الجامعة الإسلامية للتكنولوجيا
UNIVERSITE ISLAMIQUE DE TECHNOLOGIE
ISLAMIC UNIVERSITY OF TECHNOLOGY
DHAKA, BANGLADESH
ORGANISATION OF ISLAMIC COOPERATION

Renewable energy in Afghanistan

A thesis submitted to the department of mechanical and chemical Engineering (MCE), Islamic University of Technology (IUT), in the partial fulfillment of the requirement for diploma in mechanical engineering.

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(June 2017)

CERTIFICATE OF RESEARCH:

The thesis title submitted by Samiullah Nazari (141304)

"**Renewable energy in Afghanistan**", has been accepted as satisfactory in partial fulfillment of the requirement for Diploma in mechanical Engineering.

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CANDIDAT'S DECLARATION

It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any degree or diploma.

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Acknowledgments;

I express our heartiest gratefulness to Almighty Allah for his divine blessings, which made us possible to complete this thesis successfully. First of all I am grateful and appreciative from my supervisor Dr. Arafat Ahmed Bhuiyan (Lecturer of Mechanical and Chemical Engineering MCE Department) which supervised, helped and guided me to complete this project. And i acknowledge support of Islamic University of Technology Dhaka Bangladesh (IUT) and our Mechanical and Chemical Engineering (MCE) department.

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Abstract;

Energy is as a soul necessary and a prerequisite in communities. It's lead to growth the economic it can exist a strength relationship among the communities and makes unity between them. Energy can be use in various type but providing of energy is not easy due to some challenges such as unstable resource high cost and connect of living disperse population .Unfortunately all the mentioned challenges has been present in Afghanistan how to come out from these challenges we will discuss in this project. For coming out of the challenges we need to study renewable energy. Renewable energy resources could play a vital role in the sustainable economic, social, and environmental development which is low cost stable resource easy installation which can build to one area or in one public area .Afghanistan is a developing country its people still they are using from the dung of animal and firewood in the rural area and urban mostly uses liquid gas. All of them could increase the pollution of weather and environmental life. We can remove all this problem by replacing of renewable energy .The government of Afghanistan with the support of international community is setting ambitious targets for the renewable energy sector and is encouraging national and international investors to take part in the generation, transmission, and distribution of renewable energy especially.

1. Introduction:

The land which we called Afghanistan it was khorasan in 1747 it is changed in Afghanistan. Their religion is Islam and their official language is Dari (Persain) and Pashto. It's divided in 34 provinces. Afghanistan is a mountainous country. Which is mountain has been constructed 4/3 of the all area. And the highest mountain has about 7499m height. The mountain region have a cold winter and short summer .Afghanistan located for away from the ocean the nearest point on the ocean it has a distance about 772m. Afghanistan has been located in South-Central Asia ,and its enclosed from east and south by Pakistan ,from west by Islamic Republic of Iran northeast from china .and from north by Tajikistan, Uzbekistan, and Turkmenistan It is located between latitude 29°35' and 38°40' degrees north and longitude 60°31' and 75°00' east. The total land area of Afghanistan is 652,864 km2 with arid and semiarid area generally its climate is cold winters and hot summers. [**1**]

Afghanistan with the all neighboring countries

The total population is 33,370,000 people and its ranked 40th by population of 196 counties its population density is 51people per km^2 right now and it doing business in the world by 183th position [2] with more than 75% (27.5 million people) live in rural areas. [3]Fertility rates are high, at 6.8 children per woman, and the maternal mortality ratio is 1,900 deaths per 100,000 live births - one of the highest in the world [4]. The corporate tax stand is 20 percent and in during (2006 -2016) the averaged tax was 18.18percent. [5] food cost in Afghanistan increased by 9.40 percent in April of 2017 over the same month of pervious year the average was 4.98 percent from 2012 until 2017.reached an all-time of the highest value 16.30 percent in July of 2014

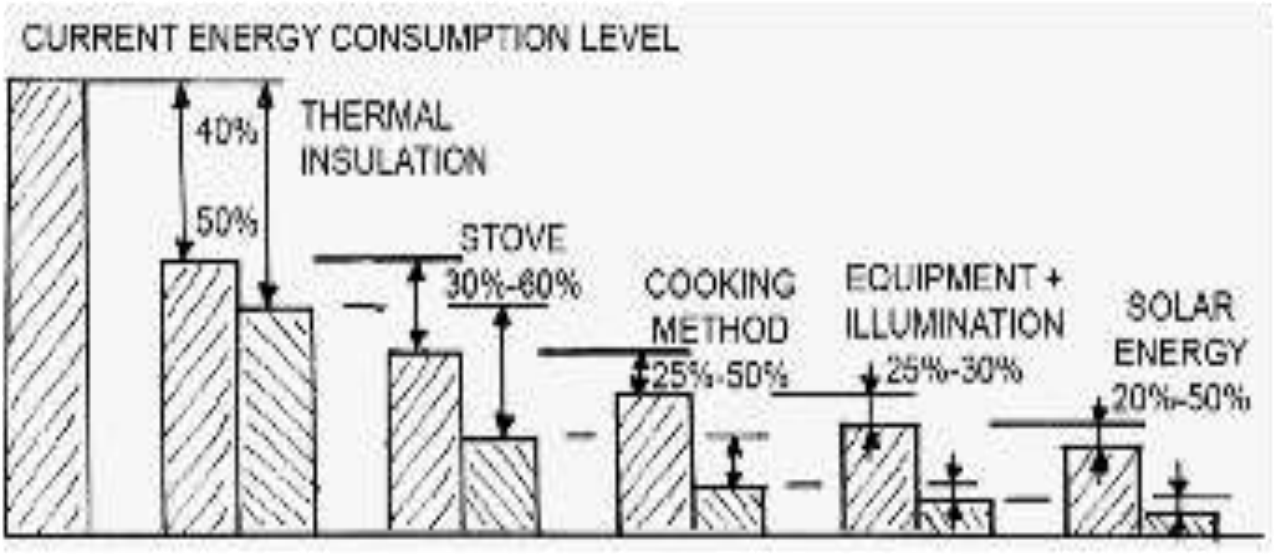
and the record low was -5.49 percent at the same month of next year 2015 [6] Afghan society has been very vulnerable and insecure over the past few decades. It was ranked 175th on the United Nation's Human Development Index and the lowest in Asia in 2012. [1] But in 2017 it has been taked place at 163th. Over the past decade, the country has achieved rapid yet volatile economic growth. Construction and agriculture have been the key contributors to economic expansion. Afghanistan became a member of the World Trade Organization in 2016 [7]in 2007 the rate of unemployment was about 8.6% but its increased gradually at 2014 its increased up to 25% then in 2015 the rate of unemployment arrived around 40% for all time .

The graph of unemployment in Afghanistan [8]

Gross national income (GNI) per Afghan was $680 in 2012 [1]but its in 2015 arrived around 630US$ its ranked in the world 179th position.[9]Foreign aid have a significant role in the economy of Afghanistan received more than $56 billion in development aid during 2002 - 2010 which translates to about 78% of GDP[1]. GDP in Afghanistan was contracted 2.4% from the previous year in

2016 and the GDP annual growth average was 8.78% percent since 2003 until 2016 and GDP per capita at the same interval of time the highest 651,00 and the lowest were 372,92 us$ and in last 2016 it arrived 619,80us$ [10]In addition, foreign aid made up 69% of the national budget for the Fiscal Year 2014-2015 [1]Afghanistan is a country which faced with significant environmental problems; such as limited natural fresh water resources, inadequate supplies of potable water, soil degradation, overgrazing, poverty, healthcare, drug trade, deforestation (much of the remaining forests are being cut down for fuel and building materials), desertification and air and water pollution.[3] And also there is too corruption of public sector problem which is Afghanistan got 15 points out of 100 in 2016 corruption index which is reported by transparency international [11] so solving all of this problem and Access to electricity is needs a higher development priority and also the second priority after the rule of law, for Afghanistan. Most of the infrastructures of the country, specifically its national grid (existed power plants, substations, transmission and distribution networks) were destroyed and demolished during the last 30 years of civil war .Besides, as energy is the backbone of the national economy of each country and also, living standard of each country's citizens is indicated by GDP of the country which is claimed to be about90% dependent on per capita energy consumption. Afghanistan with its $687 GDP per capita and78.21 kWh electricity consumption per capita (195 kWh per annum) in2014 ranks among the lowest in the world [3]. Annual gross demand for the whole country is expected to increase from 3,531GWh (2011) to18, 409 GWh in (2032) and annual peak demand from 742MW (2011) to 3,502MW (2032). This forecast is going to show us that Afghanistan will need five times more electrical energy than of the demand of

the 2011. Only 23.8% of the population was connected to electricity grid and this number is projected to reach about 83% by 2032. Biomass is still the dominant fuel source urban and rural of Afghanistan. 79.9% of Afghan residences use solid fuels for cooking while this number is 97.4% for space heating. Urban households use LPG(liquid petroleum and gas) as their primary fuel for Cooking but for doing hot the space or heating the firewood have a significant role .while For rural households, bushes firewood, and animal dung, in this order, are the most important fuels used for cooking and heating [1]



Current energy consumption;

In Afghanistan even they have been used from the coal for heating and cooking purpose . Afghanistan, large coal-burning power plants will considerably increase the greenhouse gas emission. According to the world-bank database, Afghanistan's GHGs emissions are less than 0.1 tons/capita ranks among the lowest in the world .while energy generation from fossil fuel based plants, due to drawbacks that they have, seems not relevant to the 21st

century anymore. As NASAs Earth Observatory explained that global warming was the unusually rapid increasing in Earths average surface temperature over the past century primarily due to the greenhouse gasses (GHGs) released as people burn fossil fuels. Besides, according to the world health organization (WHO), annually 7 million deaths are due to the air pollution in the world. It has been estimated that without taking any plan to reduce GHGs emissions, the global average surface temperature will rise by 1.8–4 °C by the end of this century and will increase the earth's temperature above the threshold value which could cause irreversible and possibly catastrophic changes. Finally, Such Projected global warming in this century is likely to trigger serious consequences for humanity and other life forms [3] .Afghanistan have no any interconnected centralized power system; however, interconnection of all grid segments is proposed by the year 2032. In addition, there are many decentralized local grids and stand-alone systems such as solar PV and diesel generators providing electricity. Total installed capacity (not operating capacity) that a grid has been connected and has been transmission by line are about 1,354MW electricity. but 62% of the total electricity has been imported from the neighbor countries consisting of Tajikistan, Uzbekistan, Iran, and Turkmenistan and the rest of the total electricity which is 32% generated by the thermal power plant (diesel combustion) and hydro power[1].In addition from the all imported and generated of the electricity only 9% of the rural and 30% of the urban due to the majority areas of the rural people lives and expansion of the existing transmission network will be very expensive[3]. Recently, another 42MW of hydro capacity was added when the Afghan-India Friendship Dam started generation and work on another 100MW has just started. Currently about 134MW of decentralized power generators is

installed around the country mostly in rural areas, more than half of which is diesel generators. Renewable energy resources such as hydro, wind, solar, and to some extent biomass and geothermal resources they are available abundantly in Afghanistan. Hydro resources have considerable potential to be utilized for power generation. the first hydro power generation has constructed in Afghanistan it was the 2.5MW over Jabal-e-Seraj river‘s which is lighted only the kingdom house. Afghan rivers offer estimated 23,000MW of hydropower potential. Currently, installed capacity of large hydropower plants (300KW–100MW) and micro-hydropower schemes (less than 100KW) is around 293MW.and there available which can generates about 15 KW electricity it is installed over the some small village and small river. Solar and wind energy resources of Afghanistan are excellent for applications such as water pumping, water heating, and power generation through centralized schemes, mini grids, and stand-alone systems. Afghanistan is considered to be a “sunbelt country” similar to latitude equal parts of the United States. Annual average Global Horizontal Irradiance (GHI) in Afghanistan is 1,935 kWh/m^2. So far, solar energy is mainly used for lighting purposes through photovoltaic conversion in the rural areas. Total installed capacity of solar photovoltaics is around 13MW mainly in the form of stand-alone systems. The largest solar energy system in Afghanistan is a 1MW solar PV system providing power for villages in the central province of Bamyan through a mini grid. tough it is estimated theoretically the maximum wind energy is about 158GW in Afghanistan which the mainly position is Herat province in the west and from the north of Afghanistan the main place is Balkh and Parwan provinces out of which estimated 1000KW of capacity is feasible but currently we don’t know exactly how much is the capacity of the total wind power has been installed

due to there is no reporting from any industrial or power plant but it is estimated the total wind power has been installed is about 300 KW. whereas the Panjshir province wind power plant installed and operated contains 100KW of the total 300KW.also there is the exists of potential to generate biogas from the animal manure in the rural areas and electricity from municipal solid waste in urban areas The number of biogas digesters installed in Afghanistan is around 500 units mainly installed by Ministry of Rural Rehabilitation and Development (MRRD) (about 300 units in the south), AREA (Agency for Rehabilitation and Energy Conservation in Afghanistan) (about 100 units), and BORDA (5 × 9m3) producing an annual average 1,896 to 2,654MWh (energy production from its of 4m3 and 6m3 is calculated using 1m3 biogas = 1.1L petrol = 10.44 kWh using 1 L petrol = 34MJ) of thermal. In finally this paper describes theoretical resource potential and utilization of renewable energy in Afghanistan .Such how we can electrify the urban and rural area by using renewable energy how to improve the electricity and how to reach to sustainability energy in all country and who to consent the demand of all areas. [1]

