Electricity Crisis of Bangladesh and A New Low Cost Electricity Production System to Overcome this Crisis

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Abstract- Electricity is the key factor for gradual development of any country let alone developing country like Bangladesh. The demand for electricity in both households and industries is increasing rapidly with the increase of the population in Bangladesh [11]. Currently, load shedding is common phenomenon, which is causing severe problem for the country and, is hindering the progress of economy [6]. There are some key reasons for this ongoing problem such as ever increasing demand for electricity, limited natural resources, lower capacity of electricity generation, and less investment (both private and public) in this sector etc. [1,4]. Electricity crisis needs to be abolished as soon as possible in order to become Bangladesh as a developed country [9]. In this regards, the paper presents a low cost but effective and efficient model (fan with dynamo) for generating electricity which might fulfil the increasing demand in the rural areas, where the electricity from the main grid could not be possible, as well as rest of the country. Firstly, the author discusses the present scenario of electricity production system in Bangladesh and its crisis due to the increasing demand and reduces productivity. Finally, a low cost model for electricity generation to eradicate the gap between demand and supply of electricity is presented.

Index Terms- Electricity crisis, Bangladesh, fan, dynamo

I. Introduction

In order to develop the economy and to maintain the standard of living of any country, it is very essential to have flawless electricity supply and sufficient production of power using the available national resources. Bangladesh heavily relies on natural gas to generate lion portion of the electricity [6]. Although, the government of Bangladesh is trying to produce electricity using other resources like coal, oil etc. as well as renewable energy such as wind power, bio energy, solar energy, micro hydro, tidal energy and ocean wave etc., the country is way behind to fulfil its increasing demand (not only from Industries but also from households) of electricity. In Bangladesh, a noticeable number of populations if not majority are yet to have access to electricity. Alarmingly, there are some areas of the country where electricity connection might not be possible within next 50 years. Besides, there is only slightly above 10% of the rural areas where there are electricity connection from the national grid [6]. Bangladesh is in deep crisis on producing and supplying electricity and there will be no sign of good news as the reserve of national resources (gas and coal) are decreasing day by day that will in turn hinder the production of electricity in the near future. Therefore, a low cost electricity production system, which is independent of main electricity line as well as this system can be easily install in rural areas, has been proposed in this paper in order to solve the alarming electricity crisis of Bangladesh. In our proposed low cost model, a dynamo is attached with the rod of the fan (both ceiling and table fan) using a belt. The dynamo rotates with the rotation of fan and the rotating dynamo produces electricity, which is being stored in a battery [3]. The stored electricity could be either used to run the same fan from where electricity is producing [In that case, main power line to run the fan is not required afterword] or for powering some other electric devices [10].

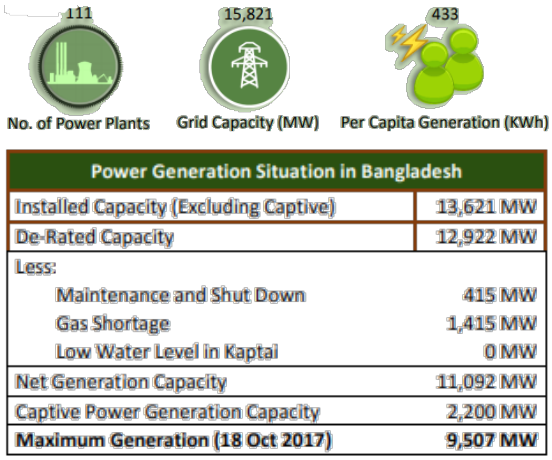
II. Present Scenario

2.0 Power Sector Review [Bangladesh]

The progress of an economy mostly depends on availability of natural resources and incessant supply of electricity. Bangladesh, an emerging economy, has been experiencing persistent period of electricity crisis that has been hindering the rate of economic development. The country is still at very low level of electrification even if electricity is regarded widely as the main form of energy at both commercial and private scales in Bangladesh [6].

2.1 Power Generation

Currently, there are 111 working power plants in Bangladesh. The grid capacity is 15, 821 MW and per capita electricity generation is as low as 433 kWh.



