SECTOR STUDY

EMPLOYMENT IN RENEWABLE ENERGY:
A FOCUS ON SOLAR AND WIND ENERGY

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EXECUTIVE SUMMARY

This study examines employment prospects in the solar and wind energy industries. It identifies the category of workers involved, required skills, qualification and salary range in Jamaica. The research also identifies the types of workers engaged in each stage of the production process both locally and internationally. Upcoming projects to be undertaken by the Government and the private sector, as well as associated job opportunities from these activities are also highlighted in this study.

Chapter 1 outlines the objectives and rationale for the study. It features the importance of renewable energy, which compares more favourably to fossil fuel in terms of cost and environmental impact. The chapter also points to the role of the National Energy Policy (2009-2030) in promoting increased use of renewable energy, which indicates prospects for employment in the sector.

The research methodology outlined in **Chapter 2** highlights a mixed approach, using qualitative research, supported by secondary information. Participants in the qualitative interviews included Government Officials and Private Employers.

Chapter 3 gives an overview of the performance for the ***Energy, Electricity and Water*** sector for the period 2010-2014, in terms of employment, productivity and salary. The trends reveal that when compared to the other sectors in the economy, labour productivity and salary are highest in the ***Energy, Electricity and Water*** sector. Figures on the consumption of energy and electricity, as well as rates charged on electricity are also analyzed in this Chapter. Statistics indicate that despite the high consumption of petroleum during 2010-2014, there was a decline in its use over the period. This coincides with an increase in the consumption of alternative energy.

The production cycle in the Jamaican context is highlighted in **Chapter 4**. Workers in Jamaica are mainly found in the areas of Designing, Construction, Installation, Maintenance, Sales and Administration. Some of the workers include Engineers (Electrical, Mechanical, Civil and Industrial) who operate in all phases but mainly in the Designing Phase. The Installation Phase utilizes workers such as Solar Panel and Wind

Turbine Installers while Technicians mainly function in the Operations and Maintenance Phase.

The Chapter highlights several solar and wind projects, with wind farms being the major ones undertaken by the Government and the main electricity generating company. Projects which are involved in delivering solar and wind energy are from large establishments in the Tourism, Manufacturing, Finance and Distribution sectors. The type of workers who are needed include:

1. Engineers
2. Programmers
3. Technicians
4. Installers
5. Repairers
6. Plant Developers
7. Scientists
8. Construction Workers
9. Labourers

Emerging jobs are found in Structural Aluminum work and Energy Auditing. In addition, the production of solar panels is said to be increasing in Jamaica.

Chapter 5 examines the application and production processes for generating solar and wind energy, as well as the associated occupations. Both solar and wind energy production processes involve workers who are found in the field of Science, Manufacturing, Designing, Construction, Installation and Maintenance.

The study concluded in **Chapter 6** that the increased use of renewable energy will create employment opportunities. Curriculum Developers and Planners should therefore focus on providing skills training in this area.

1.0 INTRODUCTION

Jamaica is highly dependent on electricity, which is used for household consumption and for industrial operations. The country has been challenged by high electricity cost which has negatively impacted the profitability and competitiveness of businesses, as well as the disposable income of domestic consumers. This is mainly attributable to rising fuel prices and costs from maintenance and construction, associated with the production of electricity.[1]

With the immense expenditure in delivering electricity, the exploration of cheaper sources of energy becomes very essential. The Government has therefore developed a National Energy Policy 2009-2030 which includes a framework for developing renewable energy. This type of energy emanates from natural resources such as sunlight, wind, rain, tide and geothermal heat. Since Jamaica is blessed with an abundance and steady source of sunlight and wind throughout the year, it has the advantage of harnessing these forms of energy.

Compared to petroleum which is the chief energy source in Jamaica, renewable energy is produced at a lower cost and allows for a cleaner environment. It also promotes a Green Economy which reduces environmental risks and scarcities, while improving human well-being and social equity.

The Government had set a target for renewable energy generation to account for 12.5 per cent of the electricity system by 2015 and 20 per cent by 2030. In order for this to take place, more Jamaicans will have to be engaged in the use of renewable energy. If these targets are met then there are prospects for job opportunities from this industry.

An objective of the Ministry of Labour and Social Security's Labour Market Information System (LMIS) is to supply information on employment opportunities, in order to provide career guidance for students and jobseekers. The Planning, Research and Monitoring Unit of the Ministry have therefore conducted this study to examine possible

[1] According to the Economic and Social Survey Jamaica (2014), average rates charged to consumers by the main supplier of electricity, increased from 2,713.2 cents/KWH in 2010 to 4102.2 cents/KWH in 2014.

employment opportunities in the Renewable Energy Industry, focusing on the solar and wind energy sectors.

The objectives of the study are to:

- Identify the type of occupations and skills;
- Determine the salary for occupations identified in Jamaica;
- Ascertain the qualifications that are required for these positions;
- Determine emerging occupations locally; and
- Identify energy projects, vacancies and the types of workers that the employers will need.

2.0 RESEARCH METHODOLOGY

A purposive sampling technique was used to identify organizations that belonged to the solar and wind energy industry. This methodology is acceptable due to the homogenous nature of the operations and the small number of operators in the industry.

The sample frame consisted of a list of business owners from Companies Office of Jamaica. Interviews were conducted face-to face and via telephone over a period of two weeks. Face-to face interviews were also conducted with consultants/experts.

A mixed methodology was employed to gather information for the study. In order to arrive at information for Jamaica, qualitative interviews were conducted and information gathered using a semi structured interview guide (**See Appendix 1**). Interviews were carried out with representatives from two Government Ministries to ascertain plans for a number of projects which should generate employment. This was also supported by secondary sources. Fifteen owners and operators of businesses in renewable energy were interviewed to determine possible areas of employment in Jamaica.