2. Literature Review:

The goals and aims of the countries across different regions of the world especially the economically emerging countries are to provide economically affordable and environmentally friendly energy to their citizens. But there is some problem it is not easy to supply the demand needy. The main issue

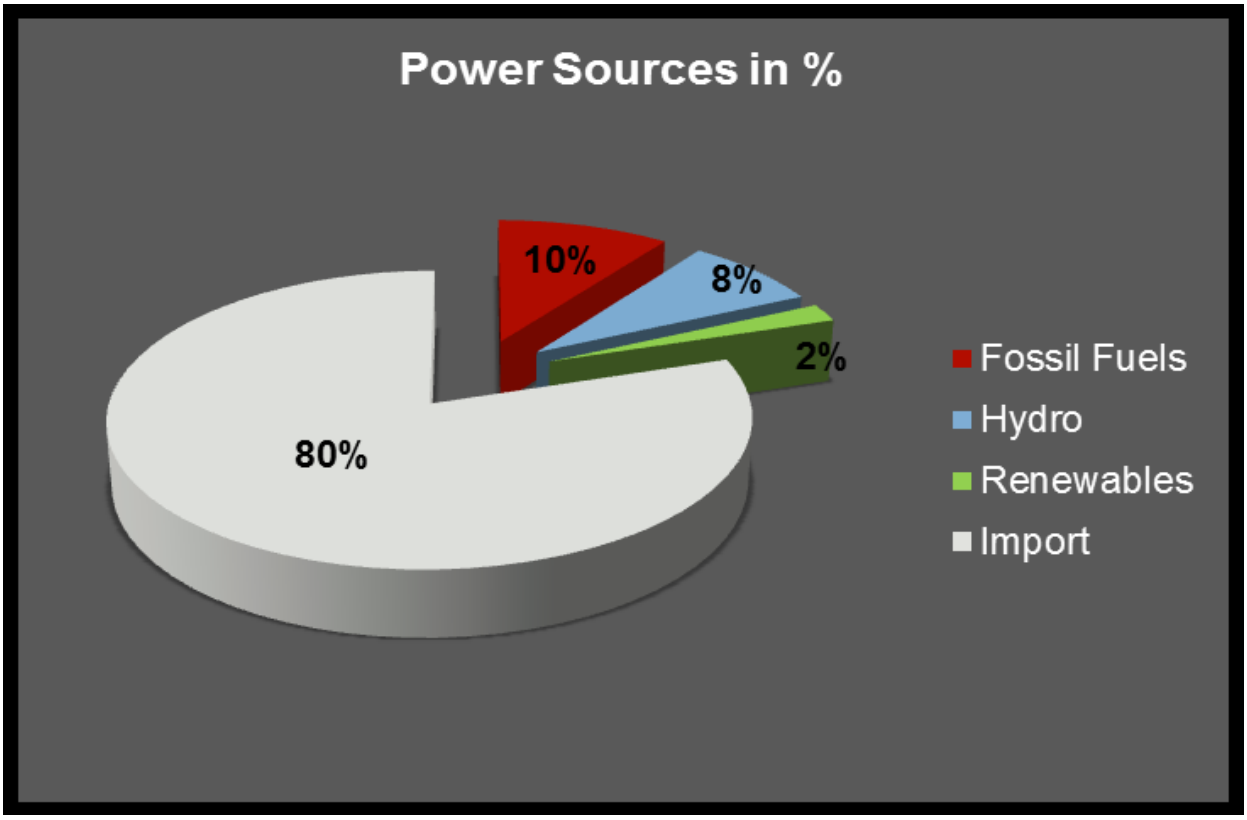
preventing the development and implementation of such projects is the lack of clear policies and legal frameworks set by the governments in addition to extremely complicated political issues and conflicts, and usually limited financial means. In order to clarify the role of renewable energy as an eco-friendly and user-friendly resource for supplying the energy demand and other socio-economic development purposes .Literature review on the renewable energy of developing country in Afghanistan has been done in this section. This research and review is one of the most great and priorities based on renewable energy in Afghanistan urban and rural area. Over 1.6 billion people in the world lack access to electricity and approximately 80% reside in rural Asia and Africa .Because of the rise level of energy consumption across the global and on the other hand some reports of decline in the level of accessibility to energy [12]. Stand-alone off-grid solar and wind energy technologies have thus far been seen as a favorable solution to electrify rural areas in Afghanistan by the government, Donor agencies and communities themselves because of lower operating cost and easy to install simple construction and get complete in short time. But currently, there are no utility-scale solar PV or wind power plants. The largest renewable energy system feeding a local grid is a 1 6 MW solar PV plant with battery storage in the central province of Bamyan. National renewable energy laboratory (NREL)published in 2007 in Afghanistan at 1km resolution wind map at 50 m to measure and quantify wind resource and to indicates how potential is possible at location on-site. The dataset includes average monthly wind speeds together with statistical parameters such as wind power density, Weibull shape factor, windiest hour, diurnal strength, and the autocorrelation factor for each 1 km^2 grid in Afghanistan. The above mentioned parameters

are able to calculate the wind speed for a site hourly. However, wind direction, turbulence, and temperature are not included. This dataset is not able to model the energy production of a wind farm thus wind speed varies by a short distances and terrains. The accuracy of modeled data is in the range of ±20% due to lack of extensive field data as inputs to the model and Afghanistan's complex terrain. NREL's estimates showed a total resource potential of about 158 GW **[13].** a study has been done for two communities in two phase on the benefits of renewable energy technologies and their impacts on both of them economically and socially in Afghanistan. The researcher found and cleared that, by electrification of these two communities with renewables energy (PV and micro-hydro technologies) the socio-economic achievements such as job creation, personal security, family interaction, learning conditions for children, entertainment opportunities, access to information, improving health conditions, household income and finally energy sustainability and affordability have increased. In other investigation investigated the resource potential of solar and wind power in Balkh and Herat, two most promising provinces of Afghanistan. It was founded that Solar PV and wind power plants in these two provinces have the potential to supply all types of domestic generation schemes and imports.**[3]** Hicks and Ison in (2011) investigated that the impacts of community-based renewable energies (CRE) in Australia. They found four major option which impacts on the CRE projects: 1) political; 2) social; 3) economic; and 4) environmental. Two case studies combined with formal and informal interviews were used to collect data and draw conclusions. Their concluded on CREs which lead to social benefits for a community in an area by the terms of creating social bond ,and makes strong the relation among communities, and fostering a sense of ownership and

collective response to common problems. Due to impact of the CRE enlisted confidence and increased community capacity. This investigation also found that CREs can cause to have a valuable economically benefits to the community by utilizing local labor, business and material; dividends paid to local shareholders and servicing of local banks. Additionally Del Rio and Burguillo (2009) researched the socioeconomic benefits of CREs by conducting three case studies in Spain. These cases included biofuel, solar and wind energy projects and used empirical methods to collect data. The aim was to identify the contribution of CREs to local sustainability including: 1) social; 2) economic; and 3) environmental. The objective was to understand of the socioeconomic benefits of CREs by the recipient community. It does this by conducting a stakeholder analysis and a perception survey of the communities. In this context, eleven indices were used including: impact on education, employment, income generation, demographic impacts, energy accessibility, social cohesion and human development, tourism and use of indigenous resources. This paper resulted that the impacts on employment of the CREs is positive. Although direct employment is relatively modest, the indirect contribution to employment creation is large compared to size of the community. While the biofuel project in any where it's installation will create more job direct or indirect but solar have no more job creation on the community .In one case, a biofuel project created 200 (i.e. direct and indirect) jobs in a community of ten thousand people .(Rio and Burguillo 2009) **.[14]**

3. Energy system in Afghanistan;

Currently there is an economical problem across the world. The price of energy from fossil based power generation has been affected by the fluctuations in the price of oil and gas at various instances. This fluctuation of price has been occurred by different factors. They are consisting as regional agitations, government policies, Internal-conflicts in different countries by the different factors affection and integrated economic uncertainties. In the most developed countries. Even the rural area has access to the sustainable energy which supplied by the use of diesel generators but the price and cost is worrisome. The energy supposed to be at all the time (24 hours) and it can't be supply by the solar or wind energy and to meet the demand because their sources are not available for all time. But they are economically easy installation and low cost can be used lonely on the requirement regions. Using hybrid system in some area which is not living closely the cost will increase due to high grid system **[12].** While Afghanistan is a country which does not possess any grid-scale renewable energy assets currently .There is a very small amount of RE utilization. It can't be compare with the amount of demand in Afghanistan but it has been gifted by solar, wind and biomass resource potential. This country relies on power imports, followed by hydro and thermal power plants and diesel generation. There are very less amount of supply power of other plant which shows on the following table.

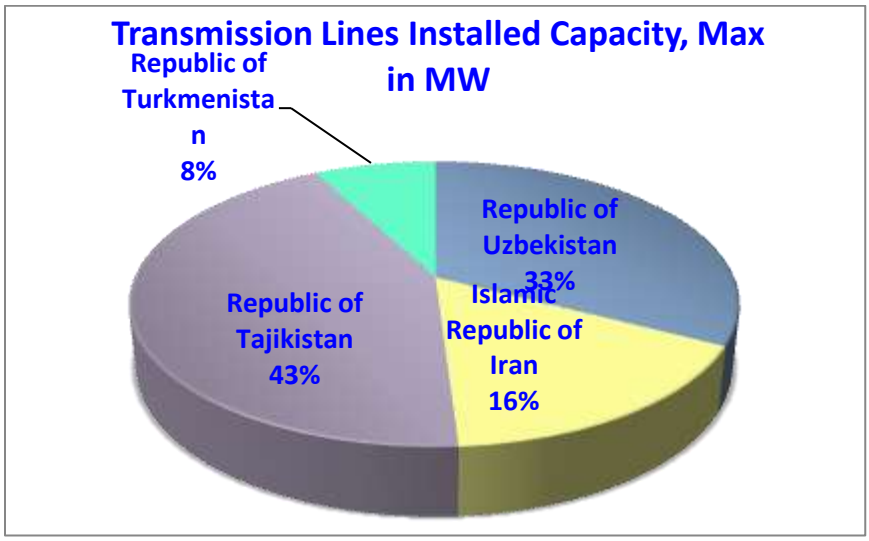


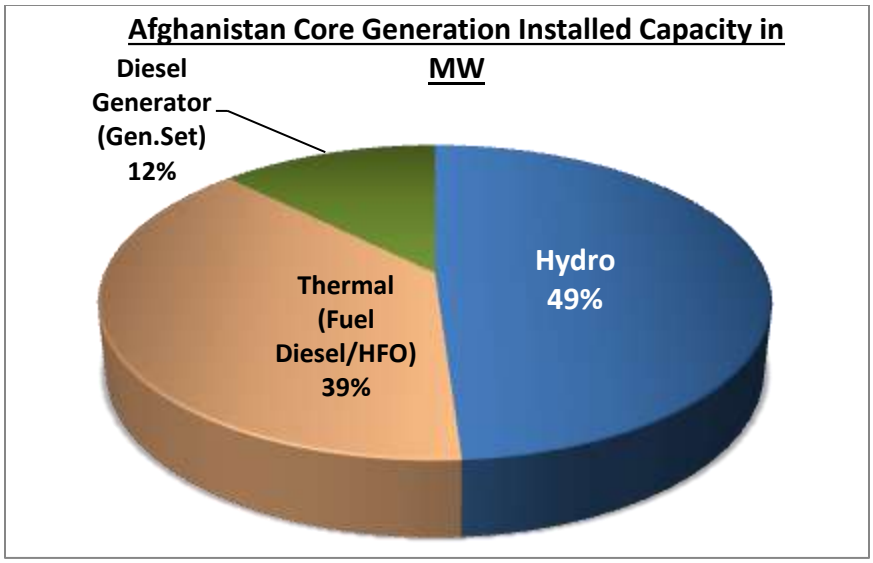
Here the amount of RE is very little I these amount has counted in 2016

DABS (Da Afghanistan Breshna Sherkat) is the state-owned provider of electricity in Afghanistan and has the possession of generation, transmission and distribution services, operation and maintenance of assets **[15].**DABS is an independent and 100% state owned corporation **[16]**. Its shares are consist

The customers of the (DABS) are connected to the national grid and it increased more than 60% from 2009-2015 within this 6 years. Power generation in Afghanistan is mainly hydro-power. But the (DABS) supplied by the north and north east power system transmitted from Uzbekistan and Tajikistan to Afghanistan. And the expansion of the Distribution Network it caused to improve the major economic hubs significantly. In Kabul, Herat, Mazar-e- Sharif, Kunduz, Zarange, Aybak, Maymana and Pul-e Khumri more than75% of the population interconnected to the 24-hour power supply for the first time in decades[17].

