



## Afghanistan renewable energy sector's human resources estimation until 2032

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Conference Proceeding

Open Access

Published

### ABSTRACT

Afghanistan with abundant sources of renewable energies has the plan to generate about 4,500 - 5,000 megawatts of its energy from renewable energies sources until 2032, but it is still one of the energy importer countries. Human resources are the most fundamental and vital part of a sector and they are the most essential part of the development of every sector. Like other sectors, the Energy sector also needs enough human resources for its development and improvement. As a sector is developing, its requirement of human resources is increasing. Therefore, the number of its human resources must be increased too. Afghanistan, with a promoting renewable energy sector, has essential need to have enough human resources for this sector. But, unfortunately in this country, the renewable energy projects are not implemented. Thus, the former number of human resources does not exist. To ensure better future for Afghanistan's energy sector, it is necessary to estimate the needed human resources. In this research, due to lack of time, we used the potential of renewable energy resources of Afghanistan to estimate the needed human resources on construction, installation, operation, and maintenance of renewable energies power plants. It is concluded from this research that the number of needed human resources for construction, installation, operation, and maintenance of renewable energy power plants until 2032 in Afghanistan is less than its renewable energy resources potential. We suggest the government of Afghanistan hire the needed human resources through meritocracy to become self-sufficient in the energy industry and to be one of the energy exporter countries.

### Keywords

- Afghanistan energy sector
- Human resources
- Renewable energy resources
- Renewable energy deployment

Received: January 17, 2020; Revised: March 16, 2020; Accepted: March 20, 2020; Published: June 12, 2020

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## 1. Introduction

Afghanistan is a land-locked country located in central Asia. Afghanistan has 32.53 million populations with \$20.04 billion Gross Domestic Product (GDP) [2]. Afghanistan is a main country in central Asia and its ability to become a bridge between south and central Asia is serious to any form of development, mostly in the energy sector. Afghanistan has a lack of energy with a high potential of renewable energy. To combat this problem, Afghanistan needs to use all of its potential energy parallel to its human resources.

Afghanistan has a high potential of renewable energy resources (300,000 MW), consisting of solar 222,849 MW with annual 300 sunny days [3], and capacitance of 4.5-7 KWh per square meter per day [4], wind 66,726 MW, hydro 23,310 MW, and biomass 4,027 MW [5].

Using this high potential of energy to produce its electric energy demand can generate job opportunities and prevent the migration of young human resources. Human resources are the number of those people who have reached the legal age of having duties and work. This number of human resources also includes those people who are jobless too. Human resources are the most fundamental and vital part of a sector, mostly in manufacturing and providing services. Nowadays, human resources are the main index of growth in economic systems; for achieving this aim, we have to use both resources: human resources and financial resources [6]. In common words, energy means the ability to do work. There are two kinds of energy resources:

- Nonrenewable energy resources
- Renewable energy resources

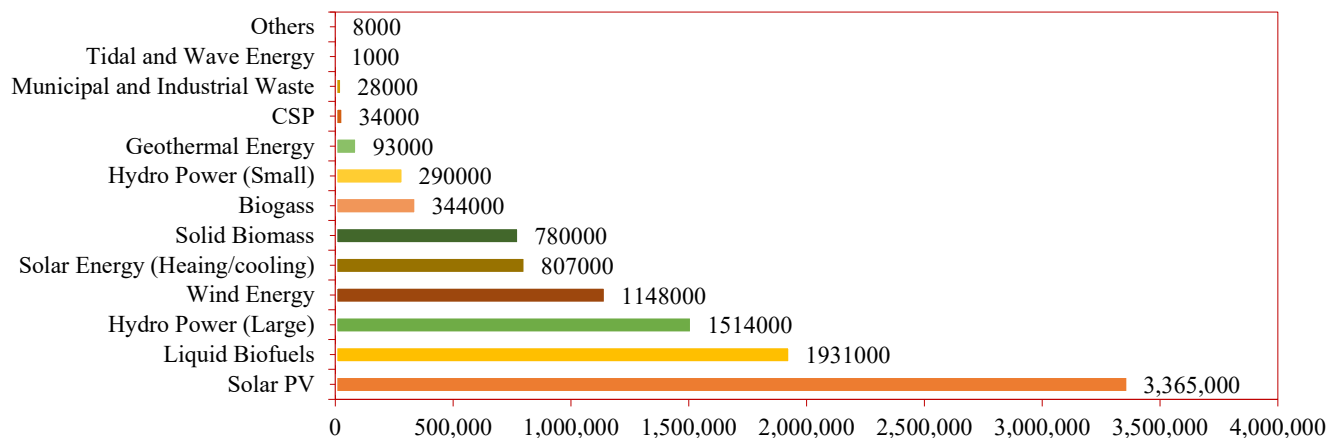


Nonrenewable energy resources are those resources that the production of its energies is less than its consumption. Renewable Energy Resources that are also called clean and green energy are those resources that the consumption of its energies is less than its production. Decreasing the cost of renewable energy equipment is the most common reason to make this sector as a job generator all over the world [7]. Reports show that renewable energy projects generate over 10.3 million job opportunities and solar photovoltaic systems own most opportunities between all of the renewable energy projects with 3 million jobs [8]. The biggest reasons in retardation of Afghanistan are not using its human resources potential for its development, not making opportunities of jobs, and letting them migrate out of the country.

Afghanistan is one of the richest countries through renewable energy resources, but it is still one of the energy importer countries. The energy demand of Afghanistan is about 2,500 MW, but imported energies (80%) supply its energy demand [9].

Afghanistan’s power sector master plan shows that Afghanistan has a plan to generate 4,500-5000 MW until 2032 through renewable energy resources. There are many constraints (Financial, Security, and skilled persons) on achieving this big goal.

Skilled human resources are one of the main indexes to achieve this aim, but the number of needed employees is not estimated. In this research, we estimate the number of human resources for construction, installation, operation, and maintenance of renewable energy power plants.



**Table 1:** Renewable energy employment by technology [8].

## 2. Proposed solution mechanism

Lack of energy and imported energies are the biggest challenges against Afghanistan’s energy sector. These challenges can be defeated by using all of its renewable energy resources.

Afghanistan’s power demand is estimated to be 3,500 MW until 2032, but the government of Afghanistan and Afghanistan power sector have plans to generate 4,500-5,000 MW from renewable energy resources that are negligible compared with its high potential of renewable energy resources [5]. Generating needed energy until 2032 through renewable energy resources creates more than 34,700 jobs (Solar 20,165 jobs, Wind 1,668 jobs, Hydro 12,690 jobs, and Biomass 178 jobs) that can play a vital role in Afghanistan’s economic growth.

**Table 2:** Energy generation estimation through renewable energy resources until 2032 [5].

No.	Power plant	Capacity (MW)
1	Solar PV utility-scale	800
2	Utility-scale wind farm	600
3	Roof-top solar PV	420
4	Solar PV, Micro-hydro Power hybrid	720
5	Solar PV stand alone	126
6	Nonconcentrated solar thermal	60
7	Biogas	6.7
8	Concentrated solar power	50
9	Floating solar PV	10.5
10	Large Hydropower	1750
11	Biomass	56
	<b>Total</b>	<b>4600</b>

### 3. Methodology and analysis

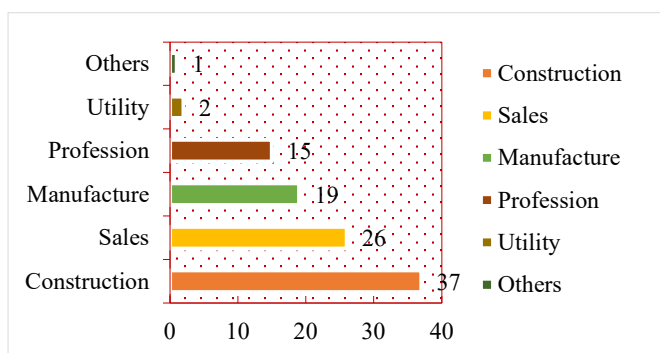
In this research, we estimate the needed human resources for construction, installation, operation, and maintenance of Afghanistan’s renewable energies power plants according to its renewable energy resources. First, Afghanistan’s renewable energy sources (Solar, Wind, Hydro, and Biomass) have been considered until 2032. Secondly, needed human resources necessary to exploit a certain amount of these resources for power generation in different countries have been considered, and its best option is accepted as a criterion. Then, with the estimated capacity of Afghanistan’s renewable energy sources and its electricity demand until 2032 and the selected criterion, a model is provided. Finally, using the above data and criterion, a linear equation is calculated and necessary human resources for Afghanistan’s renewable energy sector are estimated until 2032.

It is necessary to consider the human resources needed in planning and policy making institutions, educational institutions, and manufacturing factories in the next researches to estimate a clear variety of human resources for Afghanistan’s energy sectors.

