246	912300
April	33872	4064640000	19618	980900
May	29686	3562320000	21492	1074600
June	20348	2441760000	18648	932400
July	31368	3764160000	18431	921550
August	22148	2657760000	15934	796700
September	14255	1710600000	19135	956750
October	11293	1355160000	14874	743700
November	12584	1510080000	582	29100
December	23427	2811240000	-	-
	293479	35217480000	182354	9117700



A. Cost Of Consumption



B. Electrical Power

Figure 6 A and B: A comparison between the electrical power generation, cost diesel fuel

consumption and electrical power generation, cost natural gas consumption for the year 2010.

C . From Figure 4 shows that the losses in the electrical energy in the gas power stations are the least.

D. D. Extracted Fuel Oil through the oil refining process, while natural gas comes out directly without the need to second process.

E. From Table 3&Table 4 Shows the difference between the cases of receipt and consumption of fuel oil for many reasons leads to economic disadvantages, and this is not found in natural gas, where the amount of the receipt is the same amount of consumption of natural gas.

Power stations that run on Natural Gas is economically and environmentally the most successful, the most appropriate for the city of Samawa , Because we have in the city large areas that can be exploited to create these power stations in order to deal with the shortages of electric power for the city, and necessary to remove small generators from the city.

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