Desk reviews were used to establish the production cycle applied in creating solar and wind energy and to determine the type of workers involved in each phase of the cycle.

2.1 Limitations

Two major constraints occurred during the research. These were delays in obtaining information and reluctance of respondents in divulging certain information.

Although attempts were made to determine the desired number of workers, the researcher was unable to make projections on the number of workers needed overtime. This was problematic given the fact that many operators were engaged in short term projects.

Employers did not readily disclose information relating to salary, which is a common problem in seeking information of this nature. In addition, secondary data was not available to verify the amount of salary given.

3.0 An Overview of the Performance of the Energy, Electricity and Water Industry

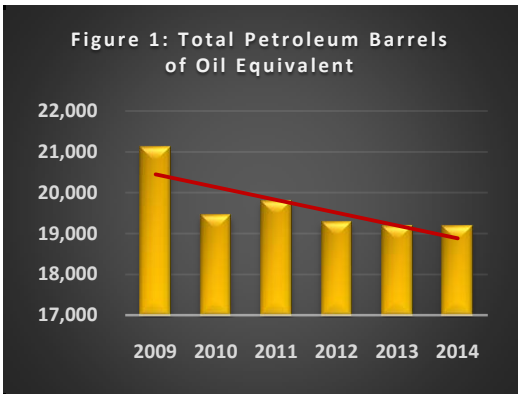
Data from the Labour Force Survey (2014) indicates that the ***Energy, Electricity and Water*** sector employed a total of 85,000 persons or 3.3 per cent of the employed labour force in 2014. The latest productivity figures showed that labour productivity for the sector surpassed the other sectors, averaging J$2,624,000, compared to J$547,000 for the national average (**See Table 1**). Meanwhile, the Economic and Social Survey Jamaica (ESSJ) revealed that weekly earnings by workers of large industries for the sector were also highest, averaging $38,786 against a national average of $20,398.

Table 1: Labour Productivity by Sector

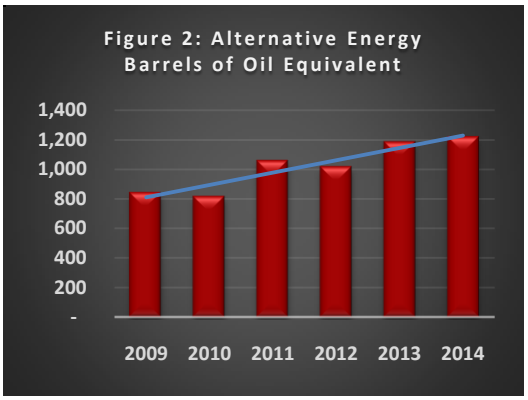
Sector	*Productivity J$'000*
Agriculture , Forestry and Fishing	236
Construction	528
Energy, Electricity and Water	2,624
Financial and Insurance Services	2,604
Government Services	428
Hotels & Restaurant Services	471
Manufacture	688
Mining & Quarrying	2,198
Real Estate, Rent and Business Services	911
Transport, Storage & Communication	940
Wholesale & Retail Trade	513
National Average	**547**

Source: Statistical Institute of Jamaica and Jamaica Productivity Centre

A look at energy consumption during the period revealed a declining trend, from 2009 to 2014 for petroleum, compared to an increase in alternative energy **(See Figures 1 and 2**). These alternative forms included hydro power, wind, coal, charcoal, bagasse and fuel wood. The decline in the use of petroleum was a result of reduced demand due to the low performance of the economy.



Source: Economic and Social Survey Jamaica 2014



Source: Economic and Social Survey Jamaica 2014

An examination of the activities which consumed petroleum in 2014 (**Table 2)**, showed that ***Road and Rail Transportation*** (29.9 per cent) used most, followed by Electricity Generation (27.5 per cent) then Bauxite and Alumina Processing (17.5 per cent).

Table 2: Petroleum Consumption by Activity for 2014

Industries	Figures	Percentage
Road and Rail Transportation	5,864,638	29.92
Electricity	5,397,470	27.53
Bauxite Alumina Processing	3,419,650	17.45
Aviation	2,281,941	11.64
Shipping	1,364,651	6.96
Residential	806,636	4.12
Petroleum Refinery	295,593	1.51
Other Manufacturing	18,455	0.09
Sugar Manufacturing	14,596	0.07
Cement Manufacturing	15,285	0.08
Other	123,361	0.63

Source: Economic and Social Survey Jamaica 2014

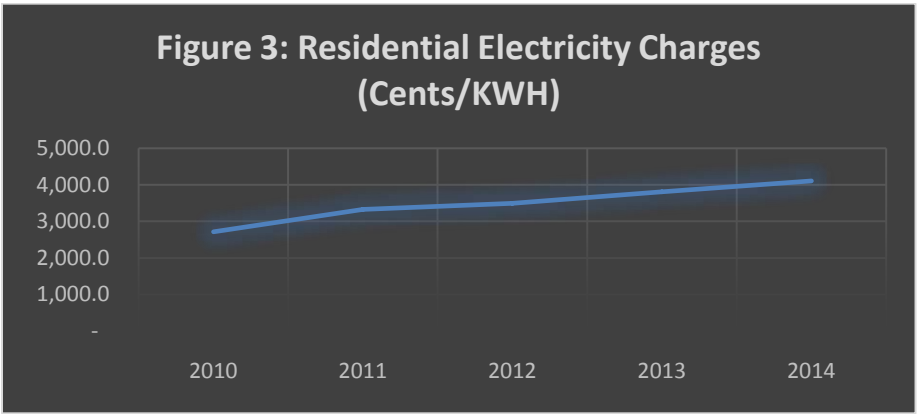
As seen in Table 3, electricity is mostly consumed by large companies in Jamaica or "Large Power" and "Other Generating Companies". Meanwhile "Residential" users which totaled 537,900 customers in 2014, consumed the least amount. A downward trend was observed in the consumption pattern of electricity for most customers during 2010-2014. The decline resulted from reduced demand due to low performance of the economy, heightened conservation practices and self-generation.

