Global Scientific JOURNALS

GSJ: Volume 11, Issue 1, January 2023, Online: ISSN 2320-9186
www.globalscientificjournal.com

Review of Afghanistan's Renewable Energy Sector: Prospects and Challenges

Mohammad Faisal Kashifi, Prof. Dr. Ing. Martin Garbrecht

Kazakh-German University (DKU), st. Pushkin, 111, 050010 Amaty, Kazakhstan

UNIVERSITY FOR APPLIED SCIENCES (HAW) HAMBURG, Hamburg and 2103, Germany

Email: student.kashifi@dku.kz

Email: Martin.Garbrecht@haw-hamburg.de

Abstract

Energy availability is critical not just for economic progress, but also for any attempt to enhance a country's health and social welfare. Afghanistan's energy industry is in disarray as a result of many years of conflict and neglect. Despite foreign organizations' assistance and recent energy regulations, Afghanistan lacks widespread access to power. Furthermore, the electricity supply is distributed irregularly in the dwellings. There is an increasing imbalance between demand and supply, and current demand forecasts do not reflect reality due to slowed economic development. The capacity of Afghanistan's power industry to become self-sufficient in electricity generation would be critical to its sustainability and security. Thus, the goal of this research is to review Afghanistan's present energy situation and to identify energy prospects for self-sufficiency as well as problems in many parts of energy sources. Afghanistan can develop its indigenous hydrocarbon and renewable energy resources to fulfill energy demand. Afghanistan can meet its primary energy needs by increasing its domestic energy potential from natural resources. Furthermore, with the proper and planned execution of renewable energy policies, energy efficiency objectives, and strategies, Afghanistan may achieve energy self-sufficiency goals while also advancing socioeconomic growth.

1 INTRUDUCTION

Asia has a huge impact on global energy and environmental trends. The region's energy policies affect nearly half of the world's population in a variety of social and health dimensions. Government actions in Asia regarding energy production and consumption, energy conservation, and greenhouse gases all have an influence on global greenhouse gas emission levels and environmental conditions [1]. Afghanistan, a landlocked country, is strategically located. Afghanistan is the world's 41st biggest nation, with a population of around 29.7 million (as of the 2017 update) and a total area of 652,864 km2 [2]. Four decades of strife, civil war, foreign intervention, and political instability have impeded the country's development and negatively damaged its economic progress. However, after the security transition in 2014, the last 10 years have seen rapid development, but poverty has risen to 54.5% [3]. Access to stable and affordable energy sources leads to economic growth. Any effort to improve a country's health and social welfare must incorporate energy availability. Various conflicts have destroyed Afghanistan's energy generation, transmission, and distribution facilities. Foreign development groups have prioritized the development and rehabilitation of the country's physical capital since 2001. Progress is hampered by the substantial damage and high costs necessary [4]. The country's growth has been impeded, and itched over Afghanistan has one of the world's lowest energy consumption rates per person, with fuel wood accounting for more than 85% of total energy use [5]. In compared to the global average of 2728 kWh, Afghanistan's annual per-capita power consumption is low at 150 kWh. Because of the growing supply-demand imbalance in Afghanistan, 85 percent of the local population still lacks consistent access to electricity [6]. Afghanistan's government has undertaken efforts to improve and expand the country's energy system, with power exchange with Central and South Asia being one of its key goals.The national grid, however, won't be able to provide service to the entire country in the near future due to its inadequate infrastructure [7]. In this context, the goal of the current study is to assess Afghanistan's energy situation in order to enhance chances for energy self-sufficiency in the nation, and then to identify any barriers that might stand in the way of achieving energy self-sufficiency.

2 AFGHANISTAN'S ENERGY OUTLOOK

Due to factors such as population growth, GDP growth, energy price changes, historical changes in energy intensity, per capita consumption, domestic energy conditions, and energy availability, demand for electricity in Afghanistan is rapidly increasing. There is insufficient information available on rural energy consumption in Afghanistan. Rural Afghans are poor by most countries' standards, with more than 20.4% unable to meet the minimal level of dietary energy required to maintain a healthy lifestyle [8].