Source: Bangladesh Power Development Board (BPDB) website

Currently Bangladesh produces 9507 MW electricity from 111 power plants. However, the current demand (12644 MW) is so high and alarmingly, the demand from both industries and households is constantly increasing day by day.

2.2 Fuel Supply Scenario

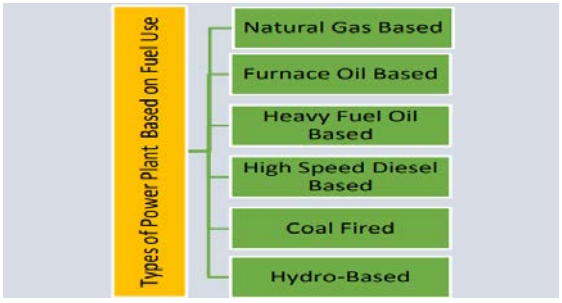


Figure: Types of power plant based on fuel use

Capacity of BPDB Power Plants as on September 2017

Fuel Type	Installed Capacity (MW)	Total (%)	Derated Capacity (MW)	Total (%)
Coal	250.00	1.84 %	170.00	1.32 %
F.Oil	0.00	0.00 %	0.00	0.00 %
Gas	8529.00	62.62 %	7936.00	61.41 %
HFO	2794.00	20.51 %	2792.00	21.61 %
HSD	1158.00	8.54 %	1134.00	8.78 %
Hydro	230.00	1.69 %	230.00	1.78 %
Imported	660.00	4.85 %	660.00	5.11 %
Total	13621.00	100.00 %	12922.00	100.00 %

Source: Bangladesh Power Development Board (BPDB) website

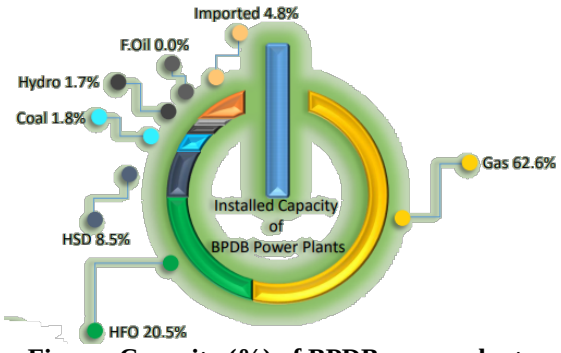


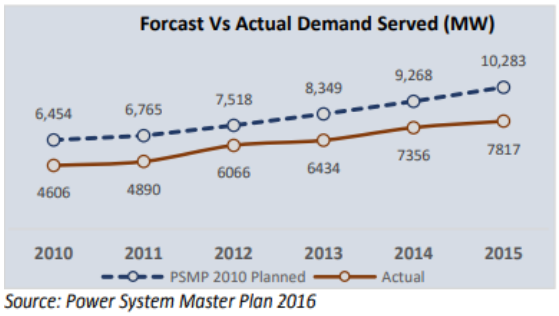
Figure: Capacity (%) of BPDB power plants

From the above statistics, it is clear that natural gas, which is well over 60% of total sources, has been playing a key role as an energy source for generating power till date. However, worryingly, there is no new gas discovery in recent years as well as the natural gas reserve remains uncertain. Therefore, the country is falling in a deep electricity crisis as the main resource to generate electricity is running out steadily.

The government of Bangladesh is looking for alternative resources (such as coal, oil and nuclear) to mitigate the electricity crisis in the near future. It seems like HFO and Furnace oil based electricity production plants are best available alternatives [6]. However, compare to gas based electricity plants oil based plants are heavily expensive to implement. Therefore, it will be only short term solution of persistence electricity crisis [8]. The next available alternative is coal based plants. The present government is trying to establish new coal based electricity plants. However, the initiative has been widely debated as coal based plants are extremely harmful for the environment [5,7].

