



Role of Natural Gas in Producing Electricity in Afghanistan

Alyas Aslami*

Kabul University, Afghanistan | elyasaslami08@gmail.com

Correspondence Author*

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Abstract

This article depicts the role of natural gas reserves in Afghanistan on the production of electricity of the country. Also, this study estimates the impacts of electricity generation from natural gas on imported electricity. Afghanistan has 62nd position in the gas reserves in the world, 79th position in the production of natural gas in the world, and 104th position in the consumption of natural gas in the world. Afghanistan has 1,750,000 million cubic feet natural gas reserves, 6,675 million cubic feet production of natural gas per annum, and 5,163 million cubic feet consumption of natural gas per annum. Afghanistan position in imports and exports of natural gas is zero in the world. Afghanistan's natural gas reserves is 16.2 trillion cubic feet that located in the northern, Amu-Darya and Afghan-Tajik that it can be respondent to energy demand of Afghanistan's people. At present, the imports of electricity from neighbor countries is 4,900 GWh per year. To carry out this study, we have used from secondary data that collected from reliable academic sources. Descriptive analysis and quantitative approach is used for analyzing the data. The result shows that electricity generation from the natural gas reserves of Afghanistan is 1,260.45 GWh per year. This amount can reduce the imported electricity from 4,900 GWh to 2,592.55 GWh.

Keywords: Natural gas, Electricity, Energy, Afghanistan, electricity Imports

Introduction

Afghanistan has huge amount of fossil fuel resources, such as coal, oil, and natural gas. The worth of Afghanistan's mineral mines is about \$1 trillion. Not sufficient researches have been carried out in the area of electricity production from energy resources due to political and economic crisis in Afghanistan (SHARIFI, MOHSINI, ASLAMI, NOORI, & PATMAL, 15 September 2023).

The huge percentage of electricity generation in Afghanistan is from non-renewable energy and renewable energy makes the small part. Afghanistan has 5.55 billion kwh capacity

production of electricity. Currently, the most percentage of electricity in Afghanistan is from neighbor countries, such as Tajikistan and Uzbekistan. (SHARIFI, MOHSINI, ASLAMI, NOORI, & PATMAL, 15 September 2023) (Qasimi, Isazade, & Toomanian, 2022)

At present, only oil power plants are active in several locations for electricity generation and zero natural gas and coal power plants. (SHARIFI, MOHSINI, ASLAMI, NOORI, & PATMAL, 15 September 2023). Sheberghan natural gas power plant has planned for 2025-2032 with 400 MW capacity. (Rahmaty , Ershad , & Sabory , 2020)

Natural gas plays a key role in the world. Natural gas provides 23% energy demand of the world. Also, natural gas play key role future growth of global energy. Natural gas is the suitable option to achieve two significance aim for the 21st century, providing the sustainable energy supply and mitigating hazardous impact on global climate change. (J.Economides & A.Wood, July 2009) In 2022, the total electricity generation in the world from natural gas was estimated about 20%. (Electricity-Energy System-IEA, n.d.)

In 1989, about 80% natural gas was generated from Sheberghan gas field and was exporting to the Soviet Union. Afghanistan has 15.6 trillion cubic feet of natural gas in two northern basins of Amu-Darya and Afghan-Tajik. 16.2 trillion cubic feet of discovered reserves in northern Afghanistan. (Mehrad , Zvolinski, Kapralova, & Niazmand , 2020)

Afghanistan position in gas reserves is 62nd, 79th in gas production, and 104th in gas consumption as shown in (Table 1). Afghanistan has huge gas reserves equivalent to 299.8 times its yearly consumption. (Afghanistan Natural Gas , n.d.)

Table 1. Shows the ranking of Afghanistan in natural gas reserves, production, consumption, yearly surplus, imports, and exports in the world (Afghanistan Natural Gas , n.d.).

	Million Cubic Ft (MMcf)	Global Rank
Gas reserves	1,750,000	62nd in the world
Gas production	6,675	79th in the world
Gas consumption	5,163	104th in the world
Yearly surplus	+ 1,512	
Gas Imports	0	
Gas Exports	0	

The objective of this study, estimation of the contribution of natural gas resources in electrical power generation and its impact on electricity imports in the country.