Table 3: Consumption of Electricity by Type of Customers

Customers	2010	2011	2012	2013	2014
	000' KWH	000' KWH	000' KWH	000' KWH	000' KWH
Residential	2,136.4	2,061.0	1,957.3	1,839.3	1,824.7
General Service	11,041.5	10,729.7	9,687.3	9,327.3	9,243.8
Power Service	463,237.7	462,107.5	447,498.6	442,927.2	436,794.1
Large Power	4,335,319.0	4,166,536.3	4,072,906.2	3,994,622.4	3,945,489.2
Other Generating Companies	15,620,881.0	13,387,168.5	14,466,064.9	14,799,442.6	11 771 278.3
Street Lighting	322,981.2	321,844.9	276,280.6	278,534.0	229,258.0

Source: Economic and Social Survey Jamaica 2014

The decline in the demand for electricity coincided with an increase in the average rates charged on the delivery of electricity to residential customers, from 2,713.2 cents/KWH in 2010 to 4102.2 cents/KWH in 2014 (**See Figure 3**).



Source: Economic and Social Survey Jamaica 2014

4.0 FINDINGS- Employment in Solar and Wind Generation in Jamaica

According to a study conducted by World Watch Institute "*Pathways to an Affordable, Reliable Low Emission Electricity System"* (2013), investments in renewable energy in Jamaica will create new jobs. These jobs are generally divided into Construction, Installation and Manufacturing (CIM), as well as Operations and Maintenance (O&M). CIM jobs are available in the first few years of setting up an energy facility, whereas O&M jobs exist for the lifespan of the installation. For example, Engineers, Technicians, Project Development Analysts, System Designers and Installers, Construction workers and Maintenance staff.

4.1 Interviews with Owners and Operators

Fifteen (15) employers were interviewed from the list of operators on the Companies Office of Jamaica sample frame. The majority (98%) of business operators were engaged in the generation of solar energy. These businesses were found to be in existence for 18 months to 30 years. Services offered, ranged from design and installation of solar water heaters and panels, retail sales and providing technical assistance and consultancies.

Employers indicated that the application of core engineering skills is expected on the job. Other skills included designing of solar system, providing technical expertise, electrical skills, and overseeing and training Installers.

The skills, qualifications and salary range for these workers are tabulated below.

Table 4: Characteristics of Solar and Wind Energy Workers in Jamaica

Category of workers	Skills	Qualifications	Gross Average MonthlySalary range (J$)
Civil Engineers	Designing systems	BSc. Degree	60,000-150,000
Electrical Engineers	Designing electrical systems, Commissioning work	BSc. Degree	60,000-150,000
Mechanical Engineers	Designing all components of systems, Overseeing and training Installers, Costing work	BSc. Degree	60,000-150,000

Category of workers	Skills	Qualifications	Gross Average MonthlySalary range (J$)
Structural Engineers	Designing aesthetically pleasing buildings and structures that are safe and capable of withstanding the elements to which they will be exposed.	BSc. Degree	60,000-150,000
Technicians	Strength to lift heavy equipment, ability to manipulate tools. Must not be afraid of heights, installing solar panels. Detail oriented, must follow instructions precisely. Mathematical and electrical knowledge are helpful.	Diploma	50,000-100,000
Welders	Operating welding equipment.	Level 3 NCTVET certification	50,000-80,000
Solar Power Plant Operators	Operating plant.	Level 3 NCTVET certification	50,000-80,000
Electricians	Installing and maintaining electrical systems.	Level 3 NCTVET certification	50,000-80,000
Solar photovoltaic installers	Installing panels and other components.	Level 2 and 3 NCTVET certification	45,000-60,000
Site Assessors	Inspecting new construction and major improvements, explaining assessed values to property owners.	BSc. Degree	Contract
Roofers/Roofmen	Assist in installing solar panels and water heater on roofs.	Level 2 and 3 NCTVET certification	45,000-60,000
Electronic installers and repairers	Installing and repairing electrical plants.	Level 2 and 3 NCTVET certification	45,000-60,000
Administrative workers	Clerical, customer service and computing skills.	Diploma /Associate Degree	45,000-60,000
Energy Auditors	Critical thinking, monitoring, problem solving, speaking and listening skills.	BSc. Degree	87,681-120,000
Sales Representatives	Sales and negotiating skills, motivation, drive to work towards targets, team work and organizational and management skills.	Diploma /Associate Degree	N/A
Accountant	Mathematical skills and use of accounting software.	BSc. Degree	49,500-75,000

Qualifications for jobs in solar energy included certification in solar installation. Bachelor of Science Degree for Engineers was considered an asset. Other qualifications included

Level II NCTVET certification, experience in sales, designing and installation. In addition, workers should have an understanding and knowledge of business operations.

Other types of workers in the industry included Administrative Staff, Receptionist, Sales Agents, Auditors, Accountants and technical support staff. Wind Technicians needed mechanical skills and an aptitude to understand turbines.

At the time of the interview, vacancies were available for Sales Representatives, Solar Installers and Managing Director. However, positions for Solar Installers and a Managing Director were difficult to fill. An emerging area which is associated with the solar business was Structural Aluminum work. Energy Auditing was also found to be emerging. In addition, employers interviewed mentioned that production of solar panels is a growing trend in Jamaica.

4.2 Government of Jamaica (GOJ) Energy Policy and Projects

The GOJ's National Energy Policy (2009-2030) focuses on:

1. Development of renewable energy sources such as solar and hydro electricity;
2. Security of energy supply through diversification of fuels;
3. Modernizing the country's energy infrastructure;
4. Conservation and efficiency in use of energy;
5. Development of a comprehensive governance/regulatory framework for the energy sector;
6. Enabling Government Ministries, Departments and Agencies to be the leader for the rest of society in terms of energy management; and
7. Eco-efficiency in industries.