Afghanistan on Grid Generation / Transmission Profile

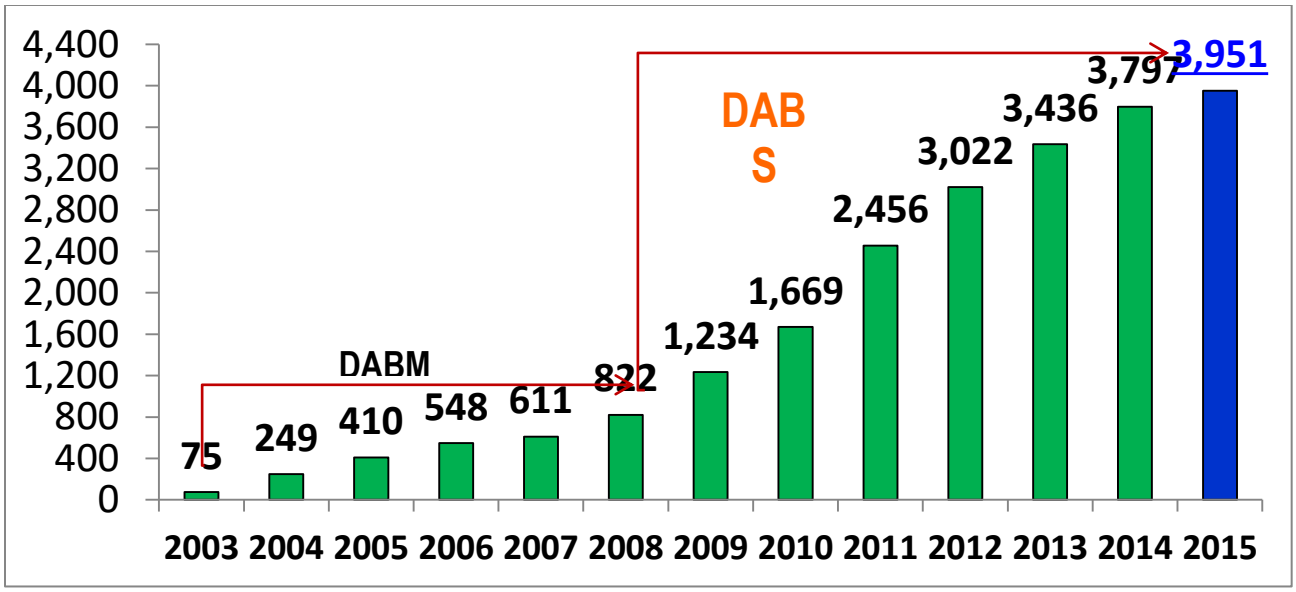




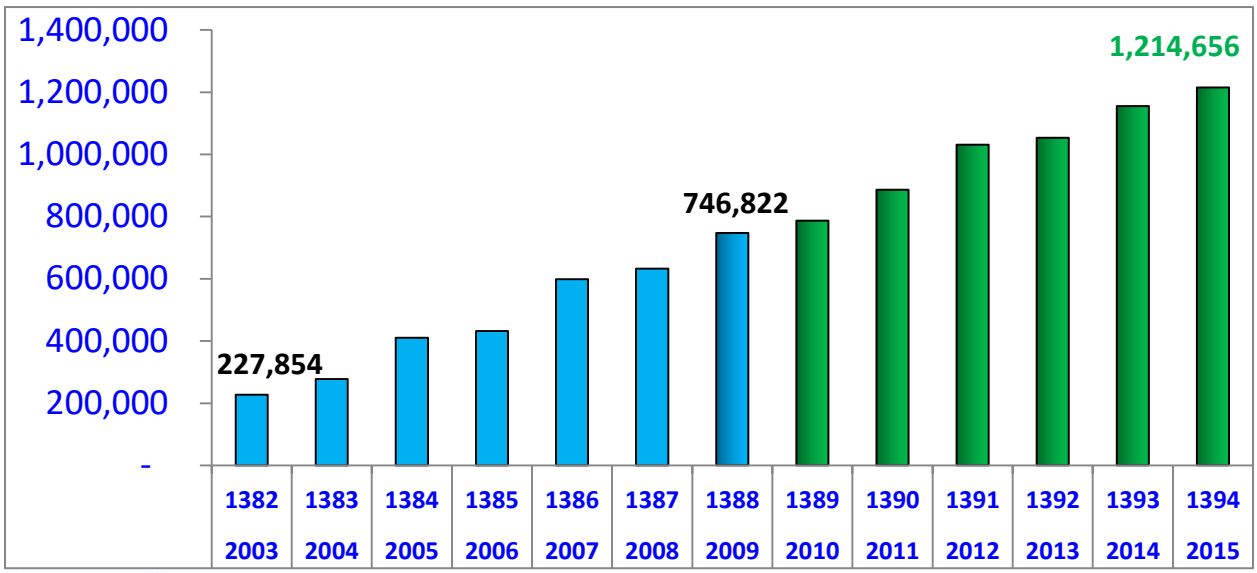
Republic of Uzbekistan	326
Islamic Republic of Iran	164
Republic of Tajikistan	433
Republic of Turkmenistan	77
Total	1,000

Hydro	**254**
Thermal (Fuel Diesel/HFO)	**200**
Diesel Generator (Gen.Set)	**65**
Total	519

Grid Generation / Transmission Profile [18]



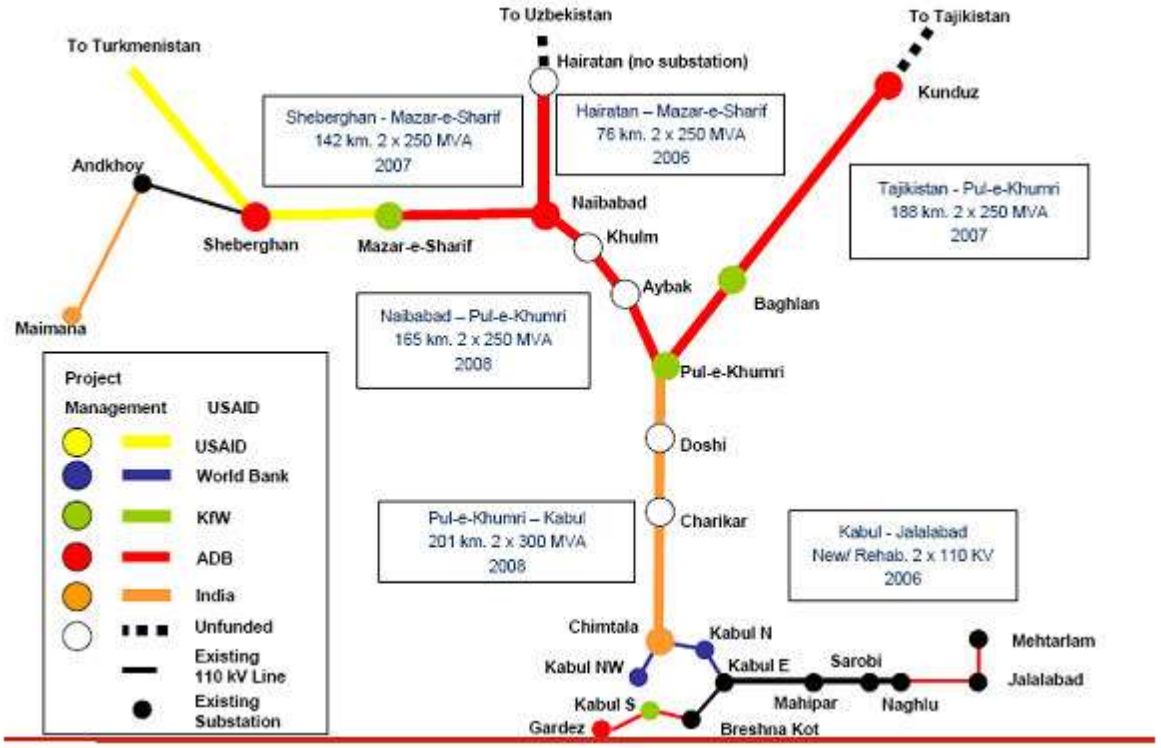
DABS Electrical energy import from Neighboring Countries (Figures in million kWh)



Residential	91.88%
Commercial	6.72%
Holy places	0.73%
Government	0.55%
Industries	0.11%

DABS growth customer at during 2003-2015 [16]

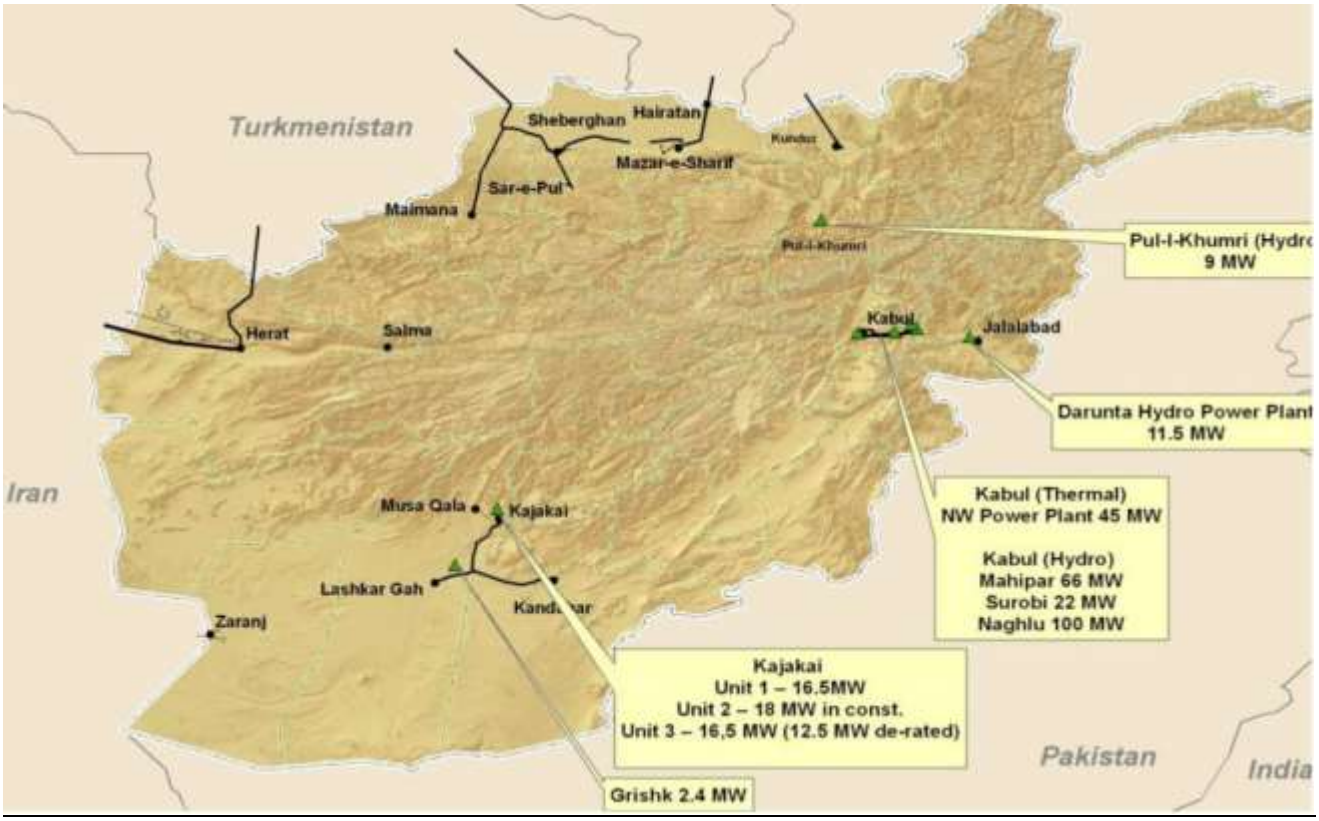
From the whole Afghanistan 3% household connected to the national grid. Most of them are in the following cities Kabul, Mazar-i-Sharif, Herat, Kandahar, Jalalabad etc. 340,000 customers are connected to the public power grid, of which 182,000 are in the Kabul area. Total energy consumption Per head is less than 25 kWh/year (in comparison to: India520 kWh/year, Germany 6200 kWh/year, world average 3060 kWh/year) the demand energy rising continuously but power station getting old .Which is older than 40 years and need to be rehabilitated.