Literature Review

People of Afghanistan in the winter often use from non-refined materials, for instance wood, dung, and waste materials for heating homes. This is the main reasons of diseases in the

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country. In general, people of Afghanistan consume 40% wood, 40% coal, 10% natural gas, and 10% electricity in the winter for heating homes. (SHARIFI, MOHSINI, ASLAMI, NOORI, & PATMAL, 15 September 2023)

About 70-80% amount of energy of the world is provided by non-renewable sources. (Siddik , Islam, Zaman , & Hasan , December 2021) The energy demand in the world is growing, such as in china demand of in energy was increased due to growth of economic. (Shalaeva, et al., 2020) In 2019, the natural gas consumption and production reached in high level 3439.4 Mtoe and 3376.1 Mtoe. In 2019, natural gas production increased 3.4% and consumption of natural gas increased 2% as shown in (Figure 1). In 2019, the five largest producers of natural gas in the world were the United States, Russian Federation, Iran, Qatar, and China as shown in (Figure 2). These countries produced 55% natural gas of the world. (Siddik , Islam, Zaman , & Hasan , December 2021)

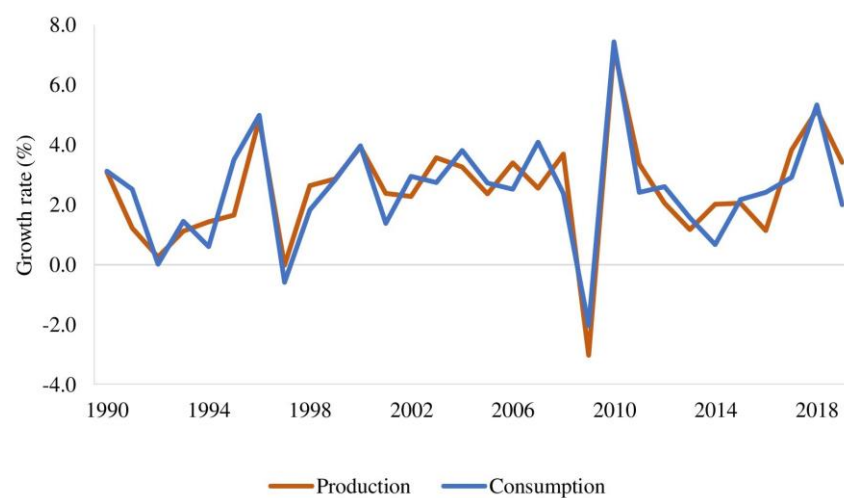


Figure 1. Annual growth rate of natural gas production and consumption.(1990-2019) (Siddik , Islam, Zaman , & Hasan , December 2021)

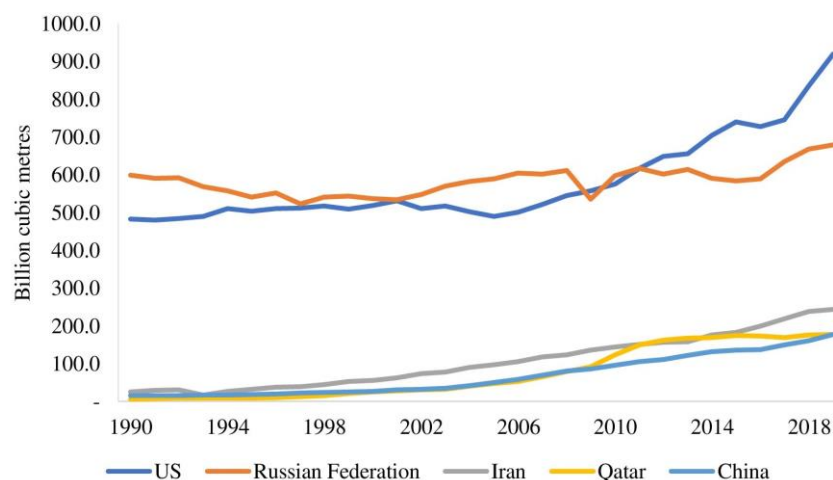


Figure 2. Annual natural gas production during 1990-2019 by the five largest producers of 2019. (Siddik , Islam, Zaman , & Hasan , December 2021)