Information from Ministries and secondary sources, were obtained on projects which will be undertaken by GOJ to increase the generation of solar and wind energy in Jamaica. These along with their employment prospects are tabulated below.

Table 5: Employment Prospects from Local Projects

Projects	Employment Prospects
Phase 3 of the Wigton Wind Farm will commence in 2016 and will include the development of 12 turbines with a capacity of 24 Megawatts.	During the Construction Phase, an estimated 150 construction workers will be employed, along with 2-3 Engineers.
Renewable project for South Central Jamaica which will be launched in Content Village, Clarendon.	This will provide employment for up to 200 persons during the Construction Phase.
Malvern, St Elizabeth for the development of a wind farm with a capacity of 36.3 megawatt.	Projected to provide approximately 200 jobs.

Other developments include:

- Solar energy production which was established in 45 homes in remote areas of rural Jamaica. These communities are Middle Bonnet in St. Catherine and Ballymony in St. Ann.
- Under the DSM/World Bank funded programme, special financing arrangements were made available to purchasers of solar water heaters. As at February 2015, a total of 2,751 persons received special financing.
- The National Housing Trust (NHT) initiative which is offering solar water heater loans of up to $100,000. Two thousand seven hundred and forty four (2,744) persons received assistance between 2006 and 2014.

- Private sector projects found in the Banking, Manufacturing, Distribution, Residential and Construction sectors. Interviews with expert solar Consultants supported the view that Jamaica is a prime marketplace for solar installation and solutions, chiefly in the commercial market. This is due to the fact that these commercial enterprises have access to loans, which are more feasible to repay, as a result of greater returns in the long-run than continuous payments of high electricity bills.

5.0 FINDINGS-Production Cycle and Applications of Solar and Wind Energy

Renewable energy originates from natural resources such as wind, rain, sunlight, biomass, water, tide and geothermal heat. This form of energy is environmentally friendly and cannot be depleted. It therefore causes no pollution or little harm to the environment. This is because it is produced or recovered without undesirable consequences such as carbon emissions which are associated with the use of fossil fuels.

5.1 Solar Energy

According to ***National Geographic***[2], solar energy produces less than one tenth of one percent of global energy demand.

5.1.1 Solar Energy Application and Production

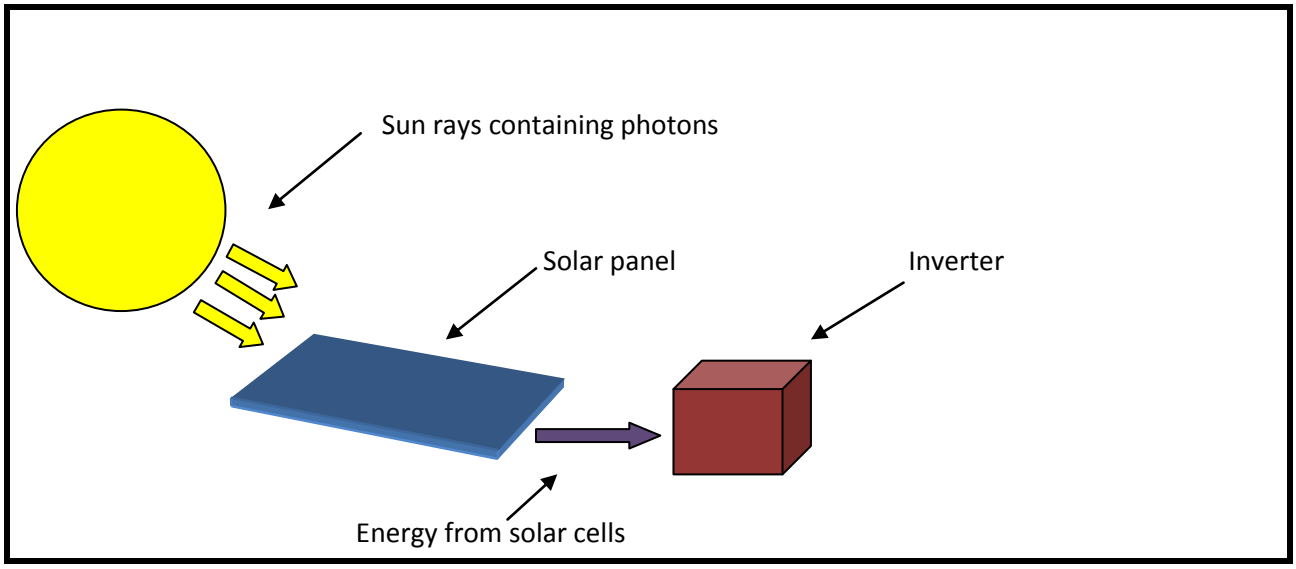
Some applications of solar energy relate to:

a) Cooling and ventilation, which are used in fans and air conditioning systems.
b) Agriculture, through the use of technology, such as greenhouse which maximizes plant production by means of radiation of the thermal energy from the sun. In some cases, it is used on the farm to assist in pumping water, drying crops and preparing manure.
c) Cooking, by means of drying and pasteurization, using a panel or a reflector cooker.
d) Transportation, through solar powered cars such as the hybrid which is found in Jamaica. The cooling systems of cars can also be operated using solar energy which lowers the consumption of fuel.
e) Heating water, via the sunlight through the use of an evacuated tube heater and flat plate collector for domestic water and pools.
f) Production of electricity is done when sunlight is converted to electrical energy using photovoltaic (PV) cells or concentrated solar power.