**Table 3:** Workers needed for renewable energies power plants [10].

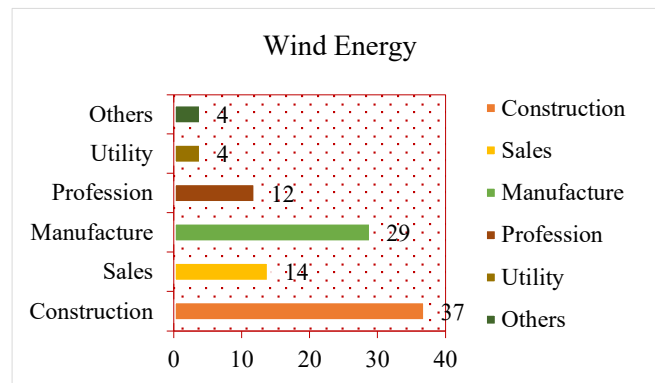
No. Power Plant		Construction and Installation	Operation and Maintenance	Total
1	Solar PV	6.21-5.76	4.8-1.2	11.01-6.96
2	Wind	2.51-0.43	0.27	2.78-0.7
3	Hydropower	3	3	6
4	Biomass	0.4	2.44-0.38	2.84-0.78

For 1 MW solar power park, we need 11.01-6.96 workers, 6.21-5.76 workers for construction and installation, and 4.8-1.2 workers for operation and maintenance of power plant [10].



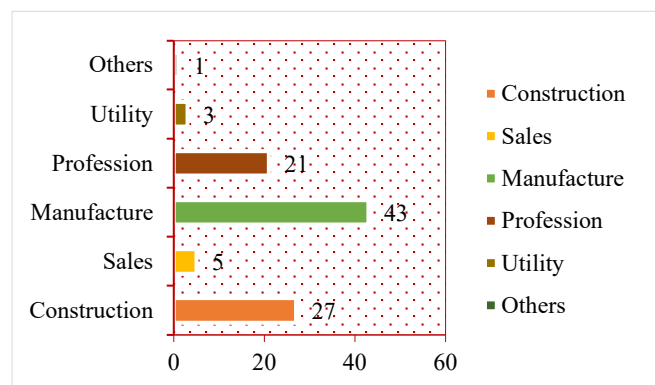
**Figure 1.** Workers needed in solar energy industry [11].

For 1 MW wind farm, we need 2.78-0.7 workers, 2.51-0.43 workers for construction and installation, and 0.27 workers for operation and maintenance of power plant [11].



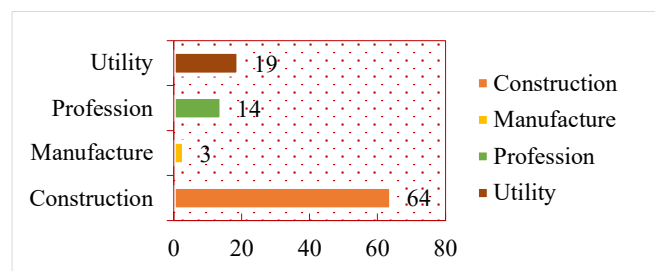
**Figure 2.** Workers needed in wind energy industry [11].

For 1 MW hydropower plant we need 6 workers, 3 workers for construction and installation, and 3 workers for operation and maintenance of power plant [12].



**Figure 3.** Workers needed in hydroenergy industry [11].

For 1 MW biomass power plant we need 2.84-0.78 workers, 0.4 workers for construction and installation, and 2.44-0.38 workers for operation and maintenance of power plant [10,13].



**Figure 4.** Workers needed in biomass energy industry [11].

#### 4. Formulation

Afghanistan’s power sector master plan announced that the government will generate (4,500-5,000) MW from renewable energy resources (Solar energy 1,831.5 MW, Wind 600 MW, Hydropower 2,115 MW, and Biomass 62.7 MW).