In 2019, the five largest consumers of natural gas in the world were United States, Russian Federation, China, Iran, and Canada as shown in (Figure 3). These countries consumed about 49.4% natural gas in the world. (Siddik , Islam, Zaman , & Hasan , December 2021) (Shalaeva, et al., 2020)

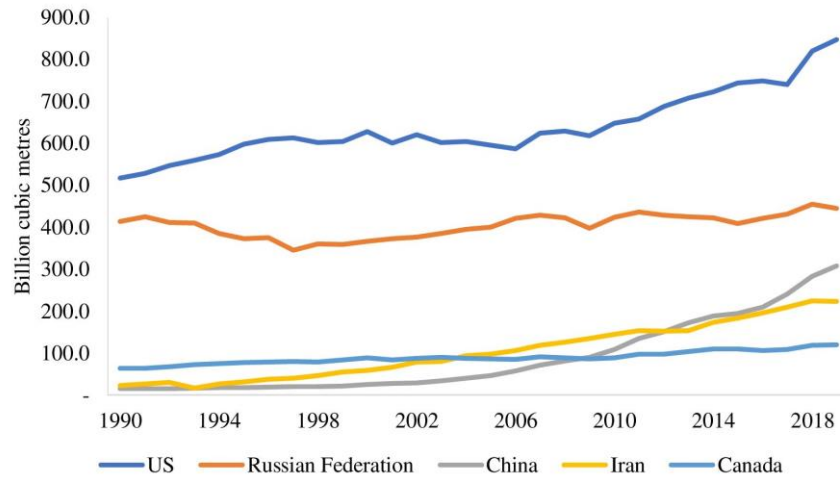


Figure 3. Annual natural gas consumption during 1990-2019 by the five largest countries of 2019. (Siddik , Islam, Zaman , & Hasan , December 2021)

Afghanistan's Electricity production, consumption, and imports

The US Energy Information Administration was reported the consumption, production and imports of Afghanistan electricity in 2019 as shown in (Table 2) and (Figure 4). The United Nation Statistical Division was estimated the total household electrical consumption about 3.4 GWh in 2020. (SHARIFI, MOHSINI, ASLAMI, NOORI, & PATMAL, 15 September 2023)

Table 2. Total amount of electrical energy consumption, production and import of fghanistan in 2019. (SHARIFI, MOHSINI, ASLAMI, NOORI, & PATMAL, 15 September 2023)

Electricity	Total	per capita
Own consumption	5.9 bn kWh	138.72 kWh
Production	1.1 bn kWh	30.40 kWh
Import	4.9 bn kWh	110.45 kWh