The system power transmitted by the neighbouring countries **[19]**

On infrastructure of Afghanistan up to 2015 more than four billion dollars was spent and yet there are still considerable deficiencies across the country. we

have seen the progress and investment and at same time also the demand of electricity growing up rapidly In 2002, less than 15 percent of Kabul residents and less than 8 per cent of all Afghanistan had access to the power. In 2015, 70 per cent of the citizens of the capital estimated at 4 to 5 million peoples, of an overall population of around 30 million are connected to the power grid or have access to electricity. This is a considerable increasing in Afghanistan. But comparing at investments on the power infrastructures is very less it could have been expected more and by the term of availability resource power's reliability and sustainability. Afghanistan's power system is a very complex system. It operates in nine different 'islands' –power grids – depending on own power supply sources. And due to technical limitations these regions are not interconnected. For instance, Turkmenistan's network supplies power to the Northern provinces of Faryab, Jowzjan and Sar-e Pol and, on a separate network, partly to Herat. Uzbekistan supplies Parwan, Samangan and partly Kabul. Tajikistan supplies Baghlan, Balkh, Kunduz and Takhar provinces and, in summer, it transmits power to Kabul (in winter, Tajikistan faces electricity shortages itself), while Uzbekistan additionally feeds Balkh province in summer. Iran supplies electricity to partly Herat and Nimruz provinces. The south of Afghanistan, that is, Kandahar and Helmand provinces, are supplied partly by the Kajaki hydropower plant. A thermal power plant gas fired power plant in Sheberghan (in Jowzjan province) that is supposed to produce 200 MW. A new transmission line from Pul-e Khumri to Kabul that can carry 1,000 MW and a 500 kV substation in Arghandi, just outside Kabul. A transmission line from Turkmenistan, bringing additional 300 MW initially and 500 MW later, will reportedly come on stream by 2018 **[20]**

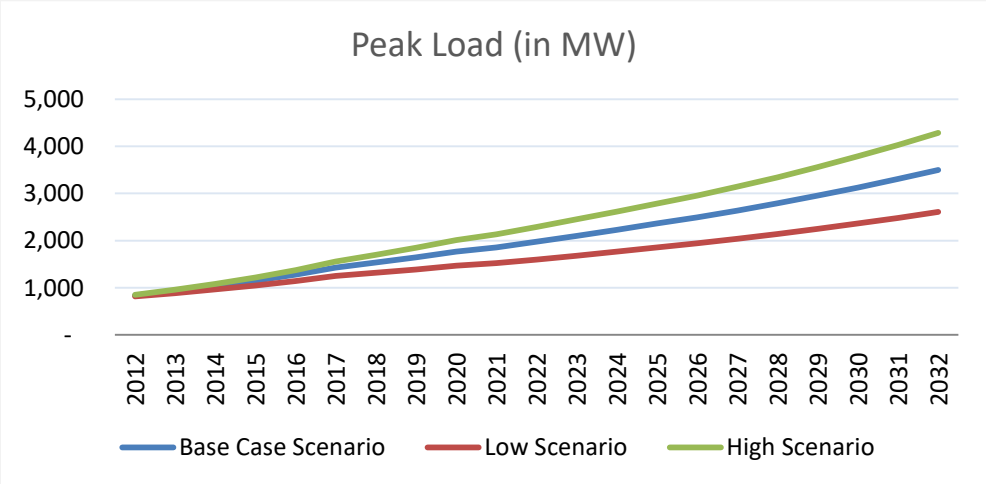


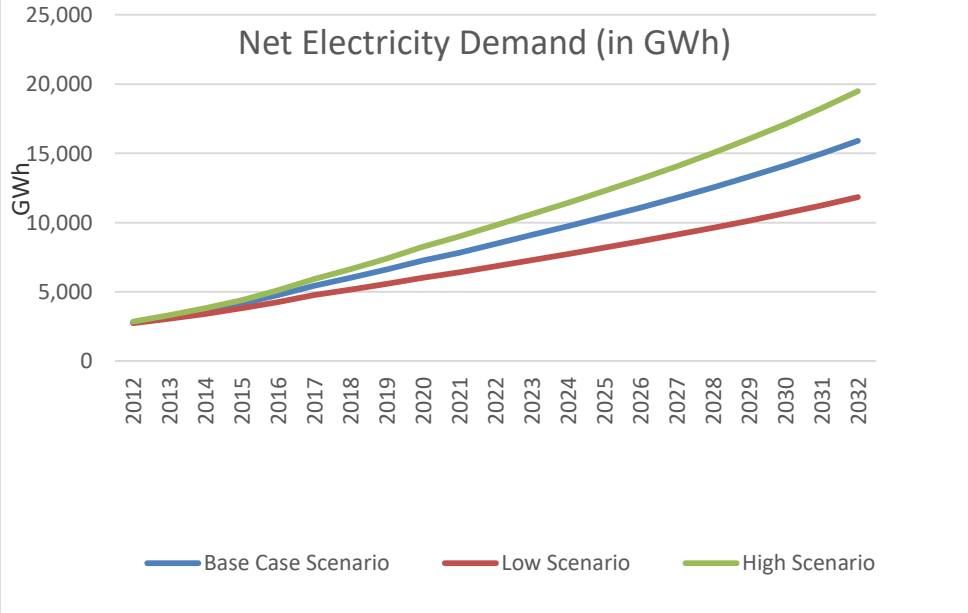
Development of peak load in Afghanistan [3]

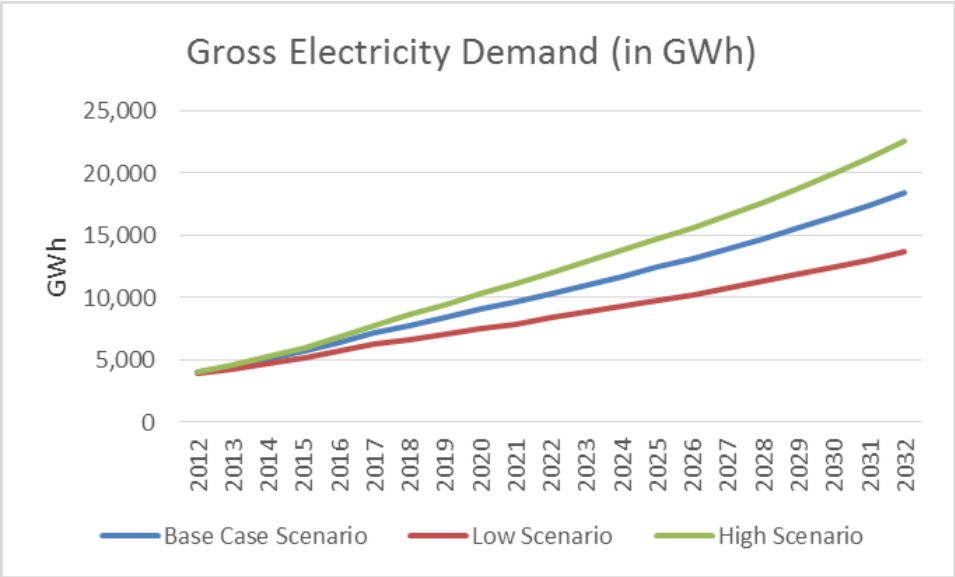
For the whole of Afghanistan, gross demand, i.e. dispatched electrical energy will increase in the base case scenario by 5.7% or 8.7% per annum on average from its current level to 18,400 GWh in 2032. Total peak demand in 2032 is expected to stand at around 3500 MW. In addition, high and low scenarios were developed which show a total gross demand of about 22,500 GWh and a peak of 4300 MW in 2032 in the high scenario and around 13,700 GWh gross-demand and 2600 MW peak in the low scenario.

Afghanistan Electricity Demand Forecast for 20 Years

Forecast Scenario 2032	Gross Demand	Net Demand	Peak Load
Base Case	18,409 GWh	15,900 GWh	3502 MW
High Scenario	22,534 GWh	19,474 GWh	4287 MW
Low Scenario	13,701 GWh	11,840 GWh	2607 MW







Afghanistan Electricity Demand Forecast for 20 Years [16]

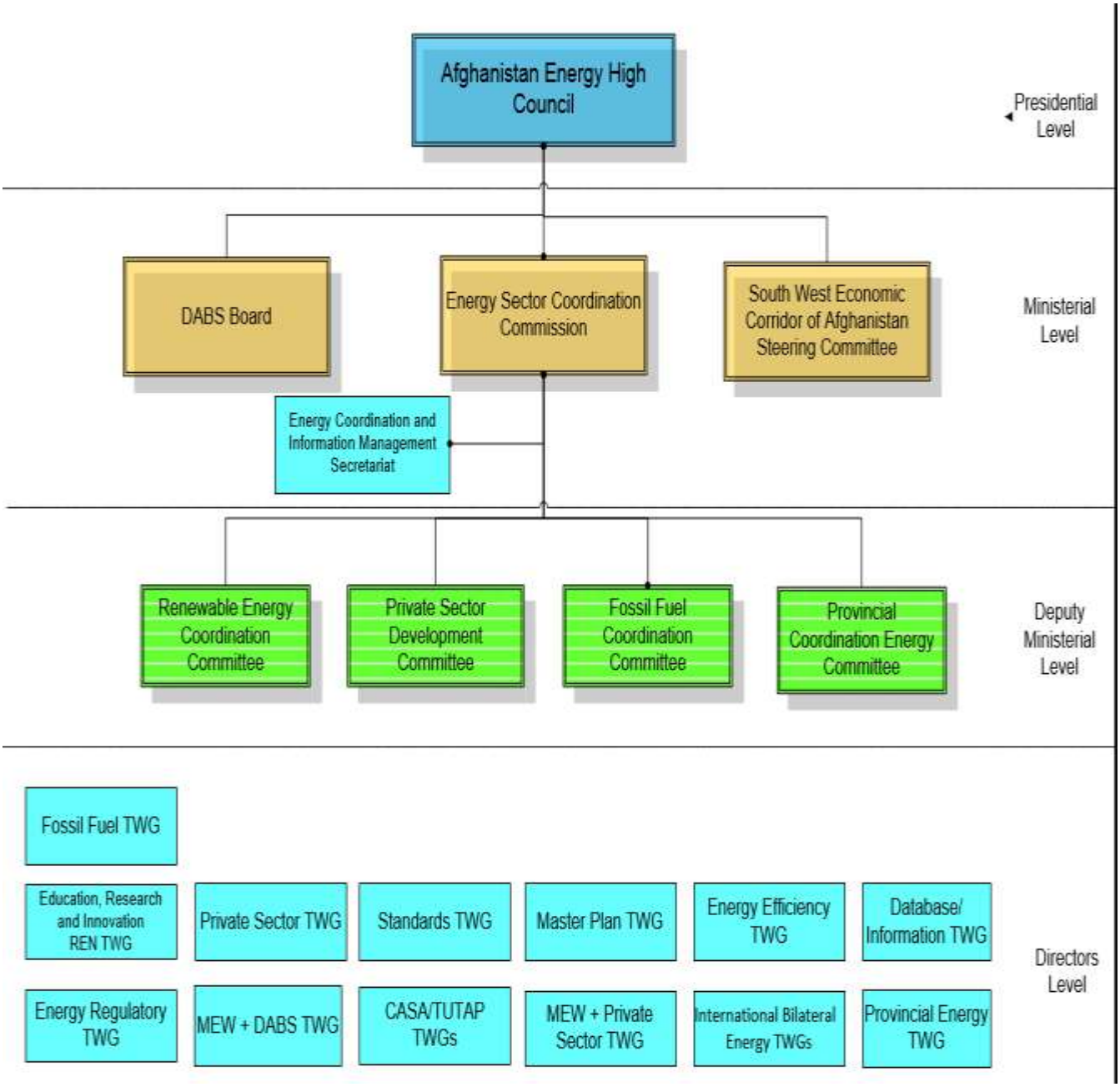
To access and provide power supply in whole Afghanistan a large investment plan is required for all the sub-areas like, Generation expansion, Transmission Network development and strengthen Distribution System. This will need a total investment of $10,096m, out of which, $7,330m for Generation sector development and network integration, $1,727m for major Transmission Projects and $1,040m for Transmission Network development within the provinces up to the year of 2032 **[18]**additionally right now there is also from Tajikistan supplied power in Tajik area (Badakhshan province)it's border with Tajikistan supply about 17 villages in Afghanistan and four villages from Tajik villages these border supply between Tajikistan and Afghanistan is not by the Panj river its supplied by the local diesel or hydropower system **[21]**