[2]National Geographic: Solar Energy. Retrieved January 2015 @ environment.nationalgeographic.com/.../global.../solar-power-profile/

Photovoltaic (PV) cell is popularly used in creating solar energy in Jamaica. The PV or solar panels are often seen on rooftops. When sunlight hits the cells, it knocks electrons loose from their atoms. As the electrons flow through the cell, they generate electricity which is converted into alternate current by an inverter (**See Figure 4**).

Figure 4: Solar Production



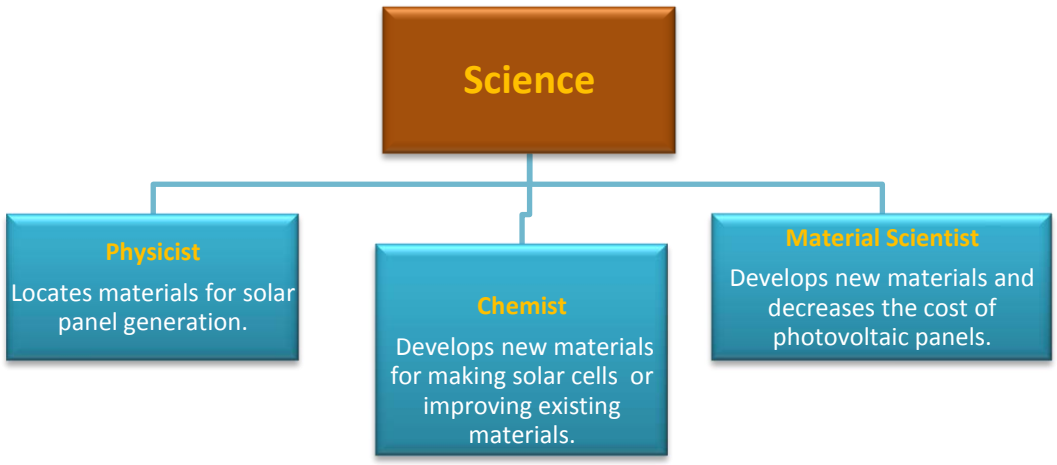
5.1.2 Occupations and Skills within the Solar Energy Industry

Information compiled from secondary sources[3] indicates that opportunities in solar energy include jobs from the fields of Science, Designing, Manufacturing, Construction and Installation.

Science

Workers from the field of Science conduct research on the development of new and more efficient materials which are used in the generation of solar energy. These workers include Physicists, Chemists, Materials Scientists and Engineers who are responsible for improving the efficiency of solar panels.

Figure 5: Occupations and Skills in the Field of Science (Solar Energy)



[3] http://www.bls.go/green/wind_energy

Designing Workers

These workers are mainly involved in designing new systems and improving existing technologies.

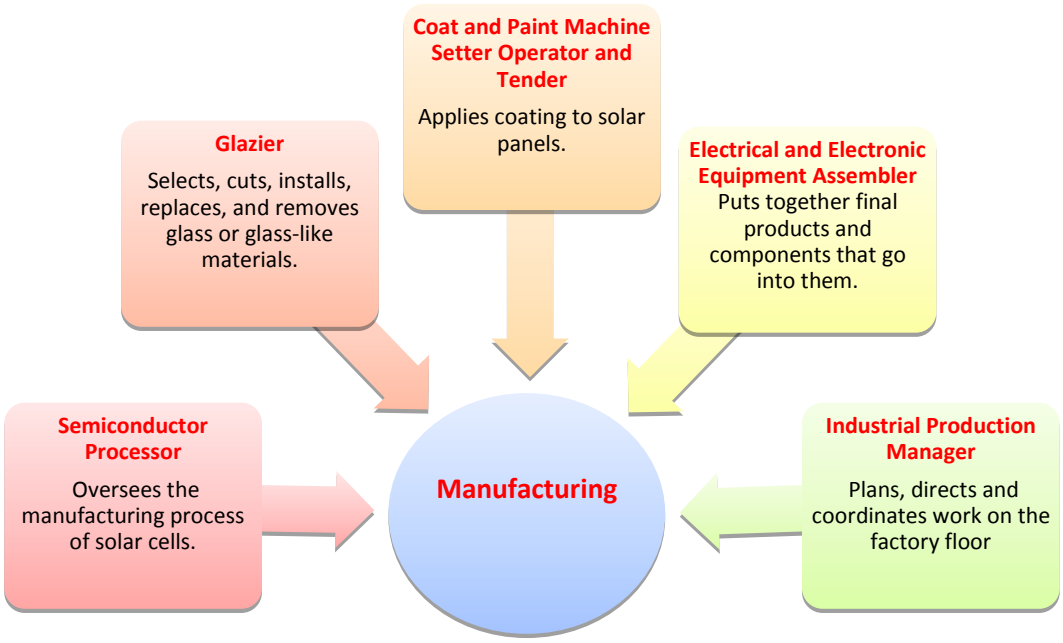
Figure 6- Occupations and Skills from the Designing Field (Solar Energy)

Manufacturing Workers

These workers are involved in making equipment used for solar power generation. Equipment include mirrors and panels, photovoltaic solar power and photovoltaic panels.

The categories of workers and their responsibilities are shown in the following diagram.