2.1 Demand for energy

According to the power sector master plan for Afghanistan, the net demand is predicted to increase from 2,800 GWh in 2012 to 15,909 GWh in 2032, with an average annual growth rate of 9.8 percent [9]. Even before Afghanistan's domestic energy supplies become fully accessible, forecasts showed that Afghanistan would need new energy supplies to meet its demand [6]. It is claimed that local resources could meet Afghanistan's mid-term primary energy needs provided the energy supplies are efficiently and successfully managed (2014-15 to 2024-25). The possibility exists that Afghanistan might quickly become energy independent thanks to its own energy resources [6]. The study claims that identified hydrocarbon reserves in Afghanistan have the potential to supply up to 80% of its needs for petroleum products [10].

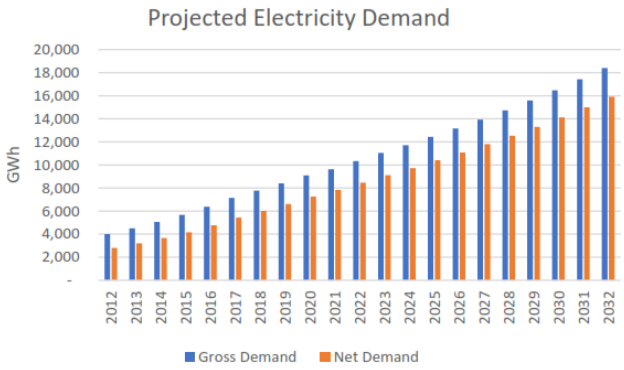

Fig 1. Projected electricity demand for Afghanistan from 2012 to 2032 [9]

2.2 The potential and supply of energy

The current power supply system in Afghanistan is deficient in a number of aspects, including flexibility, capability, cost of domestic supply, and regional geographic coverage [9]. Despite the fact that the availability of electricity nearly tripled between 2006 and 2011, Afghanistan still has a poor level of energy access. Only 30% of Afghans have access to electricity, according to the Ministry of Energy and Water (MEW). The electrification rate in Kabul is currently between 70 and 75 percent, but about 85% of people in rural areas lack access to the energy they need on a daily basis [6]. Kerosene, hydropower, and diesel are the sources of the commercial electrical energy. The most promising renewable energy sources are hydropower and solar energy, but their high initial costs are a major barrier [8]. Only 9% of the population has access to intermittent public power, and the nation depends significantly on electricity imports from its neighbors [5]. According to Da Afghanistan Breshna Sherkat (DABS), just 22.6% of the country's electricity is produced domestically; the remaining 77.4% is imported. Uzbekistan (35.3%), Tajikistan (30.7%), Iran (21.7%), and Turkmenistan (12.3%) are the countries that supply. Transmission capacity is limited, despite the fact that Uzbekistan is the major foreign source [11].

Table 1: Imports of electricity from neighboring countries [12]

Country	Apr 2013-Mar 2014	Apr 2014-Mar 2015	Apr 2015-Mar 2016
Tajikistan	947179	1137602	1179581.05
Uzbekistan	1392581	1242839	1356475.46
Turkmenistan	398586	427702	472958.96
Iran	839570	869143	831724.79
Total Imports	3577916	3677285	3840740

The Afghan government has greatly increased the availability of electricity for residential use with the aid of the International Development Organization. However, there is still a problem with the production of fossil fuels, domestic power, and an appropriate and reliable supply of energy. The installed grid-connected capacity of Afghanistan is roughly equally split between hydropower and thermal. Off-grid renewable energy sources including huge hydropower, solar, wind, and biomass provide an even distribution of energy. According to Figure 2 [12], of the 623 MW of domestic installed capacity, 312.5 MW comes from thermal energy, 255.5 MW from hydropower, and 55.0 MW from renewable energy.

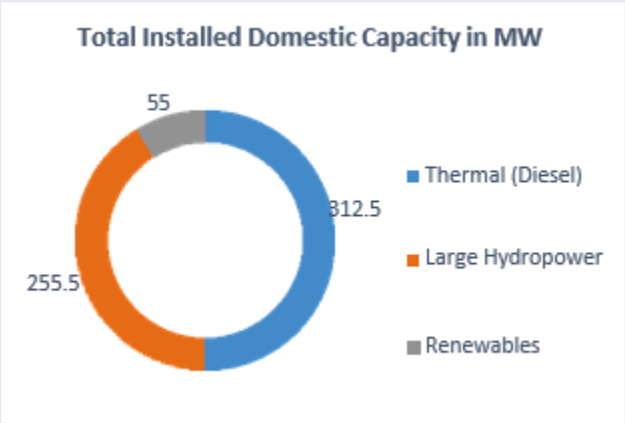

Fig 2. Energy sources in Afghanistan: Total installed domestic capacity, indicated in MW