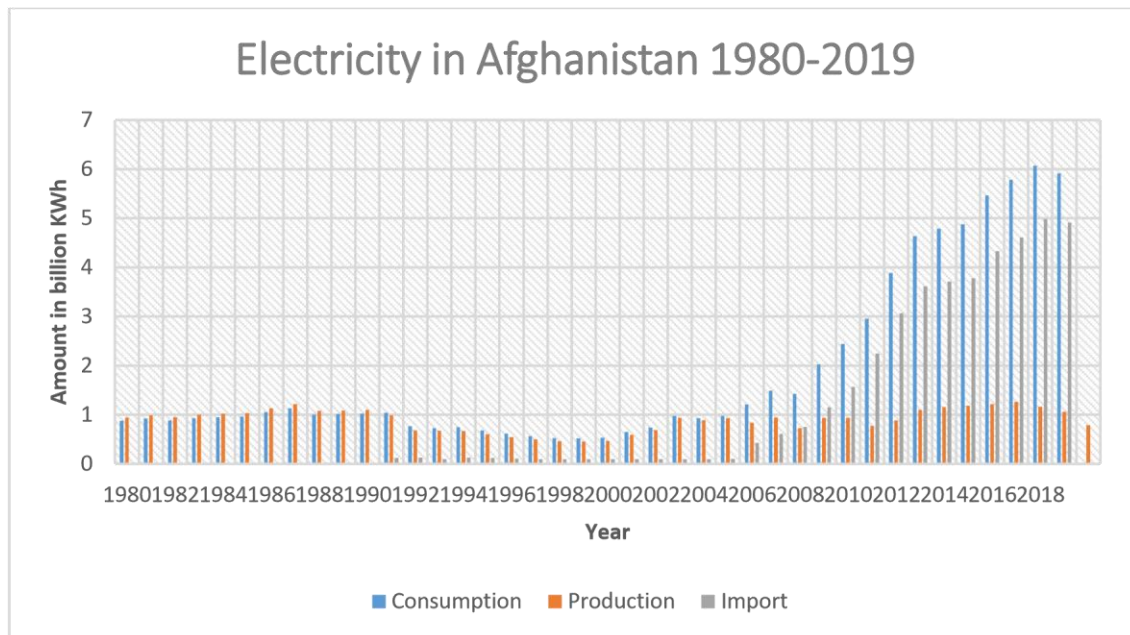


Figure 4. Electricity production, consumption, and imports level of Afghanistan between the years 1980-2019. (SHARIFI, MOHSINI, ASLAMI, NOORI, & PATMAL, 15 September 2023)

Potential electricity generation capacity by source

The potential capacity of electrical production by source is shown in (Table 3). Theoretical value of generation capacity for electric energy is only feasible under the ideal condition. They are measuring the entire energy that would be produced. Also, the wind and water power plants are not always operating under full load. (SHARIFI, MOHSINI, ASLAMI, NOORI, & PATMAL, 15 September 2023) According to Energy Information Administration, one cubic foot natural gas is equal to 0.14 kWh electricity energy. (Energy Information Administration , n.d.)

Table 3. Source based electricity generation potential of Afghanistan. (SHARIFI, MOHSINI, ASLAMI, NOORI, & PATMAL, 15 September 2023)

Energy source	Total	Percentage	per capita
Fossil fuels	2.50 bn kWh	45.0 %	62.75 kWh
Nuclear power	0.00 kWh	0.0 %	0.00 kWh
Water power	2.89 bn kWh	52.0 %	72.51 kWh
Renewable energy	222.19 m kWh	4.0 %	5.58 kWh
Total production capacity	5.55 bn kWh	-	139.44 kWh
Actual total production	1.21 bn kWh	21.8 %	30.40 kWh

Share renewable and non-renewable sources in electricity production

Electricity generation in Afghanistan from renewable and non-renewable energy resources are shown in (Table 4). This data is according to a research conducted by

International Renewable Energy Agency (IRENA) in 2020. (SHARIFI, MOHSINI, ASLAMI, NOORI, & PATMAL, 15 September 2023)

Table 4. Current domestic electricity generation by source in Afghanistan 2020. (SHARIFI, MOHSINI, ASLAMI, NOORI, & PATMAL, 15 September 2023)

Generation in 2020	GWh	%
Non-renewable	135	12
Renewable	995	88
Hydro and marine	933	83
Solar	63	6
Wind	0	0
Bioenergy	0	0
Geothermal	0	0
Total	1128	100

Natural gas reserves, annual production, and consumption

Afghanistan possesses 15.6 trillion cubic feet of natural gas in two northern basins of Amu-Darya and Afghan-Tajik. 16.2 trillion cubic feet of discovered reserves in northern Afghanistan. In 2019, Afghanistan's natural gas consumption was 17% as shown in (Figure 5). Also, Afghanistan's natural gas production was estimated 4,544.9 million cubic feet in 2019 as shown in (Figure 6). Natural gas production in Afghanistan is from the Amu Darya and Afghan-Tajik basins. (Mehrad , Zvolinski, Kapralova, & Niazmand , 2020)