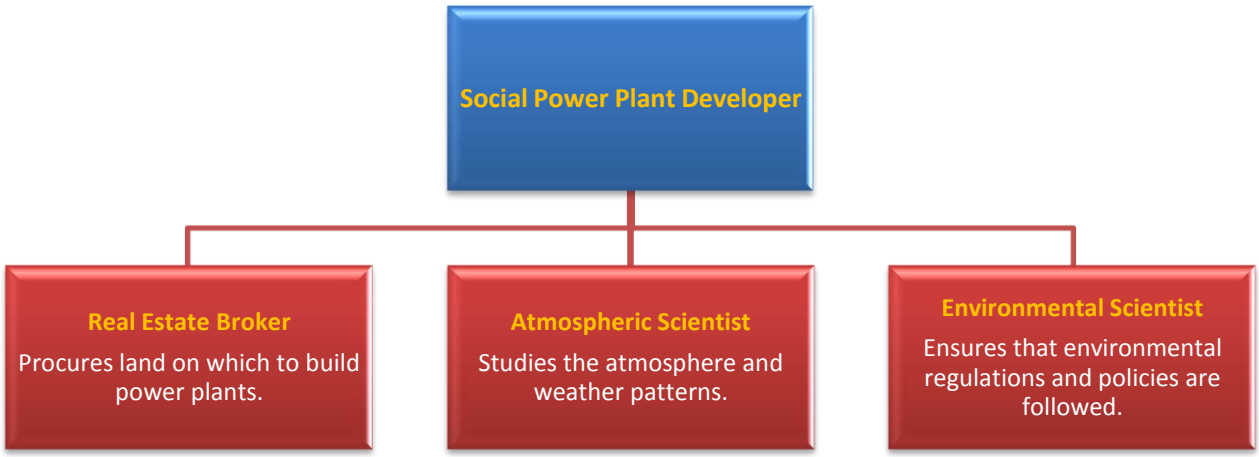
Figure 7: Occupations and Skills from the Manufacturing Field (Solar Energy)



Plant Developers

Workers in this area determine the appropriate environmental factors which facilitate a solar plant facility.

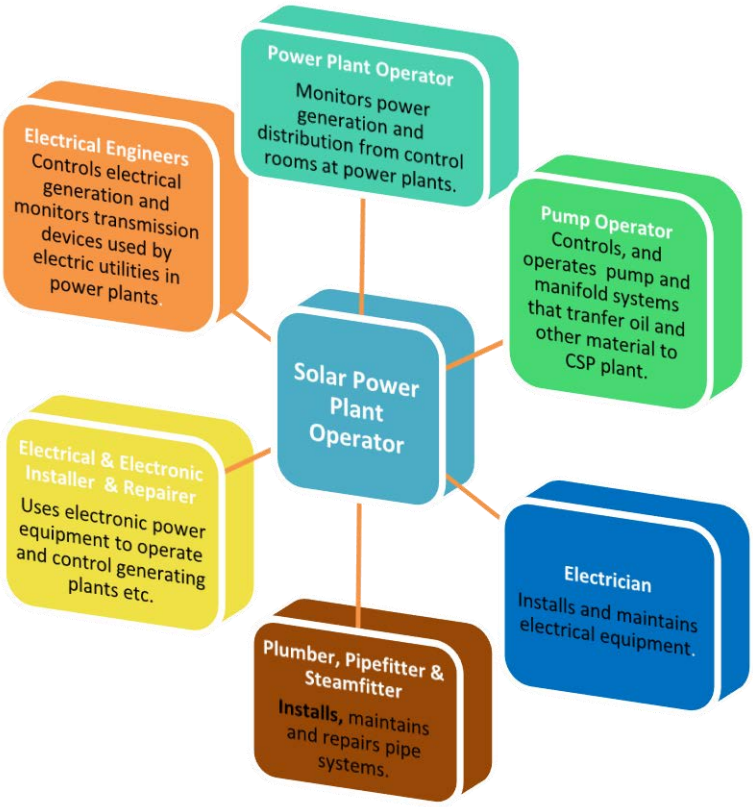
Figure 8- Occupations and Skills for Developers (Solar Energy)



Plant Operators

These workers operate and maintain equipment.

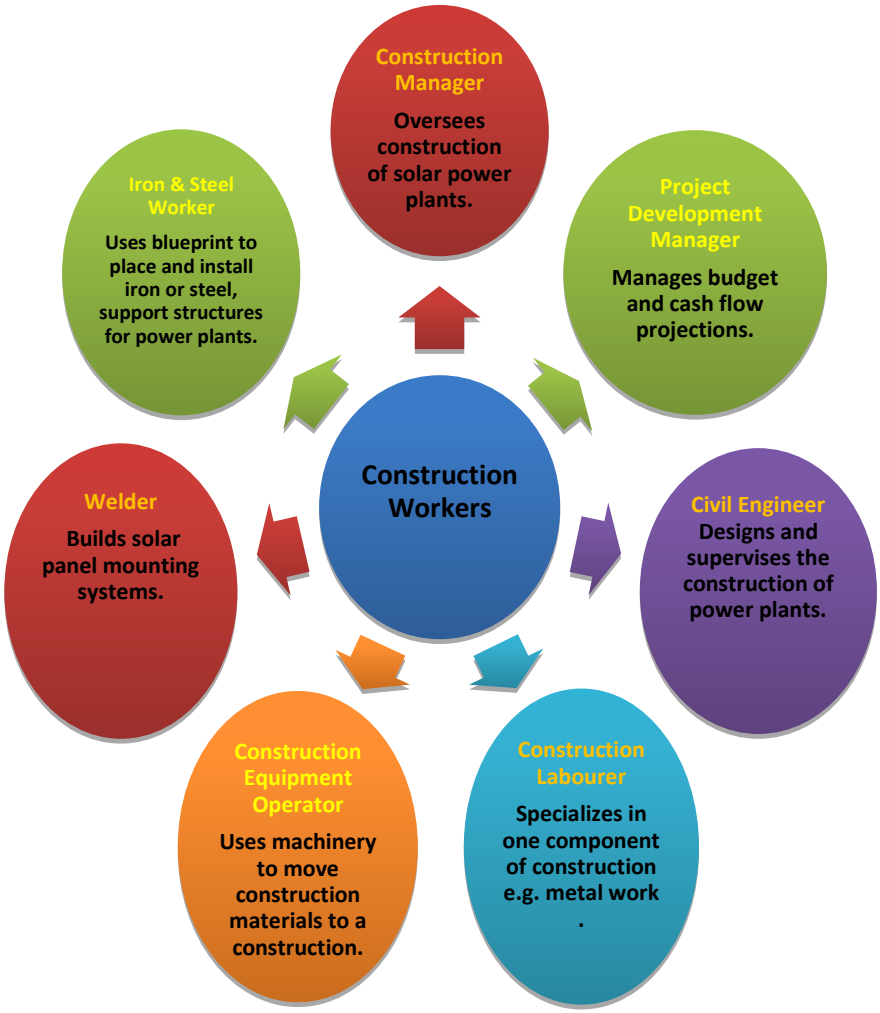
Figure 9-Occupations and Skills for Plant Operators (Solar Energy)



Construction Workers

Building the actual solar plant is done by Construction workers seen in Figure 9 below.