Fuel oil and diesel generation are the two most expensive forms of energy in Afghanistan. This can cost up to 35–40 U.S. cents per kWh, which is roughly 6–7 times more expensive than the cost of importing electricity from Central Asian countries [6]. Even though the government has made investments in renewable energy sources recently, the present thermal generation capacity is expensive to operate and increases dependence on various import sources because of the absence of grid connectivity. From 2007 to 2015, the energy import bill climbed 14 times, from $16 million to $224 million. Figure 3 compares the native and imported sources of electricity.

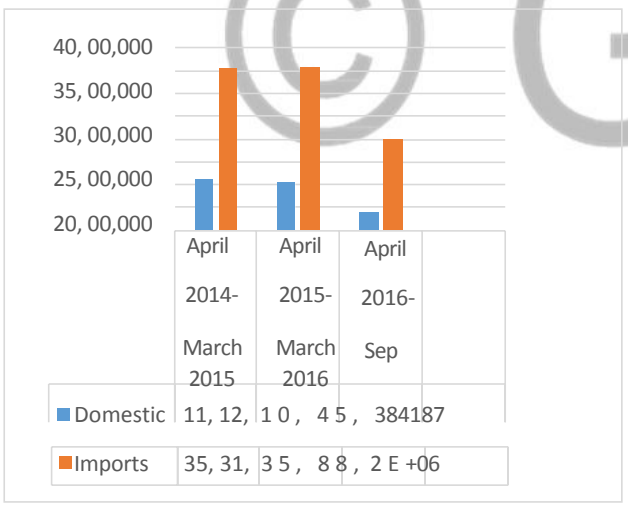

Fig 3. Electricity supply MWh (Domestic vs Imports)

The cost of supply, or the average expected unit price in Usc/kWh [8], is provided in Table 2 and Figure 4.

Table 2. Cost of Supply [8]

S/N	Type	Average Unit Price (Usc /kWh)
1	Diesel (all provinces)	29.53
2	Thermal (NW Kabul)	27.115
3	Hydro, thermal and Diesel	6.473
4	Hydro and Diesel	5.19
5	Natural gas	2.8- 3.5
6	Imported	2.62
7	Hydro	2.29
8	Coal(1MW=4.5ton)	1ton=Afs 2.200

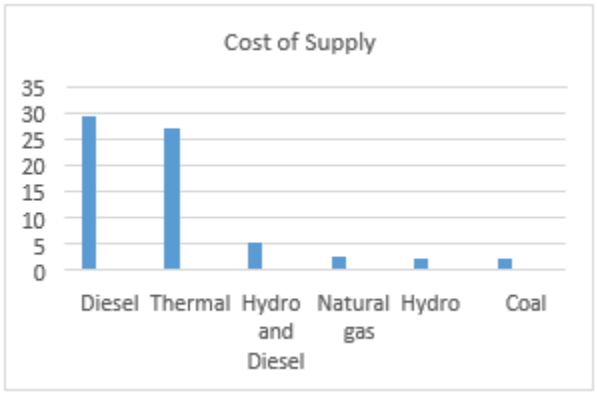

Fig 4. Cost of supply [13]

3 RENEWABLE ENERGY TECHNOLOGIES

Renewable energy technologies like hydropower, solar, thermal, wind, and conventional biomass are well-established in Asia. The International Renewable Energy Agency (IRENA) reports that Asia's capacity for producing electricity from renewable sources expanded from 387 550 MW in 2010 to 918 655 MW in 2017 [17]. The overall capacity for renewable energy in Asia is shown in Figure 5. The capability for producing renewable energy in Asia from 2010 to 2017 is shown in Figure 5.