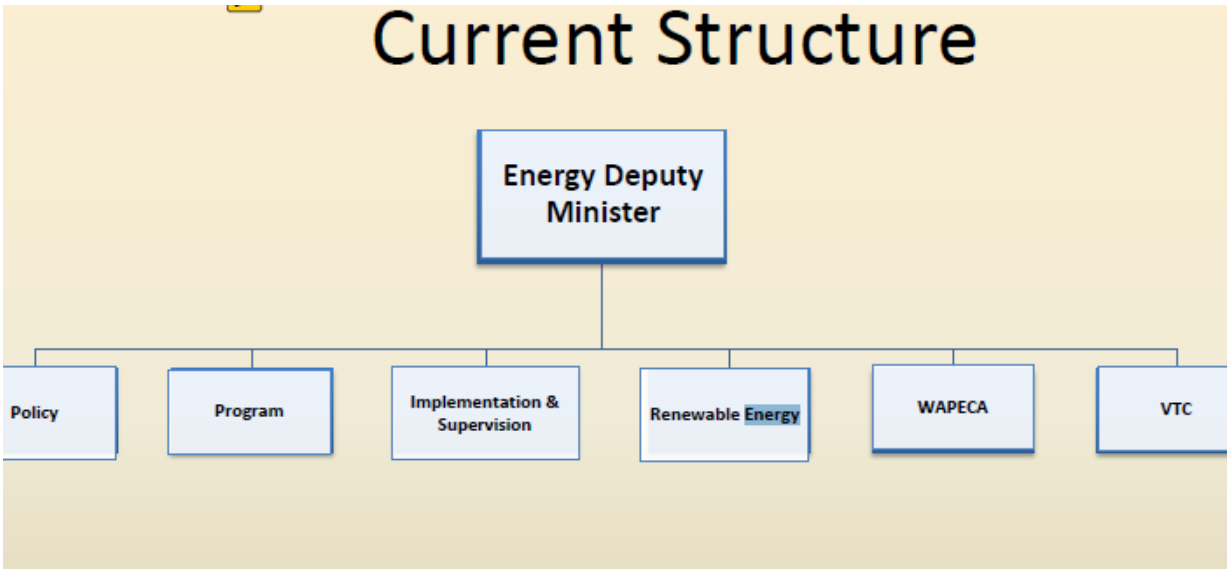
4. Afghanistan energy drivers:

4.1 Energy sectors:

Afghanistan's Energy Sector Strategic goal is to provide sustainable power supply, at affordable prices, safely environment and in an environmentally sound manner, for removing poverty and economic growth, creation job and to improve living standards. A combination of government institutions they are the responsible for the development of energy sector in Afghanistan. They are consisting Ministry of Energy and Water (MEW) and ministry of rural and rehabilitation and develop (MRRD). Each one of these institutions are independent has no relation with each other. But in required time they will coordinate with each other. Ministry of Finance (MOF) and Ministry of Economy (MOEc) are concerned with planning and budgeting.

The following figure shows the sector of energy in Afghanistan and it branches **[18]**





4.2 Ministry of Energy and Water (MEW).

Some of the main roles of MEW in developing the renewable energy sector in Afghanistan are to prepare policies, strategies, action plans, and laws, create a platform for decision-making, implement renewable energy projects, and help other developing agencies with security, land acquisition, and licensing issues. MEW supposed to have the responsibility of RE sector in the country according to the Afghanistan national renewable energy policy (ANREP) this position (MWE) mandates and orders to implement the RE project on the provinces and district levels. Which is greater than1000 KW **[1].**

4.3 Ministry of Rural Rehabilitation and Development (MRRD);

This position has the responsibility of rural energy areas to Promotion and services .The MRRD mandates to alleviate poverty and improve the livelihood

of rural households. This mandate is at the village level. But if there is present the project at district and provincial level or its demand energy is greater than specified scale (1000KW) or there will come a project across the district or provincial in that case the MRRD does not need to implement any project. Then it's belongs to the MEW or District Development Plans (DDPs) consider rural energy as one of the priority demands of communities due to coordination by the policies.

4.4 Da Afghanistan Breshna Sherkat (DABS);

Its already has been introduced DABS is the Responsible for all of the central generation, distribution, and transmission assets in Afghanistan. According to a MOU between MEW, DABS, and MOF, DABS is responsible for operation and management of power sector in Afghanistan. DABS was one part of MEW before at 2008 as Da Afghanistan Breshna Moassessa (DABM). DABS's responsibility is not only rural electrification or implementing RE since its main business is central grid connected power generation units. DABS bought 176 million USD worth of electricity from neighboring countries in 2013 and had forecasted another205 million USD for 2014. This corresponds to 79% of energy supplied by DABS in 2014. DABS's financial assets amount within about 561millionUSD and its net income amounts to about 20 million USD **[1]**.

DABS –Future Growth Plans –Transmission;

A project forecasted between Tajikistan to supply 750 KW 500 KV high voltage direct current (HVDC) in Afghanistan and trough from Afghanistan to Pakistan out of which Tajikistan 117KW through Afghanistan and 562 KW

and 71 KW to Pakistan & construction of HVDC converter stations at Sangtuda (1300MW), Kabul (300MW) and Peshwar(1000MW) another project will construct which is enable trade of 1300MW of hydropower from Central Asia (Kyrgyz Republic & Tajikistan) to South Asia (Afghanistan & Pakistan). Afghanistan will import 300MW of power, with supply period from May to September .Project cost of USD1170 million, funded by multiple multilateral agencies **[15]**.

4.5 Renewable energy policy (REP):

Renewable energy policy it's pursuit and growing up the utilization of RE in the country there are many counties in the world which have such policies and the policy of country is differs with other country even the targets and strategies are different by their government or their national. In addition, it is possible that the manners of addressing the problems may be differed based on economic perspective, technological orientation and workability of policy frameworks. RE in all the world they are expanding day by day and developing by the single or hybrid system **[12]**

4.6 Environmental:

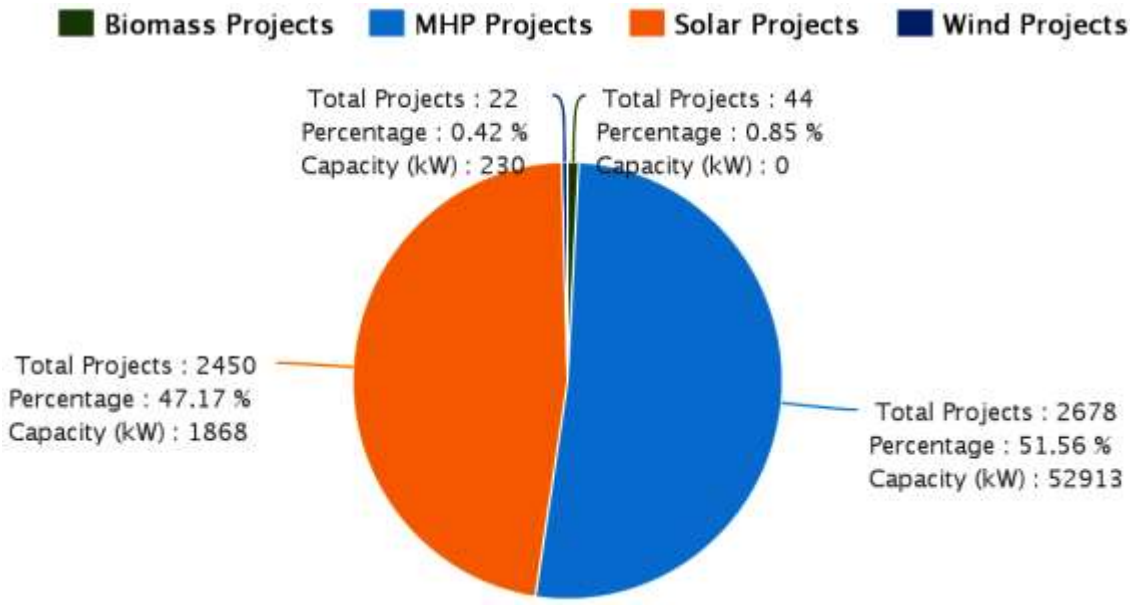
There is strong relationship between energy- induced actions and climate change factor. Production of fossil- based energy give-off greenhouse gases (GHGs) with increasing impacts on rising of global warming potential. Change of the climate can be meanly change by its properties and identified that persists for extended periods of decades or more. Changing of climate to a danger climate is a global danger there is no country to can resolve by own .This problem because of the centrality of the global atmosphere. A more

appropriate solution lies on the tendencies to synchronize national actions as contained in regional and inter- national frameworks for 30 years war Afghanistan damaged and its air polluted then by the help of the UNDP and the Wildlife Conservation Society and the Global Environment Facility's a small grant has been done on forestation and planting tree. Using of renew able energy system it will reduce the pollution of air and environment. Further using firewood to heat space .It will cause to remove the tree and deforestation and using wood traditionally have smokes **[12]**

5. Renewable Energy Potential;

Renewable Energy refers to energy from natural resource and renewable resources which are sustainable and unfinished source. The technologies of renewable energy are not used only for generating electricity in Afghanistan it used also for heating and cooking. Renewable Energy resources types are Hydro, Solar, Wind, Biomass and Geothermal. Renewable Energy can be offers opportunity for Afghanistan's peoples in general. And rural energy in particular, but unfortunately until now Renewable Energy resources Are not used and untapped in the country. Using of Renewable Energy for Afghanistan has different advantages especially under the natural conditions of Afghanistan and as well as the stage of development. Reliable power supply of sufficient quality and quantity and cost effectively, is an important input in the sustainable development of Afghanistan and it will support economic

development and employment. Renewable Energy sources are available across the Afghanistan and offer the possibility of implementing energy supply solutions independent from the national grid. Renewable Energy resources are only the resource can satisfy the demand or customers in Afghanistan Whether it is the energy service of cooking from traditionally-harvested biomass or high-quality electricity for telecommunications networks in centralized or decentralized grids, The evidence shows that from a theoretical point of view, that there is a considerable potential of renewable energy resources especially solar, wind, hydro, Biomass and geothermal available across the country. Unfortunately there is no any of grid-scale of renewable energy excluding hydropower which have been done a considerable work in the country .The upcoming Figure shows the amounts of capacities of renewable energy projects either ongoing or accomplished in the country by 2015



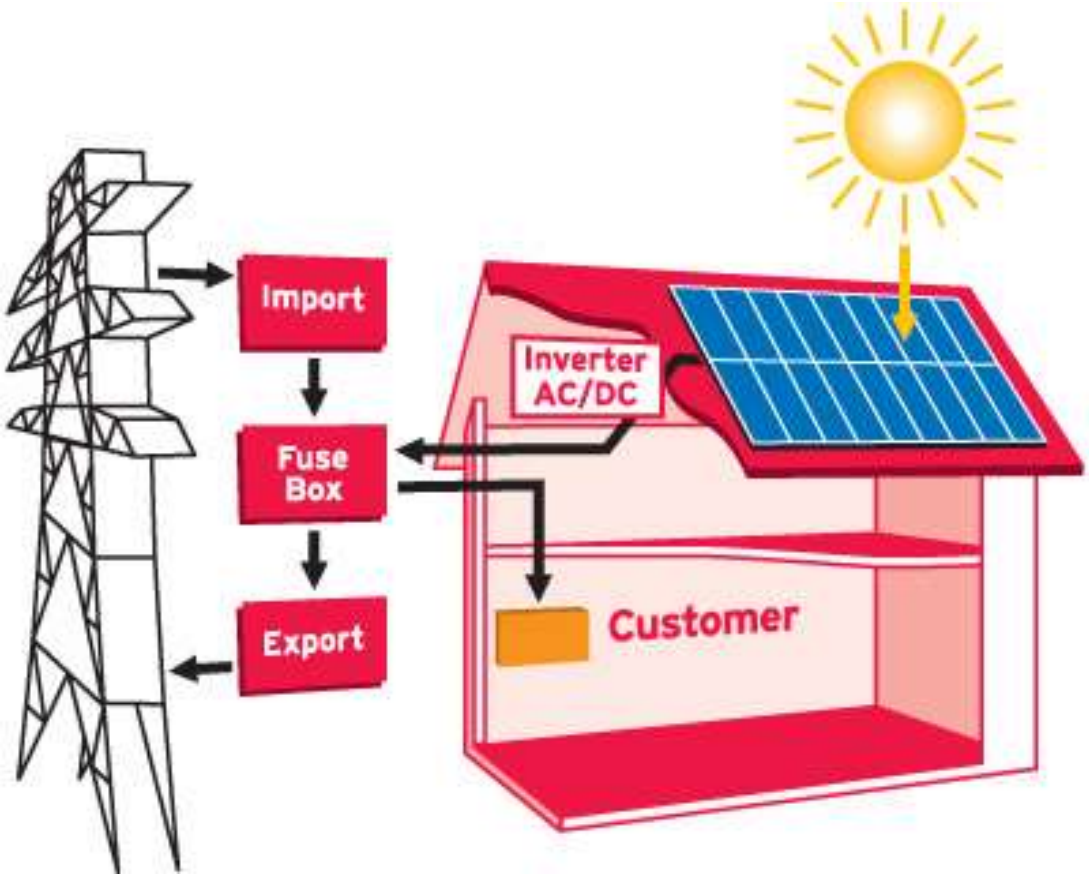
Renewable energy projects [3]