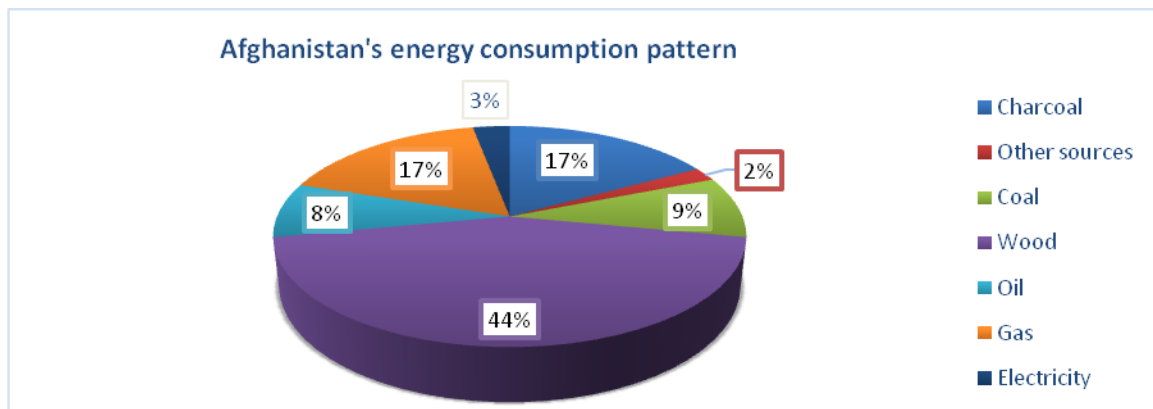


Figure 5. Afghanistan's energy consumption pattern 2019. (Mehrad , Zvolinski, Kapralova, & Niazmand , 2020)

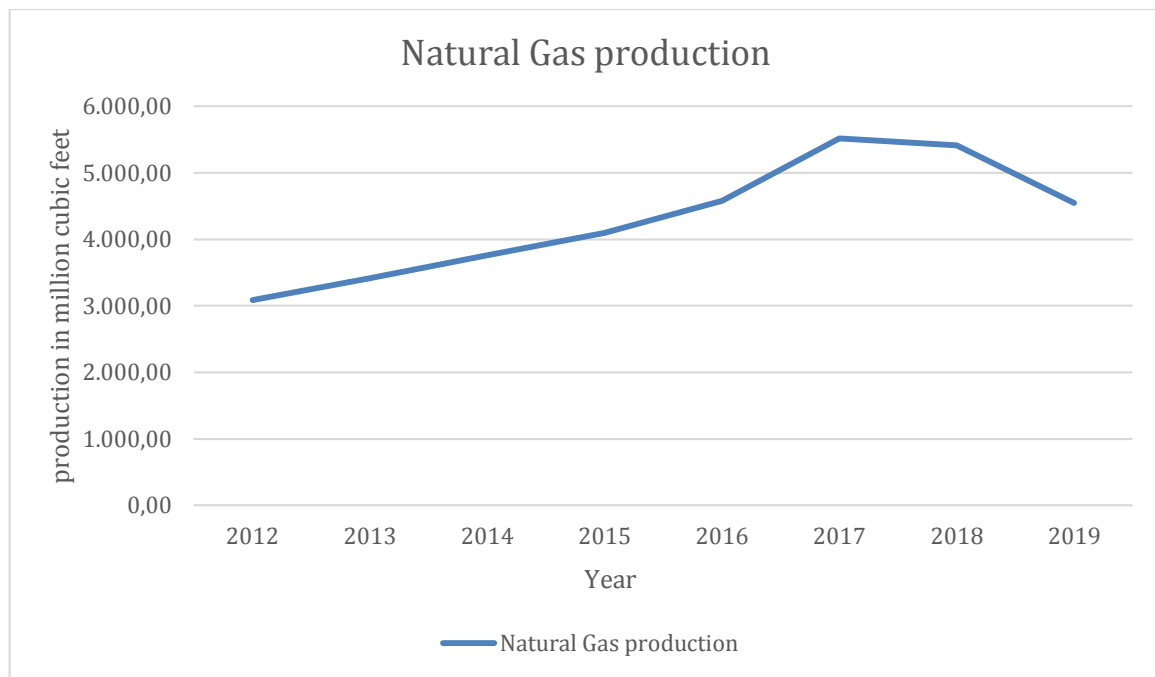


Figure 6. Afghanistan's natural gas production between 2012-2019.