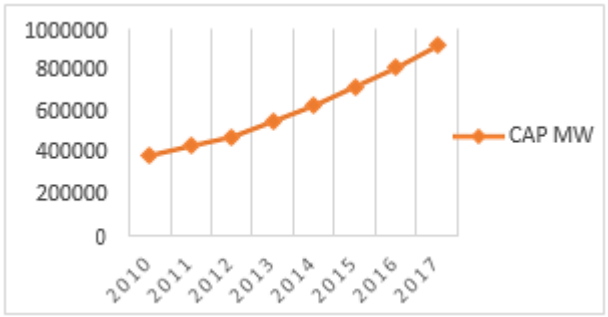

Fig 5. Total renewable energy capacity in Asia [17]

Afghanistan's economic, social, and sustainable progress will depend heavily on renewable energy. The abundance of renewable resources, including biomass, hydro, and solar, would help to close any future supply gaps in terms of both economic and financial situations. Figure 6 shows Afghanistan's overall renewable energy capacity and growth between 2010 and 2017.
According to the World Bank, the overall hydroelectric capacity of Afghanistan's north-east rivers the Amu Darya, Panj, and Kokcha is 23,000 MW, or almost 87% (20,000 MW). The Kunar River accounts almost half of the nearly 8% (1,900 MW) of Kabul's total area that lies to the east [9]. Hydro projects with an installed capacity of up to 3 Megawatts. The hydro project's capacity is depicted in Table 5 [18].

Afghanistan has 300 days of sunlight annually with an average solar energy potential of 6.5 kWh per m2. Higher solar values may be found in the southern provinces in particular Kandahar, Farah, Herat, and Helmand. The production of energy is feasible even in the northern regions, where the average irradiation is just 4.5 kWh per m2 per day [9].

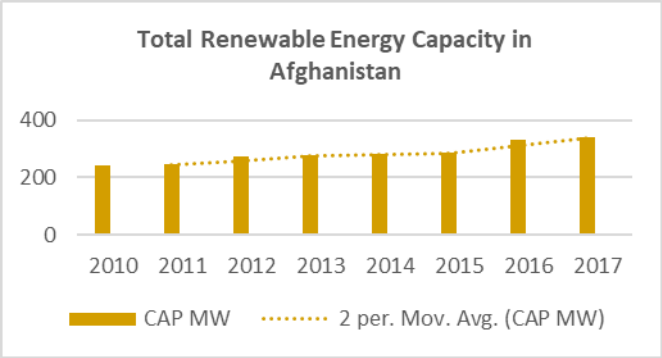

Fig 6. Total renewable energy capacity in Afghanistan, [17]

Table 5. Hydro Projects [16]

Type of Hydro project	Capacity (MW)
Small	<25000 kW
Micro	<2500 kW
Micro	<250 kW
Pico	<2.5kW

Wind resources are abundant in Afghanistan, however they are largely concentrated in the southwest, close the Iranian border. The country's total wind energy capacity is 150,000 MW, however only 66,700 MW of it is actually utilised. Furthermore, geothermal and biomass offer enormous promise, although further study into these energy sources is required [9]. Biomass is critical to meeting residents' energy needs because the majority of fuel demand comes from households in the form of fuel wood, charcoal, animal dung, and agricultural waste. Geothermal energy is inexpensive and may be utilized to generate electricity. Table 6 depicts Afghanistan's potential for renewable energy sources.

Table 6. Afghanistan's Potential for Renewable Energy [18]

Type of Energy	Potential
Solar	222000 Megawatts Average solar insolation of 6.5 kWh/m per day 300 days of sunlight
Hydropower	23000 Megawatts Potentials of large Dams, Mini and Micro potential each 600 Megawatts
Wind	67000 Megawatts 36000 Km 5 MW per Km, windy land
Biomass	4000 Megawatts Animal waste 840 Megatts 3090 Megawatts agriculture waste
Geo-Thermal	3000 – 3500 Megawatts 3 big possible regions 4-100 Megawatts

4 CHALLENGES IN REACHING SELF-SUFFICIENCY

Every country has its own strategy for achieving energy demands and transition to a sustainable energy sector. It entails a one-of-a-kind mix of source opportunities and access and efficiency challenges. Afghanistan's energy challenges differ from those of other developing countries for the reasons stated previously. Afghanistan is an energy-deficient country, as evidenced by its domestic power generation capacity, which provided only 22 percentage of total country consumption in 2015. Afghanistan is confronted with numerous challenges, including Insurgency has created an economic and political problem, as has decreased economic growth and unending poverty. Furthermore, Afghanistan's public electricity sector is experiencing workforce and technical capacity issues [21].