Figure 10- Occupations and Skills from Construction (Solar Energy)



Solar Photovoltaic Installers

PV Installers are responsible for attaching panels to roof of houses or other buildings and ensuring that systems work. The main component of a Solar Installer's job is the preparation of the installation site.

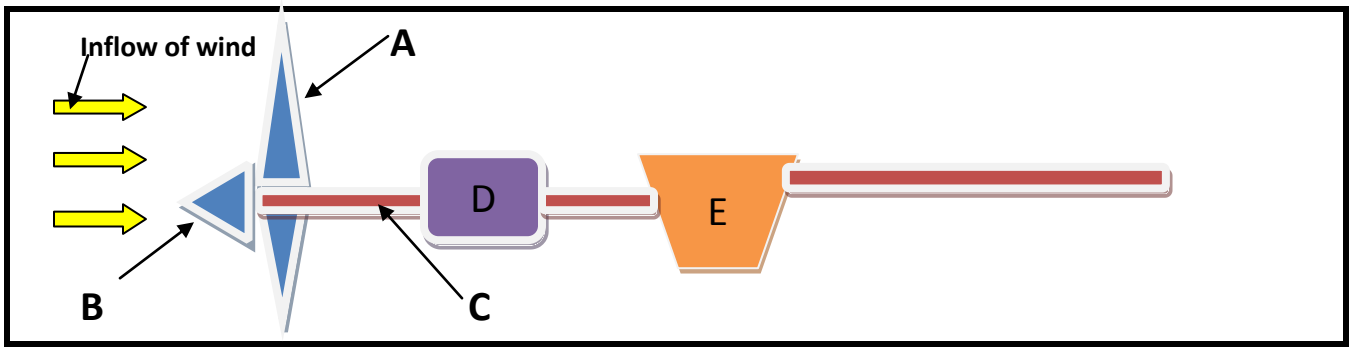
5.2 Wind Energy

Like solar energy, wind energy is a clean and safe method of generating electricity, with very little greenhouse gas emissions during production. Wind energy is created when flowing air is extracted using wind turbines or sails to produce electrical power. Jamaica is among the 75 countries[4] in the world with wind farms.

5.2.1 Production of Wind Energy

Wind farms are created to trap wind energy by placing multiple wind turbines in the same location for the purpose of generating large amount of electric power. The energy in the wind turns propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity (**See Figure 11**).

Figure 11: Wind Production



Key

A- Blades of the wind mill
B- Rotor of the windmill
C- Shaft
D- Gear Box
E- Generator

[4] grandtours**project**.com/journal/?p=883

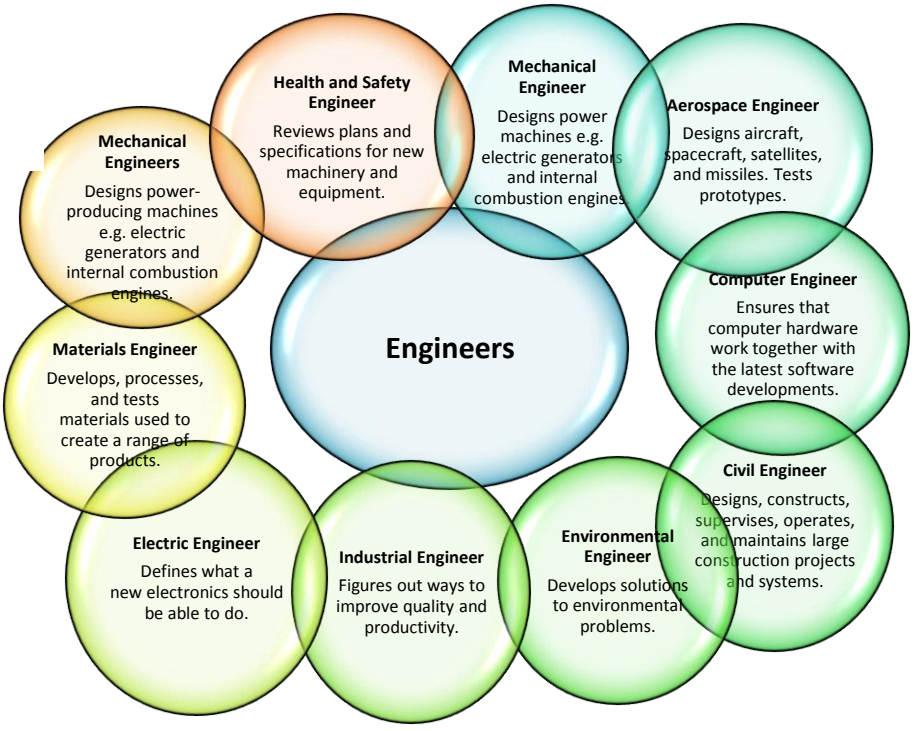
The main phases in wind energy production are Project, Manufacturing, Project Development, and Operation and Maintenance.