Renewable Energy Proposed 100 MW Projects						
No	Project Name	Province	Type of Energy	Capacity (kW)	Power Plant Est. Cost (Million USD)	No. of People Supplied
1	Kandahar Solar - DG Hybrid Project	Kandahar	Solar	30000	90	
2	Kabul Solar - Hydro Hybrid Project	Kabul	Solar	10000	25	
3	Roof Top Solar Project	Kabul	Solar	5000	15	
4	Kabul Waste to Energy Project	Kabul	Biomass	6000	23	
5	Kabul Waste Water Treatment Project	Kabul	Biomass	1000	2	
6	Bini Hisar Biogas Digester Project	Kabul	Biomass	500	1	
7	Pul Charkhi Biogas Project	Kabul	Biomass	500	0.5	
8	Ghor Solar Project + Backup + Distribution Network	Ghor	Solar	5000	25	
9	Helmand Solar Project	Helmand	Solar	3000	20	
10	Herat Wind project	Herat	Wind	14000	36	
11	Spogmee MHP Project	Badakhshan	MHP	2500	10	
12	Kuran Wa Munjan MHGP Project	Badakhshan	MHP	1500	9	
13	Yangi Qala MHP Project	Takhar	MHP	1000	6.5	
14	Farkhar MHP Project	Takhar	MHP	500	2.5	
15	Namak Ab MHP Project	Takhar	MHP	500	2.5	
16	Mazar Waste to Energy Project	Balkh	Biomass	6000	16	
17	Zari MHP Project	Balkh	MHP	500	2	
18	Sholgara MHP Project	Balkh	MHP	500	1.5	
19	Kishindeh MHP Project	Balkh	MHP	500	2	
20	Urozgan Solar Project	Urozgan	Solar	1500	4.5	
21	Noristan Solar Project + Distribution Network	Noristan	Solar+MHP	1000	4	
22	Daikundi Solar Project	Daikundi	Solar	1000	3	
23	Badghis Solar Project	Badghis	Solar	1000	3	
24	Zabul Solar Project	Zabul	Solar	1000	3	
25	Paktia Solar Project	Paktia	Solar	1000	3	
26	Logar Solar Project	Logar	Solar	1000	3	
27	Khost Solar Project	Khost	Solar	1000	3	
28	Ghazni Solar Project	Ghazni	Solar	1000	3	
29	Paktika Solr Project + Distribution Network	Paktika	Solar	1000	4	
30	Farah Solar Project	Farah	Solar	1000	3	
Total				100000	326	1000000

Renewable energy proposed[18]

5.1. Solar energy ;

Solar energy is energy which used directly from the Sun. Solar radiation varies from one region to another throughout the world. It's Estimates and indicates that in Afghanistan Solar energy is Constitute the most abundant of renewable energy resource. Besides, as it is clean, abundant, offers zero input cost and distributed throughout the country. It is a necessary type of the sustainable source especially for remote off-grid locations. Solar radiation averages about 6.5 kilowatt-hours per square meter per day .With having 300 days sunshine per year. Has a considerable energy potential by using solar thermal and PV system. The potential for solar energy development is huge, and it's not only for solar water heaters of homes, hospitals, and other buildings, it's also used for generating electricity. Solar power can be installed on homes and buildings that are already connected to the grid, allowing solar power to flow to all customers on that grid. Distributed solar power can also be installed in non-grid connected rural villages and homes



Solar power installation on homes and buildings that are already connected to the grid [4]

The plants can be both off-grid and micro grids for residential and industrial customers own use or potentially large solar plants connected to the grid .In Afghanistan More than 2000 of individual solar projects have been done by the national solidarity program (NSP) and rural electrification in 2014. Most of them are used for producing electricity and lighting in buildings and some schools, hospitals, police buildings, mosques and some residential areas in the villages. The technology has been used, is installation more than 100,000 PV systems mostly of less than 50Wp capacity .A10km resolution annual map for PV technology in Afghanistan solar radiation prepared by national renewable energy laboratory (NREL). It's shown that the majority of solar

resources are located in southern, south-eastern and south-western areas of the country.

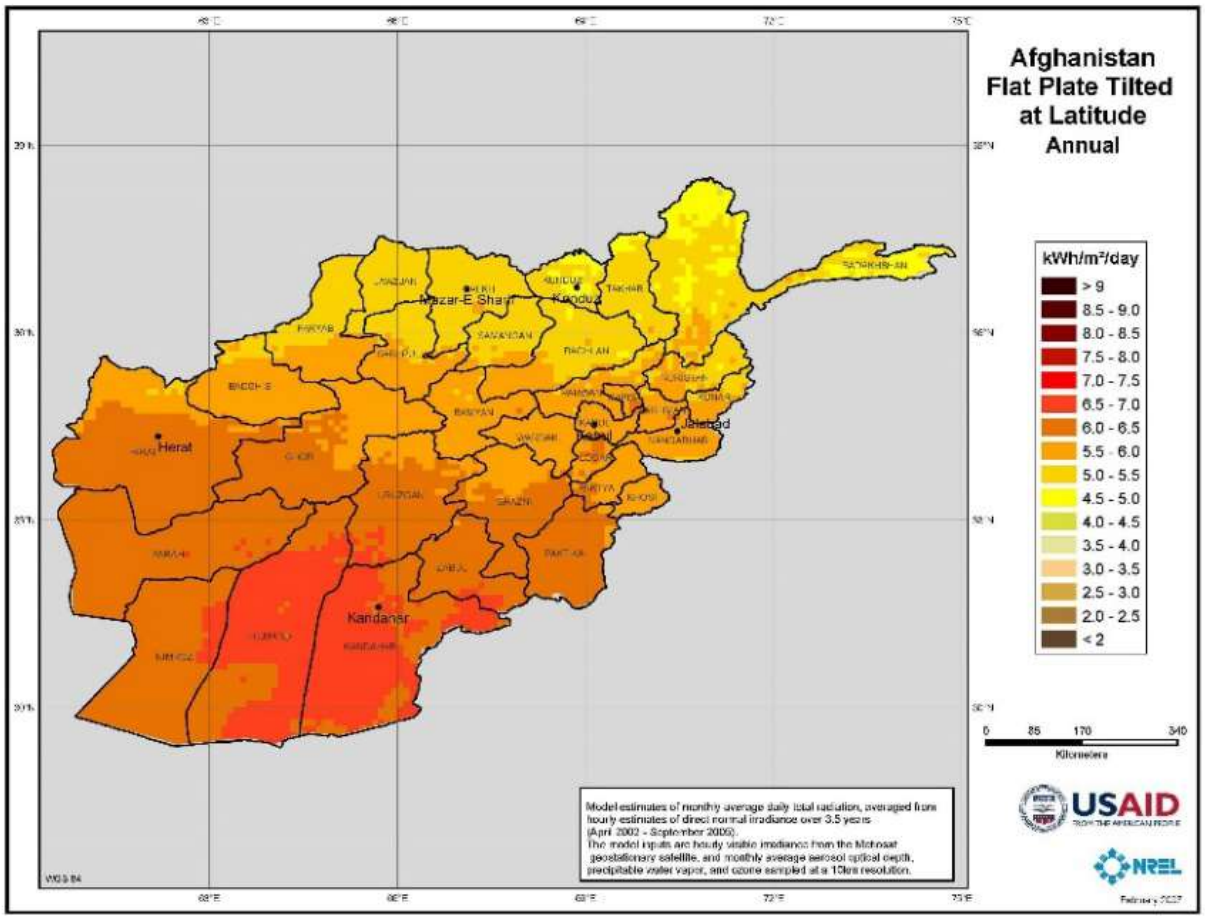


figure shows results of the resolution that mentioned

If we assume that, only 5% of the total land (652,864 km2) is used considering 300 sun shining days, 12 hours per day and average 6.5 kWh/m2/day energy density, then the maximum feasible potential can be 39given as Eq. 1. Now, if poly-crystalline silicon PV cells with having 16% conversion efficiency are used, then it will produce 3,768.32 MW power. This

is still a huge capacity and even it can satisfy the future power demand of the country.

Percentage of total area 2% = 0.02

Total area of Afghanistan = 652864km^2
0.02 * 652864 = 13057.3km^2 =13057.3* 10^6m^2
Time 1hour= 60minut =60*60sec=3600sec

$$p_{max} = \frac{6.5\text{KWh} * 13057.3 * 10^6 m2}{3600h * m^2} = 23575680.7kw = 23.575GW$$

The total solar energy potential is 222 GW in the Afghanistan it equal to 222,000MW

No.	Provinces	Provinces area (km^2)	Solar radiation ($kWh/m^2/day$)	Total potential (MW)	Feasible potential (MW)
1	Badakhshan	44,836	5	3,736,325	3,736
2	Badghis	20,794	6.15	2,131,385	5328
3	Baghlan	18,255	5.05	1,536,479	1,536
4	Balkh	16,186	4.3	1,160,018	2,900
5	Bamyan	18,029	6.2	1,863,017	1,863
6	Daykundi	17,501	6.55	1,910,570	1,911
7	Farah	49,339	6.6	5,427,301	27,137
8	Faryab	20,798	5.4	1,871,784	4,679
9	Ghazni	22,460	6.2	2,320,867	5,802
10	Ghor	36,657	6.9	4,215,601	10,539
11	Helmand	58,305	6.85	6,656,499	33,282
12	Heart	55,869	6.13	5,707,898	28,539
13	Jawzjan	11,292	4.74	892,029	2,230
14	Kabul	4,524	5.73	432,032	432
15	Kandahar	54,845	6.8	6,215,710	31,079
16	Kapisa	1,908	5.75	182,850	183
17	Khost	4,235	5.15	363,530	364
18	Kunar	4,926	5.45	447,436	447
19	Kundoz	8,081	3.8	511,790	1,279
20	Laghman	3,978	5.08	336,796	842
21	Logar	4,568	5.93	451,471	451
22	Nangarhar	7,641	5.3	674,964	1,687
23	Nimroz	42,410	6.4	4,523,680	22,618
24	Nooristan	9,267	5.75	888,059	888
25	Paktia	5,583	5.48	509,932	510
26	Paktika	19,516	6.2	2,016,643	5,042
27	Panjshir	3,772	5.95	374,017	374
28	Parwan	5,715	5.75	547,697	548
29	Samangan	13,438	5.2	1,164,609	2,912
30	Sar-i-pul	16,386	6.05	1,652,215	4,131
31	Takhar	12,458	4.9	1,017,387	2,543
32	Urozgan	11,474	6.83	1,306,090	6,530
33	Wardak	10,348	6.05	1,043,454	1,043
34	Zabul	17,472	6.5	1,892,778	9,464
Total		**652,864**	**6.5**	**65,982,912**	**222,652**

Solar resource potential per each province [3] .

5.2. Wind energy;

Wind energy is a kind of energy which turbine rotates by the blowing of wind and it will convert directly to the electricity. The wind energy can displace the fossil-fuel derived electricity **[4].** It is common to see different seasonal variations throughout the world and even a country. In recently wind energy resource gaining attention for electricity generation, because it is free, relatively low capital cost and pollution free source. Wind resources in Afghanistan the lowland areas in the south and west of Afghanistan have a variable wind which will blow 120 days per year, with an average velocities of four meters per second. In during year with having four seasons the wind speed will change in the Seasonal dusty winds may be as high as 6.5-9 meters per second around western, northern and central provinces of Afghanistan, by the average velocity of four meter per second. Theoretically Afghanistan can be Have an electricity production of 158GW **[19].** In Afghanistan wind energy sources have been estimated by national renewable energy laboratory NREL. By its predication that, the windy resource major areas are in the country include western of Afghanistan especially, Nimroz and Herat, northwestern Farah, northeastern areas especially Balkh, Takhar, wind corridor areas including near Jabalsaraj, Sarobi and Tirgari, eastern Afghanistan particularly

Qalat, Gadamsar, Walakhor, Golestan, and Gorzanak and elevated mountain summits in central/southern and northern Afghanistan. By the total theoretical potential is estimated about 158000 MW which is equal to 158 Gw (with 5 MW/km2), and the total feasible potential is 66726 MW.