2.3 Gap between Actual Supply and Demand

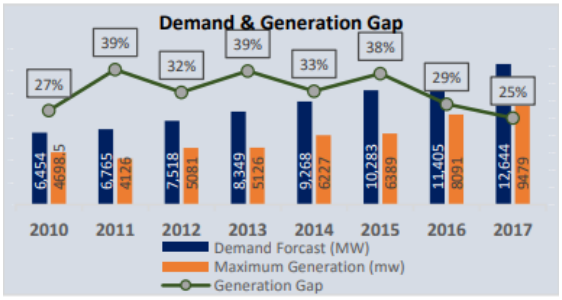
Due to the lack of electricity production and ever increasing demand, the gap between projected demand and actual demand served remained very significant. The following figure depicts electricity shortage between 2010 and 2015:



Source: Power System Master Plan 2016

Figure: Forecast Vs Actual Demand served (MW)

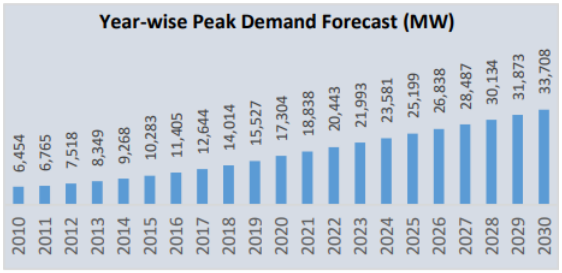
The chart below represents the scenario of steady increment of electricity demand from 2010 to 2017. Although, maximum generation (mw) increase in every year with the increase of demand but the gap between generation and demand remain almost identical.



Source: BPDB & EBLSL Research

Figure: Demand & Generation Gap

2.4 Demand Forecast



Source: Power System Master Plan 2010

Figure: Year-wise peak demand forecast (MW)

According to Power System Master Plan (PSMP) -2010, demand forecast for electricity in Bangladesh was made on the basis of GDP growth rate of 7%. The above figure shows the exponential increase of demand from 2017 (12644 MW) to 2030 (33708MW). In order to increase wide access to electricity and sustain economic development, rapid electrical development is essential. The proposed electricity generation model will mitigate the lion portion of the demand especially come from household if the government of Bangladesh sponsor this project during the implementation phase.

III. Proposed Electricity Generation Model

3.1 Overview of Proposed Model

The following block diagram illustrates the proposed low cost electricity generation model:

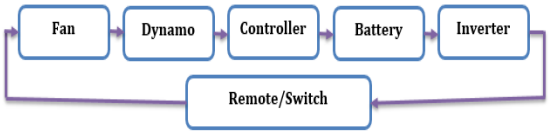


Figure: Block diagram of the proposed model

It can be seen from the above block diagram that

1. Fan gets the power from battery through inverter.
2. Dynamo, which is attached with fan using a belt, produces the power with the rotation of fan.
3. The generated power is saved in the battery with the help of charging controller.

The following figure shows abstract view of the proposed model:

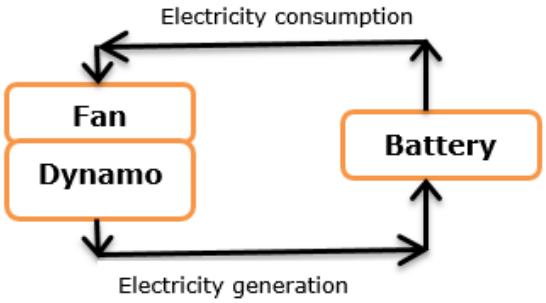


Figure: Abstract view of proposed model

3.2 Working Mechanism of Proposed Model

From the abstract view of the model, it can be seen that there are two sections

1. Electricity generation
2. Electricity consumption

Electricity generation:

In the electricity generation phase, there are two power sources [main power line and battery] and either one can be used to start the fan. Here, main power line is optional because it does not require as long as we start the fan using other power sources. For example, if we can start the fan using saved battery power then main power line will not be required at all. Even if we use main power line as a redundant connection, it can be used only to start the fan. As long as fan starts rotating, the main connection can be disconnected because fan will be running afterwards using its own power that has already been generated with the help of dynamo.

A dynamo is attached with the fan using a belt. Belt is installed in the moving rod of each device in such a way that dynamo rotates with the rotation of fan. As long as dynamo rotates, electricity is produced in the form of DC. The produced electricity is stored in a battery through charging controller. Here, charging controller is used to protect and prevent the battery for overcharging and overvoltage. So, in this phase, electricity is produced and saved in a battery.