To estimate needed workers for 1,831.5 MW of solar energy parks due to lack of technology in Afghanistan we choose the 11.01 workers for 1 MW from above criterion then

MW	Needed Workers
1	11.01
1,831.5	X

Solving the equation for X:  $X = \frac{11.01 \times 1831.5}{1} = 20,164.8 \cong 20,165$  Workers

To estimate needed workers for 600 MW of wind energy farms due to lack of technology in Afghanistan, we choose the 2.78 workers for 1 MW from the above criterion then:

MW	Needed Workers
1	2.78
600	X

Solving the equation for X:  $X = \frac{2.78 \times 600}{1} = 1,668$  Workers

To estimate needed workers for 2,115 MW of Hydropower due to lack of technology in Afghanistan we choose the 6 workers for 1 MW from above criterion then:

MW	Needed Workers
1	6
2,115	X

Solving the equation for X:  $X = \frac{6 \times 2,115}{1} = 12,690$  Workers

To estimate needed workers for 62.7 MW of Biomass energy due to lack of technology in Afghanistan we choose the 2.84 workers for 1 MW from the above criterion then:

MW	Needed Workers
1	2.84
62.7	X

Solving the equation for X:  $X = \frac{2.84 \times 62.7}{1} = 178$  Workers

#### 5. Results and discussion

According to the information announced by the ministry of energy and water, the Afghanistan government will generate 4,500-5,000 MW of energy through renewable energy resources. From the above calculations, we obtain this result that the implementation of renewable energy projects in Afghanistan generates over 34,701 jobs (Solar 20,165 jobs, Wind 1,668 jobs, Hydro 12,690 jobs, and Biomass 178 jobs).

By implementation of renewable energy projects Afghanistan will supply its energy demand by its own resources and will become one of the energy exporter countries. Renewable energy will generate jobs in Afghanistan and reduces the level of migration. The Afghan government will be able to use its own asset for the development of its energy sector and will be one of the energy exporter countries. The government of Afghanistan must consider the Sustainability Goals on generating energy and using renewable energy resources is the best option to achieve this aim. Some recommendations are proposed as following:

- The Afghan government should have the necessary information on the number of existing and needed human resources for energy sectors until 2032.
- It is recommended to the Afghanistan government to use this article for applying their future plan projects to generate energy through renewable energy resources.
- It is recommended that the Afghanistan government must create further research areas and invest in these issues.
- It is recommended that the Afghanistan government use all renewable energy resources for becoming self-sufficient in energy areas.
- The government of Afghanistan must consider the Sustainability Goals of generating energy.
- For a better future in Afghanistan’s power sector it is recommended to create a department of planning and policy making, educational institutions, and manufacturing factories.
- It is recommended that estimated human resources must be managed and led by experienced employees.
- Afghanistan government must set up more technical and practical workshops to raise the technical level of estimated staffs.

- It is recommended that the Afghanistan government must consider the meritocracy on hiring these estimated staffs for a better future of its energy sectors.

## 6. Conclusion

Afghanistan is a land-locked country located in central Asia. Afghanistan has 32.53 million populations with \$20.04 billion Gross Domestic Product (GDP) [2]. Afghanistan is a main country in central Asia and its ability to become a bridge between south and central Asia is serious to any form of development mostly in the energy sector. Afghanistan is one of the richest countries in renewable energy resources, but it is still one of the energy importer countries.

Afghanistan power demand is estimated about 2,500 MW, but imported energies (80%) supply its energy demand [14]. Nevertheless, predictions show that the demand for Afghanistan electrical energy will rise up to 3,500 MW until 2032 [1]. To supply this demand until 2032 Afghanistan's power sector master plan shows that the government has the plan to generate 4,500-5000 MW until 2032 through renewable energy resources

In common words, energy means the ability to do work. There are two kinds of energy resources: 1) Nonrenewable energy resources, 2) Renewable Energy Resources. Nonrenewable energy resources are those resources that the production of its energies is less than its consumption, like: Coal, Gas, Oil, etc.

Renewable Energy Resources that are also called clean and green energy are those resources that consumption of its energies is less than its production. There are many sources of renewable energy such as Solar, Wind, Biomass, Tidal, Wave, Geothermal, and Hydropower. Human resources are the number of those people who have reached the legal age of having duties and work. This number of human resources also includes those people who are jobless too.

Human resources are the most fundamental and vital part of a sector mostly in manufacturing and providing services. Afghanistan has a high potential of renewable energy resources (300,000 MW), consisting of solar 222,849 MW, wind 66,726 MW, hydro 23,310 MW, and biomass 4,027 MW [5]. There are only 317.69 MW of hydropower plants all over the country and it is not comparable with its high hydroenergy potential (23,310 MW) [15].

Renewable energy projects create more than 34,700 jobs (Solar 20,165 jobs, Wind 1,668 jobs, Hydro 12,690 jobs, and Biomass 178 jobs) in Afghanistan. There are many constraints on the implementation of these projects:

- Technical constraints
- Financial constraints
- Security constraints
- Institutional constraints

When the future projects will be implemented then we can say that the Afghanistan government supplies jobs for its young human resources and reduces the high level of migrations.

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