- There are no policy frameworks in Afghanistan that outline the supply of energy for sustainable development. Due to inadequate infrastructure, which presents numerous obstacles to encouraging energy efficiency, it has been difficult to put into practice current policies and enforce legislation.
- Customers in Afghanistan are suffering as a result of an uneven distribution system in the country. Currently, only about two-thirds (67–75%) of the population of the country has access to reliable electricity, whereas over 70% of users in Kabul have a steady supply [22].
- To have a high level of energy security, the nation's transmission and distribution networks must be expanded from their current size. In March 2015, there were 1,176,030 households that were wired into the energy system, an increase of 11% over the previous few years. The length of the transmission lines has extended from 2,261 km to 6,907 km as a consequence of the government's power extension policy [16].
- In the country's long-term energy planning, access to the water resources under the uncertainties of climatic - for future hydropower generation - is a serious concern [9].
- The lack of funding for gas production and transmission infrastructure restricts the expansion of 75 billion cubic meters of gas reserves to only 150 square kilometers.

Significant renewable energy and fossil fuel resources are required for development through private and public investment [23].

- Because the administration process involves multiple organizations, authorizing procedures and maintenance activities cause coordination problems among the various authorities.
- There is a lack of public awareness and responsiveness to renewable energy technologies, social and environmental benefits, and the availability of affordable fuel energy resources.

5 SELF-SUFFICIENCY OPPORTUNITIES

Self-sufficiency in the energy industry can be achieved in any region through the government's well-defined vision and objectives to produce enough energy locally. Demand stability can be achieved by providing Afghan citizens with consistent, secure, and high-quality energy services, as well as by promoting renewable energy and energy conservation measures in various sectors.

5.1 Best use of autochthonous hydrocarbon and renewable energy resources

Afghanistan has an enormous energy resources of fossil fuel and renewable energy that must be used to fulfill the country's energy needs. Adoption of national and regional policies can help to promote and implement indigenous hydrocarbon and renewable energy development and implementation. It will aid the country in determining priorities and methods for constructing a sustainable and cost-effective energy market.

The greatest hope for Afghanistan is renewable energy, which includes hydro, solar, wind, geothermal, biomass, and wood. Although it has great potential, hydropower is currently mostly unutilized in Afghanistan. The yearly renewable surface water resources of the nation, which are split among five river basins, are estimated to be 57 billion m3. However, the availability of water resources varies during the year or is not uniformly accessible across the nation [24] [25]. There is proof that geothermal energy and biomass have a lot of potential [9]. Fortunately, the government is setting precise goals for the renewable energy industry with the help of the international community in order to meet the nation's energy needs and achieve self-sufficiency in the near future.

5.2 Energy efficiency and conservation

Energy may be efficiently saved in developed countries by minimizing losses and waste, increasing efficiency through technological advancements, and optimizing operation and maintenance [26]. The most effective solution for closing the energy demand gap in Afghanistan would be to increase energy efficiency via renovation, the deployment of practical technologies, and the building of energy-efficient communities. When the initial investment cost is returned, energy usage will be reduced, resulting in savings on costs. In addition to the financial benefits, energy conservation may assist to protect the environment by cutting greenhouse gas emissions. Energy conservation reduces energy use, which benefits the environment, national security, personal financial stability, and cost effectiveness.

As a result, the government must promote energy efficiency by emphasizing application mechanisms in various sectors and must adhere to energy efficiency rules. Buildings consume a lot of energy, thus more careful energy efficiency in the construction industry will go a long way toward helping with energy conservation. Improving energy efficiency, in combination with other

programs, is the cheapest, fastest, and most ecologically friendly approach to satisfy a major amount of Afghanistan's energy demand, lowering the need for energy supply investment.

6 CONCLUSION AND RECOMMENDATION

Afghanistan is not now able to generate its own electricity. However, the Afghan government is looking at ways of achieving it in cooperation with the international organizations. The energy condition in Afghanistan may be described as "energy poverty," defined as a lack of access to modern energy services. Energy availability in the nation is restricted, however it has increased dramatically in recent years. Renewable energy resources, such as hydro, wind, and solar, are abundant, but mostly unexplored. In recent years, the prices of mining such resources have reduced, allowing the government to examine them.

The provision of inexpensive and dependable power and primary energy is crucial for socioeconomic growth. Furthermore, in order to make effective policy and planning, the Afghan government, funders, private sector actors, and civil society groups require access to credible information and data regarding the country's existing energy picture.