Research Method

In this study we have used from secondary data that collected from reliable academic sources, such as academic manuscripts and reports. The data used were primarily collected via interviews conducted by various national and international organizations and laboratory tests. We have used from tables and figures in the literature review for achieving the results. The Energy Information Administration experimental laboratory tastes was estimated that one cubic foot natural gas is equal to 0.14 kWh electricity energy. To achieve the result of this study, we have used from quantitative method to analyze the collected data, present results, and calculation with the help of formulas, figures and tables.

Results

Potential electricity production capacity of natural gas reserves

From one cubic foot natural gas can be generated 0.14 kWh or (0.00000014 GWh) electricity energy. Afghanistan natural gas reserves is about 16.2 trillion cubic feet that can generate 4,747,751.34 GWh electricity in total. Afghanistan's annually consumption of electricity is about 4,442 GWh as shown in (Figure 7). Therefore, Afghanistan can supply its electricity demand for 1,068.83 years with only using its natural gas reserves.

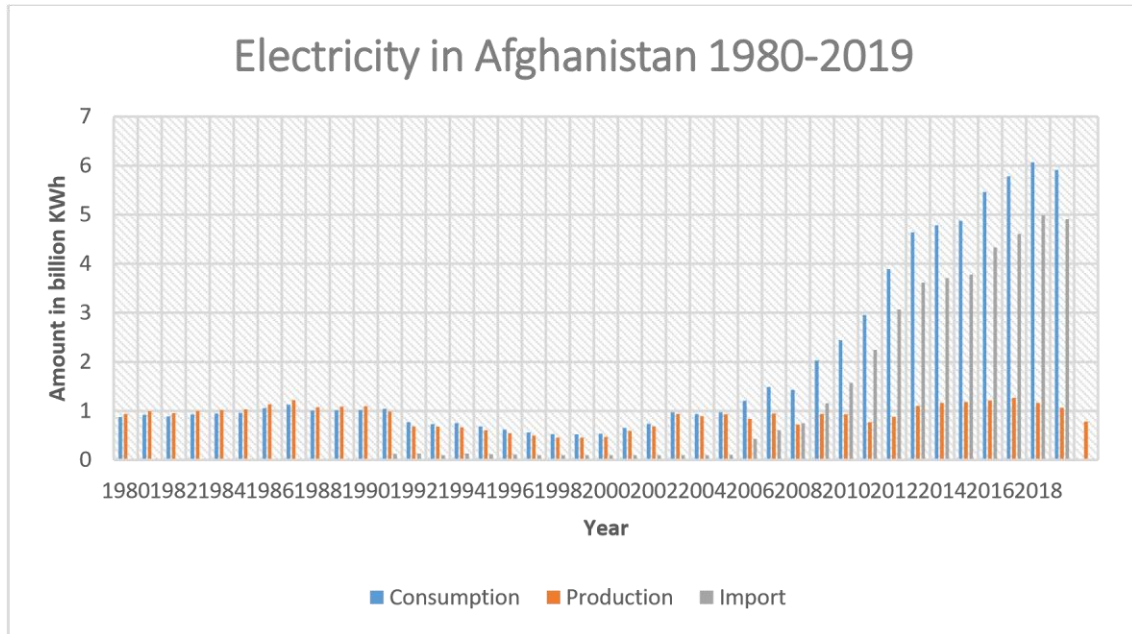


Figure 7. Electricity production, consumption, and imports level of Afghanistan between the years 1980-2019.

Potential electricity production capacity (GWh) = (Energy cubic feet of natural gas) $(2.9307107017222E-7)$

Potential electricity production capacity (GWh) = (16,200,000,000,000 cubic feet) $(2.9307107017222E-7)$ = 4,747,751.34 GWh

Total Years for a single source to meet the annual electricity demand = (Electrical capacity of the source) / (Annual Energy Consumption)

Total Years for a single source to meet the annual electricity demand = (4,747,751.34 GWh) / (4,442 GWh / year) = 1,068.83 years

The role of natural gas generated electricity to imported electricity and generation

We found that the average of natural gas production between 2012-2019 is approximately 4,300.84 million cubic feet and can generate 1,260.45 GWh electricity annually. We found that the average of electricity generation of Afghanistan is 1,047 GWh between 2010-2020. With addition of annual electricity from natural gas will increase to 2,307.45 GWh and reduce the imported electricity from 4900 GWh to 2592.55 GWh as shown in (Figure 8).