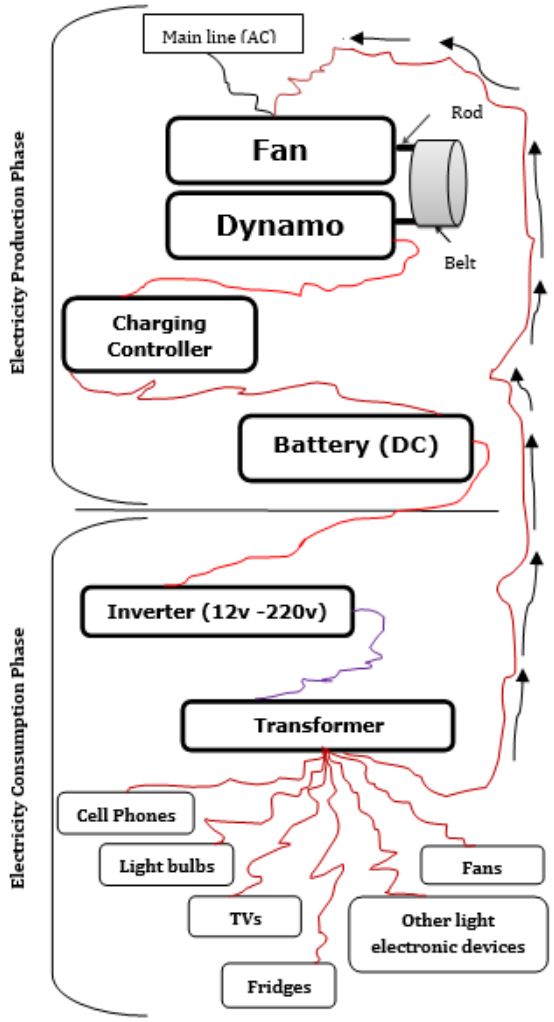


Figure: Working mechanism of proposed model

Electricity Consumption:

It this phase, we use the electricity from battery. The electricity, stored in the battery, is in DC form. Hence, we need to convert it to AC form. In order to do that, we use a 12v-220v inverter to convert 12v DC to 220v AC. Moreover, we require a transformer to supply desired output to various electrical devices shown in the figure above. Here, most interesting thing is that fan uses the electricity from battery that has been produced by fan itself with the help of dynamo. Therefore, in order to get cooling air from fan we do not require any external electricity. On top of that, we can power other electronic devices from the generated electricity for free of cost.

3.3 Components Required

To implement the proposed model the following components are required:

Fan, dynamo, battery, inverter, switch, charging controller, transformer, microcontroller, resistors, capacitors and a belt.

Fan:

It is a device that circulates air for the purpose of cooling. Any kinds (table fan, ceiling fan etc.) of fan can be used to generate electricity using dynamo [10]. Here, we have used a table fan for easy installation in a board.

Dynamo:

It produces DC (Direct Current) power with the use of electromagnetism. It other words, dynamo can be used to get electrical energy from mechanical energy [10]. The produced electrical energy can either be used to power the devices straightway or can be stored in a battery for later use.

Charging controller:

A charging controller prevents overvoltage and protects overcharging by limiting the flow of electric current to and from an electric battery. The performance of a batter can be degraded without a charging controller [3].

LCD display:

LCD is used along with a microcontroller to display different messages on a miniature Liquid Crystal Display (LCD) [10]. We have used 2*16 LCD in our implementation, which displays the generated messages in two lines with 16 characters per line.

Battery:

Battery is used to store DC power. Here, we have used 12v battery made by QUANTA.

Inverter:

An inverter is an electronic circuit or device that changes Direct Current (DC) to Alternate Current (AC) [13]. Here, we have used CD4047 inverter to convert 12v (DC) battery power to 220v (AC) supply power for powering fan or other electronic devices.

Transformer:

Transformer is an electrical device, which transforms, with the help of mutual induction between two windings and without any direct electrical connection, electrical energy from one circuit to another [12]. Here, we have used transformer to supply the desired output.

Microcontroller:

Microcontroller is a highly integrated chip (IC) comprising CPU, RAM, ROM, timers and some I/O ports. It is designed for the purpose of doing a very specific task, for instance, controlling a system [1]. We have used PIC16F73 microcontroller in our model.