5.2.2 Occupations and Skills within the Wind Energy

Engineers

These workers are very important in the design and development of wind turbines. They work in testing, production and maintenance. Engineers may also supervise production in factories, test manufactured products to maintain quality, and troubleshoot design or component problems. They are responsible for supervising projects, other Engineers and Technicians. Several types of Engineers are employed such as Mechanical Engineers, Aerospace Engineers, Computer Engineers, Civil Engineers, Environmental Engineers, Industrial Engineers, Electrical Engineers, Materials Engineers and Health and Safety Engineers.

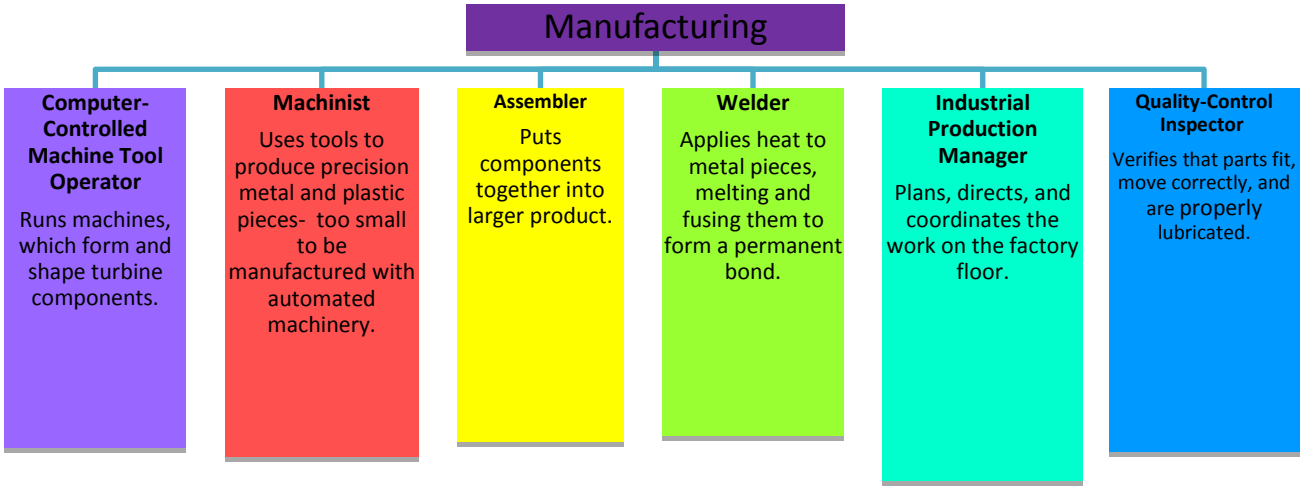
Figure 12: Occupations and Skills for Engineers in Wind Energy



Manufacturing Workers

Workers in this sector produce turbine components which require the skills of many different production occupations. They are Machinists, Assemblers, Computer-Controlled Machine Tool Operators, Quality-Control Inspectors, Welders and Industrial Production Managers.

Figure 13: Occupations and Skills in the Manufacturing Stage of Wind Energy Production



Project Development Workers

In order to select a wind farm, research and planning is required. The proposed site must meet several criteria, such as developable land, adequate wind speed, suitable terrain, and public acceptance. Workers involved in this type of project development include Scientists, Land Acquisition Specialists, Asset Managers, Lawyers, Financers, and Engineers.

Managers

Project Managers oversee the construction of the wind farm from site selection to the final installation of turbines. They oversee a diverse team, including Engineers, Construction Workers, Truck Drivers, Crane Operators and Wind Technicians.

Scientific Workers

Atmospheric Scientists also referred to as Meteorologists, monitors the atmosphere. Geologists spend most of their time in the field, identifying and examining the underlying landscape of a proposed wind farm.

Environmental Scientists work with Wind Farm Developers to help them comply with environmental regulations and policies and to ensure that sensitive parts of the ecosystem are protected.

Construction Workers

These workers are needed to install the turbines and support structures after the construction site is selected. They include Crane Operators, Wind Turbine Service Technicians, Truck Drivers, Construction Labourers and Construction Equipment Operators.

Electricians are needed to extract energy from the turbine's generator to the power grid on the ground. They wire the turbine to connect its electrical system to the power grid.

6.0 CONCLUSION AND RECOMMENDATION

With the expected increase in the consumption of solar and wind energy solutions and increase in investment to accommodate this expansion, employment opportunities from renewable energy will be realized. The drive to consume more alternative forms than fossil fuel energy is also a global phenomenon and forms a part of the Green Economy movement. It is therefore anticipated that jobs will be available both locally and internationally which means that Jamaicans should seek opportunities both locally and overseas. In the Jamaican context, Engineers and Technicians are mainly needed throughout the developmental phase of renewable energy.

Locally, education and training institutions have recognized the importance of renewable energy and have incorporated it in their curriculum. However, there is still room for improvement in the Scientific, Designing and Manufacturing of materials. It is recommended that training institutions continue to tailor their programmes and develop the curriculum to facilitate the expected need for study and training in the field of renewable energy.

APPENDIX

Interview Questions

1. What type of service do you offer in alternative energy?
2. Do you employ the following type of workers in your organization?
3. What are the main skills associated with these workers?
4. What are the other type of workers in your organization?
5. What are the main skills associated with these workers?
6. What are the qualifications required for each of these position?
7. What is the salary range for each worker?
8. Do you currently have a vacant position?
9. Which position/s is/are vacant?
10. How long has the position been vacant?
11. How many vacant positions do you have for each category of worker specified?
12. What are the hard to fill positions in our organization?
13. What are the qualifications required for these position?
14. How long does it usually take to fill these positions?
15. What are the factors which hinder you from filling these positions?
16. Has there been a change in demand for occupations in your organization?
17. Do you plan to expand you operations?
18. What type of skilled workers would you need?
19. Do you see your business using the following emerging occupations in alternative energy?
20. What are other emerging jobs associated with your business?

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