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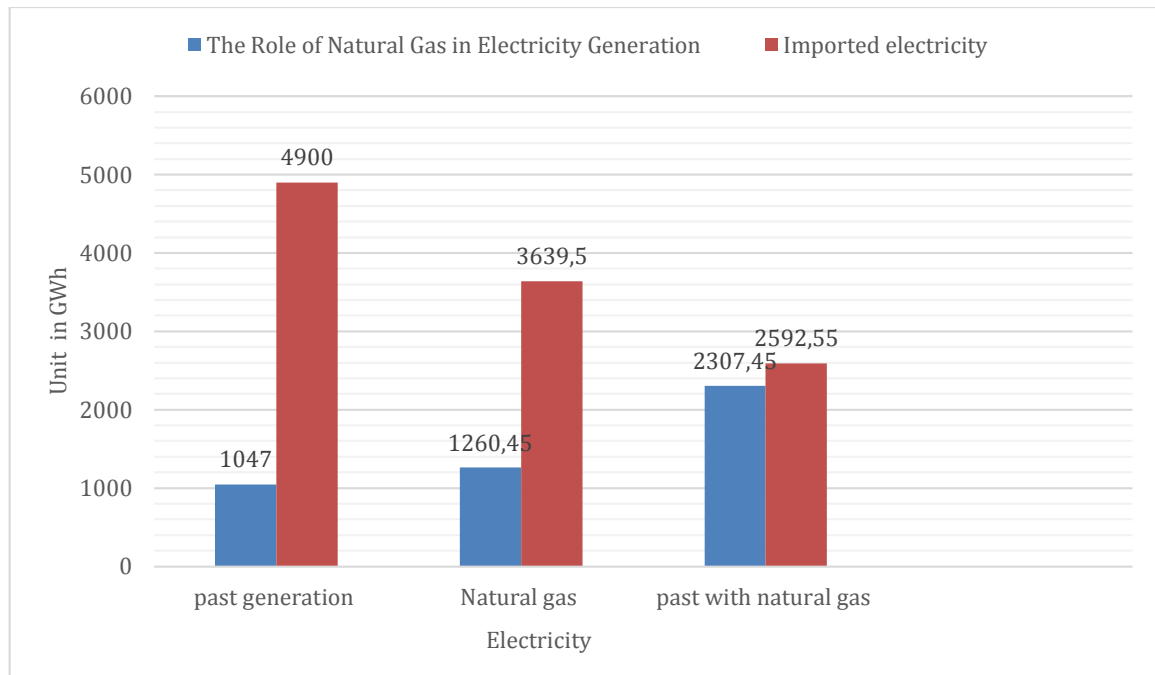


Figure 8. The role of natural gas in producing electricity in Afghanistan.

Discussion

Natural gas is very important source to produce electricity in Afghanistan. Afghanistan has huge amount of natural gas reserves and it can provide the necessary energy demand of Afghanistan people. At present, Afghanistan relies to imported electricity that it is unreliable. Electricity generation form natural gas reserves can decrease the imported electricity. If Afghanistan develop its annual production of natural gas, the imported electricity will be reduced to zero.

Conclusion

Afghanistan has large reserves of fossil fuel. The natural gas reserves are located in the northern of Afghanistan that the total amount of Afghanistan's northern reserves are 16.2 trillion cubic feet. The most electricity generation in Afghanistan is from fossil. Afghanistan's position in the reserves of natural gas is 62nd and 79th in production in the world. Afghanistan import about 4,900 GWh electricity form neighbor countries. one cubic foot natural gas is equivalent to 0.14 kWh electricity energy. Afghanistan possesses 16.2 trillion cubic feet natural gas and can generate 4,747,751.34 GWh electricity only from natural gas reserves. Afghanistan has 4,442 GWh consumption of electricity per year and 4,747,751.34 GWh electricity energy is sufficient for 1,068.83 years. Currently, Afghanistan has 1047 GWh electricity production and 4,900 GWh imports, the annual production electricity form natural gas in Afghanistan is estimated 1,260.45 GWh that it can reduce imported electricity from 4,900 GWh to 2,592.55 GWh.

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