3.4 Practical Observations

In order to implement our low cost electricity generation system, we mounted entire components on a black wooden board. We have used table fan for experimental purpose. The following figure demonstrates pictorially how new proposed model has been implemented in the lab.

In this experiment, numerous types and sizes of the cables have been used. We used the battery that already has some electricity in it. As such, we did not use main power line at all.

As soon as we turned on the switch, microcontroller activated battery to discharge power to output line through

inverter and transformer. We got the power connection for the fan by plug-in power cable to the output line. Fan rotated as a result of power connection and so the dynamo.

Electricity produced by the dynamo and the resulting electricity was regulated charging controller before storing in the battery. And this electricity production and consumption continued until the switch turned off.

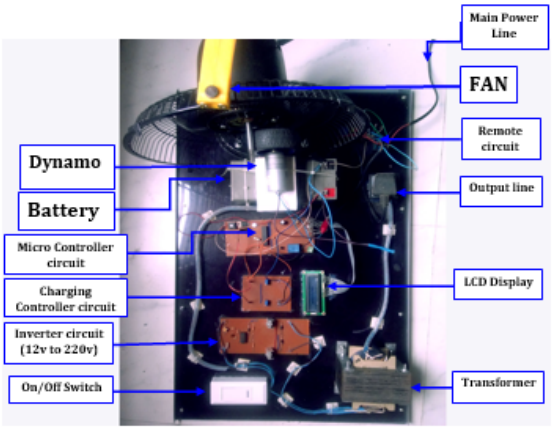


Figure: Implementation of proposed model

It can be seen from the LCD screen that the rate of charging (12.74v) the battery is higher the rate of using (12.15v) the power from battery. In such case, fan will be running forever without any external power unless we manually turn the fan off.

Figure: LCD output

IV. Conclusion

Electricity production, in comparison to its demand, is very inadequate in Bangladesh. In addition, the natural resources (gas, coal) to produce electricity are running out day by day. So, load shedding is common phenomenon in Bangladesh. Therefore, in this paper, a new model, which does not rely on natural resources to produce and is very easy to setup and also is completely free of cost after installation, is proposed. Prior to present the model in details, the author rigorously investigated the current electricity production scenario and the reasons for electricity crisis in Bangladesh.

In the following section, the author provides the applications, relative advantages and disadvantages of the proposed electricity generation model.

4.1 Applications

- New electricity connections in remote places, where electricity from the main grid is a dream.
- Households, schools/ colleges/ universities, hospitals, hostels, and hotels etc. have number of fans equipped and been running by using mail electricity line. As such, they have to pay lots of money for using electricity. However, they can save all expenses on electricity just by replacing main power connection to our low cost model.
- Generated electricity through the use of our model can be used to power other electronic devices that are used in households such as cell phone, light bulb, iron, TV, fridge and microwave, and oven etc.

4.2 Advantages

- The proposed model can easily be installed anywhere [islands and rural areas in Bangladesh, where main electricity connection is unreachable in next 50 years or so].
- Unlike IPS (Instant Power Supply), this model does not require main electricity connection in order to perform.
- Uninterrupted power supply unless we manually turned off the fan.
- Unlike solar, wind, biogas, geothermal and hydropower applications, the initial cost of this model is negligible. Besides, there is no specific cost of electricity, power plant, and no other fuel cost.
- Minimum or no maintenance cost. Once initial set up has been done. The dynamo associated with fan operate efficiently without any expert supervision for long period, which in term save substantial maintenance cost incurred in other form of electricity production systems.
- Unlike other electricity production system, Electricity loss due to long transmission line is negligible in this model as the scope of the proposed model span within house/flat/building.
- The proposed model for electricity generation is environment friendly as the model does not emit nitrogen oxide (NO_2), mercury (Ag), carbon dioxide (CO_2) or any other particulate hazardous matter into the environment. Hence, the proposed model helps protect and preserve the environment for upcoming generations.
- In this model, people ultimately get electricity for free. Firstly, dynamo generates electricity, and then this electricity is stored in a battery. Finally, stored electricity is used for rotating the dynamo through fan.

4.3 Disadvantages

- The normal speed of the fan might be slightly affected due to the incorporation of dynamo mechanism.
- The production cost of the fan for the proposed model slightly increases. However, it might be negligible in case of economies of scale.

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