Electrifying is a long and hard process that involves political stability, adequate law and regulation, and international backing. To deliver power, the government must use the chance to remove impediments by drawing on the experience of other emerging countries. Energy services must be affordable, consistent, safe, and environmentally benign.There are some strategies that can be taken for the betterment of the energy sector:

- Power generation strategy must focus on low cost energy generation, capacity utilization optimization, regulating the input cost, optimization of fuel mixture and its technology, and adoption of renewable energy sources.
- Proper implementation can help in improving the - reliability of the energy system of the country.
- The strategy should conserve and optimize the utilization of electricity with a focus on demand management, load management and up-gradation of the technology by providing energy-efficient equipment
- Regulation -should aim at -balancing the - interest of all stakeholders and making energy sector commercially viable.
- For the growth of the energy sector, finance-related strategies must be adopted.
- Local manufacturing of renewable energy product must be implemented at the central level.
- The government should provide an energy planning process to create competition and stability for domestic and foreign investors.
- Promote energy efficiency by proper management of utilities distribution systems.
- Government and private sector units along with community should work together for achieving the long-term energy efficiency initiatives benefitting its citizens.
- A large amount of energy is consumed in buildings; therefore energy efficiency strategies should strictly implement in buildings.

REFERENCES

1. M. A. Schreurs, J. Balanowski, Promoting socially and economically just energy transformations in Asia possibilities, challenges and the road ahead. Hanoi, (2017).
2. CSO, Afghanistan statistical yearbook 2016–2017. Kabul : Central Statistics, (2017).
3. World Bank, Afghanistan development brief, the implications of Afghanistan's 2014 security transition. World Bank Report, (2019).
4. NEPA, Second national communication. Kabul: national environmental protection agency, 2-30, (2017).
5. ADB, Proposed multi-tranche financing facility Islamic republic of Afghanistan: energy supply improvement investment program. Manila : report and recommendation of the president to the board of directors, (2015).
6. D. Bochkarev, Afghanistan reconnected linking energy supplies to consumers in Asia. Eastwest Institute, (2014).
7. MEW, Afghanistan investment opportunities in energy sector. Kabul : Da Afghanistan Breshna Sherkat, (2017).
8. ANDS, Energy Sector Strategy (2007/08 – 2012/13). Afghanistan National Development Strategy Secretariat, (2008).
9. World Bank, Afghanistan renewable energy development issues and options. Washington, D.C, (2018).
10. World Bank, Afganistan economic updated, Washington D.C, (2013).
11. DABS, Afghanistan energy information center. Kabul : Da Afghanistan Breshna Sherkat, (2016).
12. ICE, inter-ministerial commission for energy, electricity imports (2016). Available on https://Sites.Google.Com/Site/Iceafghanistan/Electricity-Supply/Electricity-Imports)
13. ICE, Inter-ministerial commission for energy transmission and distribution, (2015). Available on Https://Sites.Google.Com/Site/Iceafghanistan/Transmission-And-Distribution-Development
14. MEW, Draft power sector strategy for ANDS. Kabul : ministry of energy and water, (2007).
15. World Bank, Afghanistan overview. Kabul: The World Bank. (2013).
16. ICE, Number of DABS electricity connection. inter-ministerial commission for energy, (2016). Available on Https://Sites.Google.Com/Site/Iceafghanistan/ Electricity-Supply/Connections)
17. IRENA, Renewable capacity statistics. Masdar : Internaitonal renewable energy agency, (2018).
18. MEW, Renewable energy policy. Kabul: Ministry of Energy and water, (2015).
19. ADB, Power sector master plan, islamic republic of Afghanistan. Asian development bank. (2010) Available on: Https://Www.Adb.Org/Sites/Default /Files/Project-Document/76570/43497-012-Afg- Tacr.Pdf
20. MEW, *Ministry of Energy and water*. Kabul: Afghanistan national integrated energy policy,, (2016).
21. USAID, *Advisor to the secretariat of the inter-ministerial commission for Energy*, Kabul: United States aid for international development , (2010).
22. MEW. Call for expression of interest (EoI) for implementation of 100 Mw grid connected.Kabul : ministry of energy and water, Renewal, (2016).
23. ADB, Sector assessment, energy.Asian development bank, (2015).
24. NEPA, Second national communication. Kabul : national environmental protection agency,

2-30, (2017).
25. MEW, Afghanistan investment opportunities in energy sector, Kabul : DABS, (2017).
26. A. Al-Mofleh, S. Taib, M. A. Mujeebu, W. Salah, Analysis of sectoral energy conservation in Malysia. J. Energy, (34) 733-739, (2009).