If installed capacity is assumed 5 MW/km2 and also if 5% of the total land (652864km^2) is used as stated then theoretical or total potential, of wind energy in the country can be calculated as:

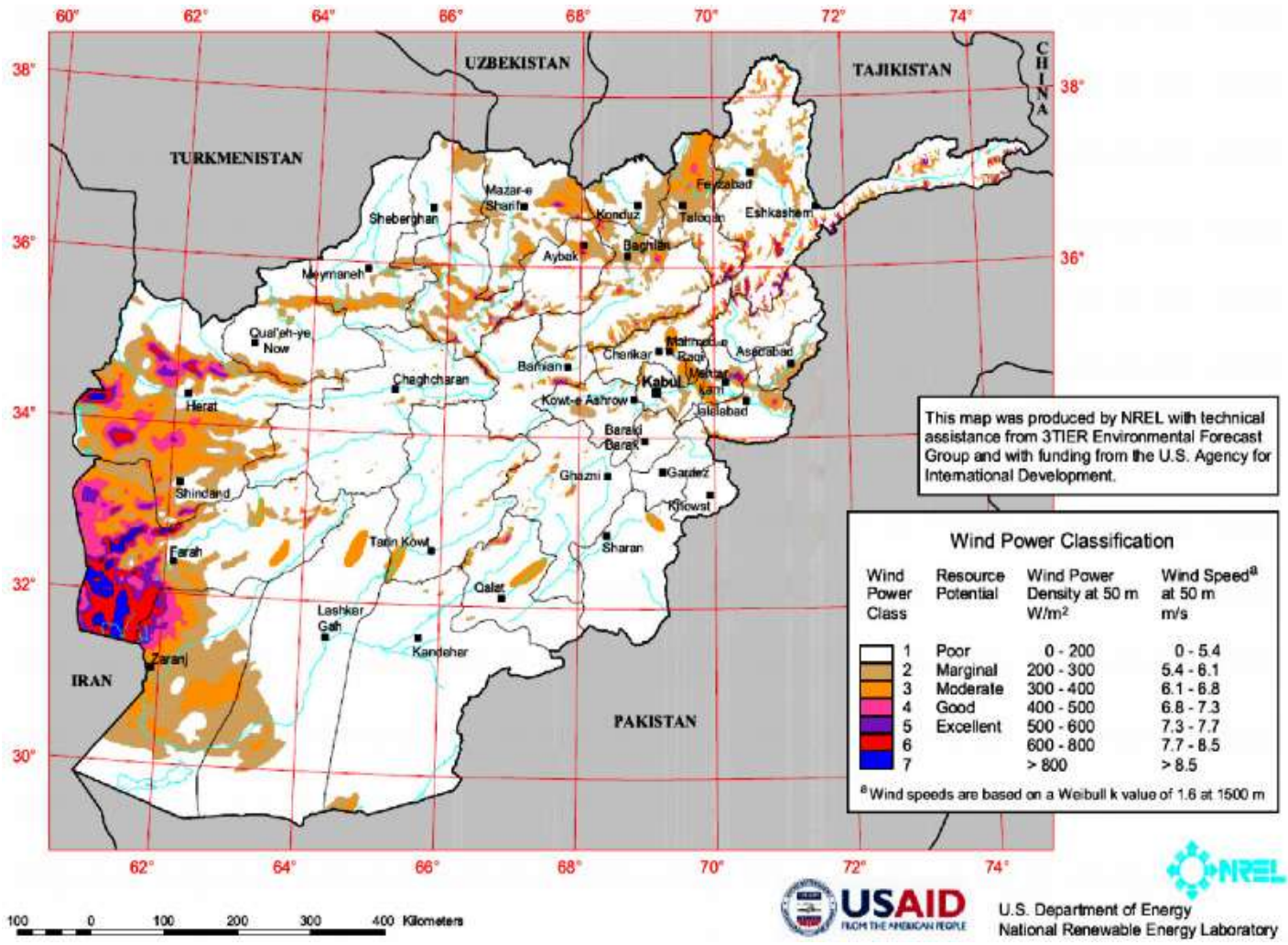
Percentage of the total area = 5% = 0.05

Total area of Afghanistan =652864 km^2

Assumed energy per area =5MW/km^2

5 percentage of total area is equal to 0.05*652864km^2=32643.2km^2

$$p_{max} = \frac{5mw}{km^2} \times 32643.2km^2 = 163216mw$$



A bout 12% of the Afghanistan land are claimed to have better wind energy resource. There is not any utility-scale wind generation available in the country, though totally six projects with 230 kW installed capacity are completed by 2015.in Panjshir There is a power generation of wind by ten turbines capacity of 100kw for the first time in 2008 has been installed **[3].** Household systems (e.g. up to 500W) are more complicated in maintenance (sand, dust) than solar-photovoltaic systems; solar- wind-hybrid systems most feasible **[19]**.

No.	Provinces	Provinces area (km^2)	Windy area (km^2)	Total potential (MW)	Feasible potential (MW)
1	Badakhshan	44,836	1,428	3,314	331
2	Badghis	20,794	410	762	191
3	Baghlan	18,255	1,064	2083	208
4	Balkh	16,186	1,689	3,145	786
5	Bamyan	18,029	100	240	24
6	Daykundi	17,501	-	-	-
7	Farah	49,339	19,270	61,353	30,677
8	Faryab	20,798	560	1,008	252
9	Ghazni	22,460	93	191	48
10	Ghor	36,657	160	336	84
11	Helmand	58,305	1,040	1872	936
12	Heart	55,869	14,694	36,947	18,473
13	Jawzjan	11,292	95	171	43
14	Kabul	4,524	230	414	41
15	Kandahar	54,845	130	234	117
16	Kapisa	1,908	450	810	81
17	Khost	4,235	-	-	-
18	Kunar	4,926	40	72	7
19	Kundoz	8,081	180	324	81
20	Laghman	3,978	460	1020	255
21	Logar	4,568	-	-	-
22	Nangarhar	7,641	300	582	146
23	Nimroz	42,410	10,130	21,450	10,725
24	Nooristan	9,267	90	-	-
25	Paktia	5,583	-	-	-
26	Paktika	19,516	220	396	99
27	Panjshir	3,772	80	180	18
28	Parwan	5,715	705	1269	127
29	Samangan	13,438	503	1,064	266
30	Sar-i-pul	16,386	385	729	182
31	Takhar	12,458	2,547	4,795	1,199
32	Urozgan	11,474	550	990	495
33	Wardak	10,348	80	180	18
34	Zabul	17,472	860	1,632	816
Total		**652,864**	**58,543**	**158,055**	**66,726**

Wind power potential per each province **[3].**

5.3. Hydro power;

Hydropower generates energy by rotating turbine from the flowing water through turbine. The major portion of electricity production is comprised of large hydro power plants inside the country. Theoretical potential of hydro energy is estimated 23, 310 MW (258 MW operating, 56 MW under construction and 22998 MW still untapped), where totally more than 5,000 MW is claimed to be technically possible to tap According to the latest

Data base of MEW and MRRD, the total installed capacity of micro hydropower plants (MHP) in Afghanistan is 36.907 MW with further 5.845 MW are under construction and 10.144 MW is surveyed by the various organization including MEW and MRRD associated programs. Micro hydropower is the most wanted of peoples for electricity due to its clean and less operating and maintenance cost **[3].** from this reference it has been stated

For the near term of 5 to 10 years, the potential is estimated at least 800 MW for mini and micro hydro, which consists of hydropower plants, including storage based and run-of-the-river plants **[22].** In Afghanistan Kokcha, Amu and Helmand River can provide a suitable and big hydro power, also these rivers can connect a width areas irrigation. Particularly in the North, Northeast and Southeast (Badakhshan, Takhar, Kunar, Paktia, etc), in the mentioned place the advantages are also electricity can be generated at lowest cost and minimum environmental damage. In Afghanistan the total of the renewable energy of the hydropower has been indicated are 125 sites. With the potential to generate about 600 megawatts of electricity .New capacity for small hydropower is expected at 615 MW until 2018, 185 MW **[23]**.

Advantages and disadvantages of the hydropower [12] .

Advantages	Disadvantages
Economic aspects	
Provides low operating and maintenance costs	High upfront investment
Provides long life span (50–100 years and more)	Precipitation
Provides reliable service	Requires long-term planning
Includes proven technology	Requires long-term agreements
Instigates and fosters regional development	Requires multidisciplinary involvement
Provides highest energy efficiency rate	Often requires foreign contractors and funding
Creates employment opportunities and saves fuel	
Social aspects	
Leaves water available for other uses	May involve resettlement
Often provides flood protection	May restrict navigation
May enhance navigation conditions	Local land use patterns will be modified
Often enhances recreation	Waterborne disease vectors may need to be checked
Enhances accessibility of the territory and its resources	Requires management of competing water uses
Improves living conditions	
Sustains livelihoods (fresh water, food supply)	
Environmental aspects	
Produces no pollutants but only very few GHG emissions.	Inundation of terrestrial habitat
Enhances air quality	Modification of hydrological regimes
Produces no waste	Modification of aquatic habitats
Avoids depleting non-renewable fuel resources	Water quality needs to be managed
Often creates new freshwater ecosystems with increased productivity	Temporary introduction of methyl-mercury into the food chain needs to be monitored/managed
Enhances knowledge and improves management of valued species due to study results	Species activities and populations need to be monitored
Helps to slow down climate change	Barriers for fish migration, fish entrainment
Neither consumes nor pollutes the water it uses for electricity generation purposes	Sediment composition and transport may need to be monitored/managed

The upcoming Table indicates the summary of hydropower potential by each zone in Afghanistan **[3].**

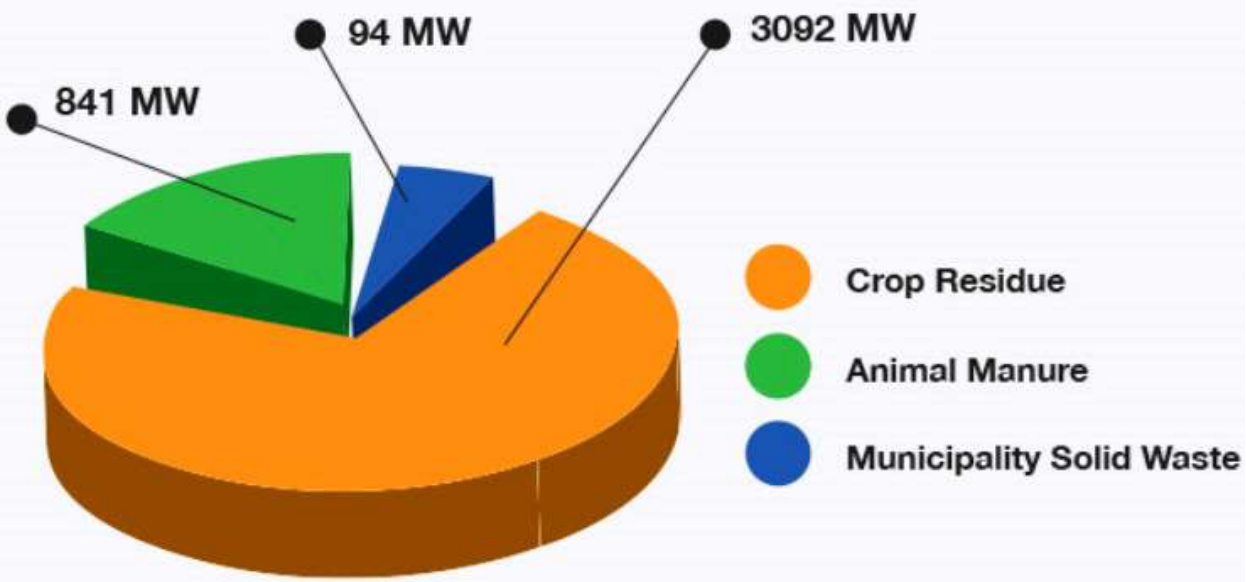
No.	Zone	River	Potential [MW]
1	Kabul	Kabul	408
2		Panjshir	400
3		Laghman	44
4		Kunar	1089
5	Panj-Amu	Panj	9050
6		Amu	9110
7		Kokcha	1927
8		Kunduz	50
9	Northern	Jawzjan	460
10		Balkh	300
11	Harirod-Murghab	Harirod	102
12		Murghab	100
13	Helmand	Helmand	190
14		Farah Rod	80
Total			**23,310**

Hydro potential resources by zone

5.4. Biomass;

Biomass is all the material of plants and animals and with their waste and residues .Or all living organic matters which used to produce energy. Biomass has been constructed by three major portions of the resource which consist agricultural waste from crop residues; biodegradable wastes from industrial sludge, dung and food waste; and forest bioenergy resources. Biomass is one of the promising sources of energy. Technical and economic viability of biomass is still under proving circumstances in different countries of the world. And also biomass is the largest portion of the primary energy in Afghanistan. Using biomass for energy generation still largely depends on index factors such as system efficiency, resource availability, social acceptability, emission factor, land use policy, technology, Economic-cost of power plant and fuel flow .Some constraints such as socio-economic adversity of land and water usage. Biomass can be subjected to processes producing heat or steam for electricity as well as other useable energy resources such as

biodiesel, bio- ethanol, biomass pellets and bio-methane gas. In some countries, existing trend includes combined heat and power (CHP) on a building or community scale mainly for electricity or district heating applications **[12].** Biomass in Afghanistan also could be summarized as agricultural resources such as crop residues, animal wastes, forest resources and urban wastes. According to the ministry of energy and water database, there are many biomass project about 44 biomass projects has been completed. But they are used for non-electricity purposes in the country. According to Milbrandt and Overend (2011), animal manure has been used as a form of Chemical feature to the Afghan agriculture. About 79% of rural households and 94% of Kuchi population own some kinds of livestock. But it used only for cooking heating it's not used for the electricity generation purpose. Besides, municipal solid waste (MSW) in the urban areas of the country can be considered as an important source of electricity and heat production using waste-to-energy (WTE) combustion technologies. Converting animal manure to electricity, the coefficients used are 550 kWh/tone of organic waste, 155 kWh/tone of animal manure and 4170 kWh/tone of crop residues, respectively



Potential of biomass resources by MW **[3]**

According to a study by the ADB, in Afghanistan more than 85% of the people which needs energy the met by traditional biomass, specially wood and animal dung .Though2-4% of the land vegetation remains as forest.by the using of n- wood- biomass for electricity generation. The climate can effect on the potential significantly. Particularly for biogas-production, a steady ground temperature above 25°C is needed .Which excludes large parts of Afghanistan **[23].** To making biogas suitable for different climatic conditions .And developing models. That takes into account local problems such as low temperature, and different fuel inputs for biogas systems. To reduce the consumption of the fuel wood that's enough to use efficient stove for cooking and heating or by designing of the Improved Cook Stoves (ICS). According to the latest report of NREL "Assessment of Biomass Resources in Afghanistan, Theoretically, Afghanistan has the potential to produce about 1,408 million cubic meters (MCM) of biogas annually from animal manure, based on the

number of livestock in the country as of 2008-09 and this volume is equivalent to about 6,619 GWh of electricity, its estimated that from combusting Municipality Solid Waste (MSW) in the urban major areas and using thermo chemical are 134 GWh per year **[22]**.

Table indicates the amount of crop residues, animal manures and municipal solid waste and expected electricity generation potential per each province of the country in 2014 **[3].**

Biomass resource potential per each province.

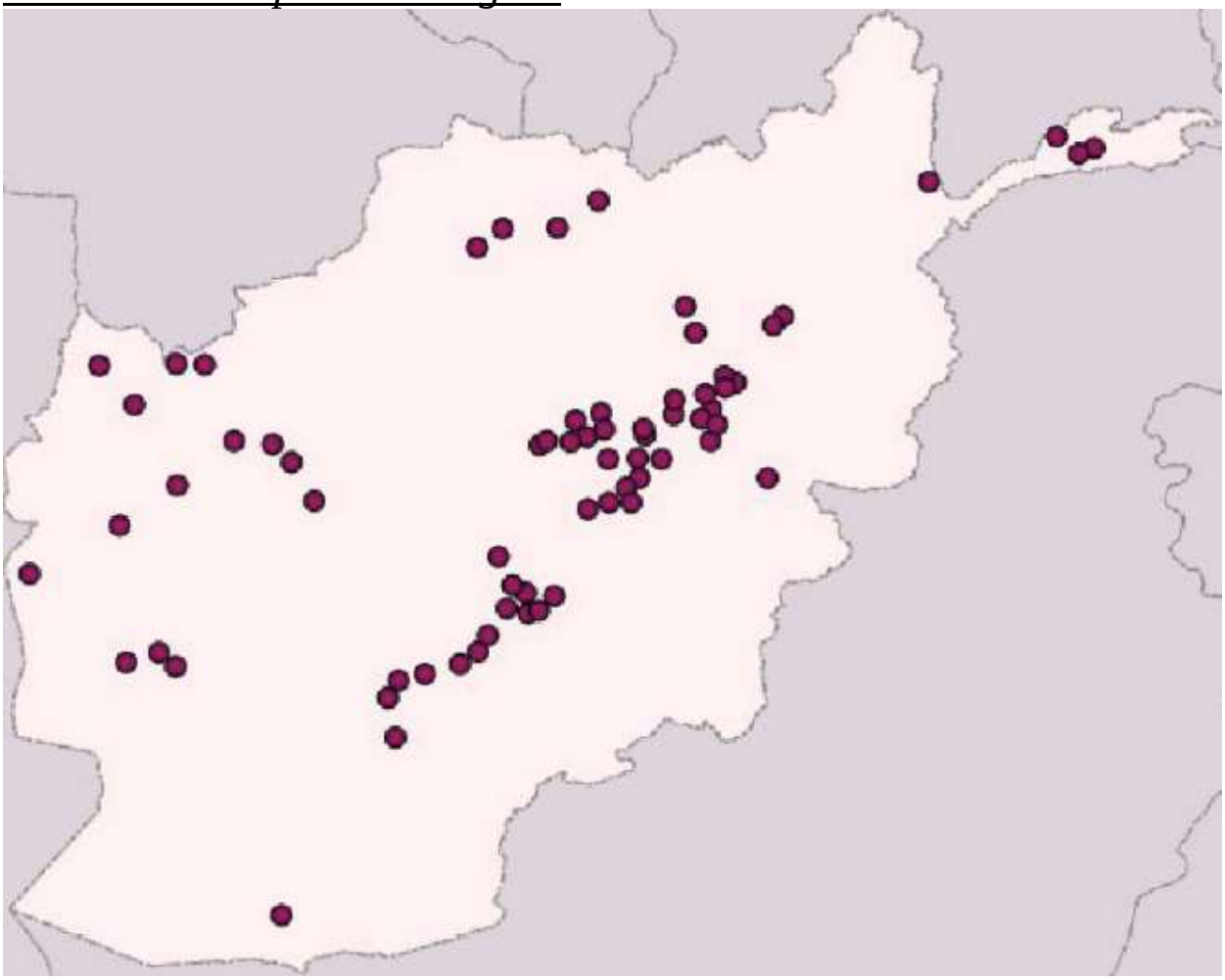
No.	Provinces	Municipal solid waste (Tonne/year)	Electricity production potential (MWh/ year)	Animal manur (Tonne/year)	Electricity production potential (MWh/year)	Crop Residue (Tonne/year)	Electricity production potential (MWh/ year)
1	Badakshan	132086	29059	2407756	452658	143550	598604
2	Badghis	68897	15157	787318	148016	138570	577837
3	Baghlan	126100	27742	1579481	296943	345860	1442236
4	Balkh	181785	39993	1045096	196478	415330	1731926
5	Bamyan	62123	13667	761429	143149	68720	286562
6	Daykundi	64021	14085	1114886	209599	46620	194405
7	Farah	70430	15495	865514	162717	90030	375425
8	Faryab	138408	30450	971824	182703	323940	1350830
9	Ghazni	170645	37542	1212019	227860	322200	1343574
10	Ghor	95951	21109	1236102	232387	97470	406450
11	Heart	259880	57174	2258046	424513	415470	1732510
12	Helmand	128407	28250	2033377	382275	482920	2013776
13	Jawzjan	74767	16449	403238	75809	217440	906725
14	Kabul	576744	126833.6	367493	69089	111600	465372
15	Kandahar	168061	36973	2164179	406866	266440	1111055
16	Kapisa	61291	13484	911902	171438	106020	442103
17	Khost	79833	17563	1956218	367769	90290	376509
18	Kunar	62605	13773	1669748	313913	107680	449026
19	Kundoz	139255	30636	2066156	388437	446790	1863114
20	Laghman	61919	13622	1431920	269201	156870	654148
21	Logar	54473	11984	386770	72713	202020	842423
22	Nangarhar	209656	46124	3333441	626687	419610	1749774
23	Nimroz	22864	5030	252388	47449	71730	299114
24	Nooristan	20571	4526	832461	156503	22420	93491
25	Paktia	76650	16863	1263836	237601	147740	616076
26	Paktika	60415	13291	768982	144569	114090	475755
27	Panjshir	21331	4693	197212	37076	44560	185815
28	Parwan	92214	20287	852559	160281	135580	565369
29	Samangan	53845	11846	282627	53134	99890	416541
30	Sar-i-pul	77672	17088	664815	124985	147900	616743
31	Takhar	136320	29990	1434745	269732	365550	1524344
32	Urozgan	48691	10712	847924	159410	140190	584592
33	Wardak	82870	18231	451688	84917	127030	529715
34	Zabul	42238	9292	374493	70405	62700	261459
	Sub Total	3723015	819063	39187641	7367277	6494820	27083399
	Total energy production from biomass resources				**35,289,739 (MWh/year)**		

5.5 Geothermal;

The heat water underground which has been reserved using by steam and hot water to generate electricity or heating and cooling. Geothermal energy has been used for thousands of years in some countries for cooking and heating. It is simply power derived from the Earth's internal heat. The location of Active geothermal systems are generally in the main axis areas of the Hindu Kush,and runs along the Herat fault system, all the way from Herat in the westernmost part of the country, up to the Wakhan corridor of Badakhshan province Pamir mountains in Afghanistan. The potential geothermal energy reserves in

Afghanistan could provide the electricity of the demand of the peoples. That using of geothermal in form electricity is the most profitable and has the most widely use in the world .Adequate technology and abundant high-temperature water or steam. At present, efficient and durable technology is readily available to Afghanistan to produce this low-cost electricity from its geothermal resources **[23].** To generate electricity from geothermal hot water, two prerequisites must be fulfilled: Adequate technology and abundant high-temperature water or steam .At present, efficient and durable technology is readily available to Afghanistan to produce this low-cost electricity from its geothermal resources **[4].** even there is way and application to use this resource such as in the food processing, fruit drying, refrigeration, fish hatchery and farming, carpet and wool processing, recreation and tourism and other small scale industries According to the New York University, USA & Afghanistan Centre for Policy and Development Studies, Kabul, 2004 report on Geothermal Energy in Afghanistan: Prospects and Potential, Afghanistan has enormous potential of geothermal energy **[22].** The Herat-Panjshir east-to-west striking geo suture is a deep-seated strike-slip fault of up to 700 km into the mantle. In addition, there are similar structures along the Chaman-Moqor NE-SW striking fault system, the Sarobi-Altimore Northeast-to-Southwest arcuate fault system and other secondary faults which cover most of the regions of the country According to Saba et al (2004), taking average by 400 square meters of land. Geothermal power plant can produce a GW of power over a period of 30 years, which is incomparable to the huge acreages needed for other power plant developments. Currently there is not any geothermal power plant to generate energy but it's identified that totally 70 sites and each site can produce a capacity of 5-20 MW of power.

The major areas of the country for the available geothermal reserves are depicted in Figure



Major locations of geothermal resources **[3]**

6. Discussion and Conclusion;

In this paper about renewable energy has been studied with the all component which consist solar energy, wind energy, hydropower, biomass, geothermal energy. With all possibly and feasible potential .Also it has been pointed about the energy system of Afghanistan. Due to the data and predictions about energy potential in Afghanistan .There is enough potential renewable energy to meet all the demands. The source of renewable energy possible to supply and satisfies peoples of urban and rural areas with their various type of requirement such as electricity light, cooking, heating and cooling the space and using for industrial and commercial machine. But unfortunately does not take place any investment on this resource. Due to Security challenges civil war and corruptions. However the total energy concluded about 66000 GW, and total feasible potential is 297GW, where the major portion dominates by solar energy .As a comparison, the total feasible potential of renewable energy is almost 66 times the total demand of 2032. As a conclusion, if only 2% of total feasible potential could be utilized, it can lonely satisfy the total energy demand of the country. Besides, as most of the country's population live in the rural area with 36% under the absolute poverty line with the excluding of the geothermal energy. The available resource potential data of geothermal energy is limited in the country. On the other hand, it is included in the country's rural renewable energy policy that, efforts will be undertaken to demonstrate the potential of geothermal energy as a pilot project in the feasible areas **[3].** the Afghanistan population are

disperse generally in the rural area the best solution to meet rural demand are solar energy to install individually because no long distance easy installation little time of construct.

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