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Performance Analysis of Non-Renewable Energy in Bangladesh

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Abstract

The demand of energy is dramatically increased nowadays and the demand either can renewable or non renewable depends on the drawbacks. Hence, non renewable energies show the better performance where the limitations are comprisable very few and environmental friendly. Already developed countries are being used renewable energies as the main sources of energy to produce electricity where it proved the less easy and more benefits. However, non renewable energies such as natural gas, gas generator and so on still have been producing more and more electricity and this amount is around 10 times more than renewable energies especially developing countries like Bangladesh. This paper is being discussed the importance of renewable energies and non renewable energies to produce electricity, comparing the different countries electricity production and the using sources. Here analysis the data of different power plants in Bangladesh and the types of fuel, CO2 emission and electricity production. In additionally, Gazipur district has been selected to show the power consumption factories with the cost analysis in selected fuel types.

Keywords*: Renewable energy, Non renewable energy, Demand, Electricity, CO2 emission*

1. Introduction

Energy demand dramatically increased and it will be escalating rapidly with time [1]. Electricity generation purposes the most uses sources are coal, oil and natural gas where all are in non renewable energy sources and these sources are mainly the best reason to pollute the environment [2]. In contrast, renewable energis such as hydro, solar, wind, bio-mass and so on [3-12] are environment friendly. The challenges of developing the countries and make sustainable are really dramatically increased. In order to achieve the sustainable development, both the choices and the way of implementation of the energy sources are really important. However, Low-income developing countries like Bangladesh are very much prone to the setbacks arising from the ongoing energy crisis [13, 14]. This crisis is not possible to overcome through renewable energy sources rather than using non renewable energy sources due to cost effectiveness. In Bangladesh, huge electricity demand in Industry, Agriculture and service sector. At present, around 48.5 percent can access electricity from total population where only 200kwh power is generated in per capita. As this rate is very low compared to develop countries, Government has given the maximum priority to power sector improvement where has committed to fulfill the electricity production to all people by 2021. In additionally, Government takes action to produce around 11,456MW power to the national grid by 2015 [15]. In Bangladesh, the total amount of energy is 29,247 Million-kilowatt hour (MkWh) net energy (including REB) where 16,072 MkWh in public sector as well 13,175 MkWh in private sector was generated during FY 2009-10. In the base of percentage the Public sector power plant generated around 55 percent and the remaining 45 percent by private sector of total production. The share of gas, hydro, coal and oil based energy generation were 89.22 percent, 2.49 percent, 3.52 percent and 4.77 percent respectively [15]. In government policy based, the forecasting of electricity demand will be 15,527 MW where the generation rate will be 81,610 GWH by 2019 and it will be gradually increased and will reach to 191,933 GWH by 2030 [16].

In the next steps will be discussed about the different energy sources in both renewable and non renewable energy. Focusing the non renewable sources where shown the developing countries especially in Bangladesh. After that, here will discuss the different power

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plant in Bangladesh with electricity consumption, CO2 emission and fuel types. Moreover, data has been collected in Gazipur district especially in Industry sides due to produce electricity. At the end, has shown the cost and analysis of selected fuel types in Bangladesh.

2. Energy

In socio-economic development, energy sources are the vital that can be renewable (solar, wind, biomass, hydro, geothermal and so on) or non renewable (oil, coal and natural gas) energies especially to produce electricity where the infrastructure is quite small as well as insufficient [17]. Moreover, the increase in production and total demand is fully related with the increase in energy consumption. On the other hand, the increase in energy consumption is not the related of the economic growth and total demand. Hence, the current production and total demand fully depend on energy consumption [18]. Global electricity production is nearly 60 percent in between 2011 and 2017 through from renewable sources plus hydro power according to the report from the OECD and the International Energy Agency (IEA) in Figure 1 [19].

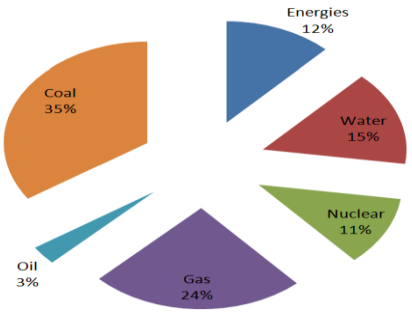

Figure 1. Electricity generation mix Worldwide (in TWh)

The per capita energy consumption in Bangladesh is one of the lowest (321 kWH) in the world [20, 21]. This energy rate is very low compared with population growth in Bangladesh. Hence, electricity production is less satisfactory whereas demand for electricity is going to peak. On the other hand, today the number has increased to around more than 50% of the population where that percentage was just 3% in 1971. However, still one of the lowest in the world-but access often amounts to just a few hours each day [22]. According to the Power System Master Plan (PSMP), Bangladesh electricity demand was made based on 7 % GDP growth rate in 2010 and this GDP growth rate requires investment 38 % of GDP by 2021 [23]. After the increasing access and attain economic development, its rate has been increased. Based on this study the peak demand would be about 17,304 MW in FY2020 and 25,199 MW in 2025 [22-27] that has been given through Figure 2.

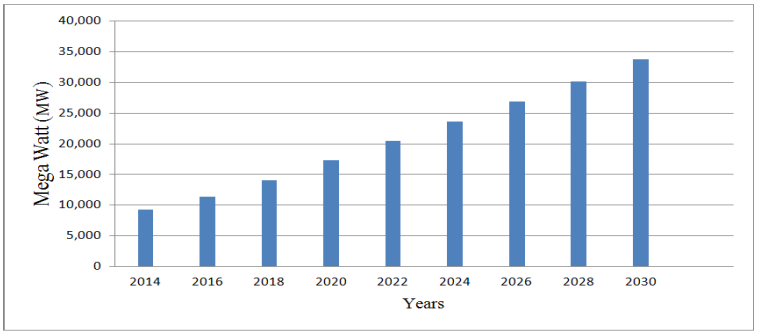

Figure 2. Electricity forecasted demand in Bangladesh

2.1. Renewable Energy

The developed countries currently remove the use of coal, oil, and natural gas for its energy [28]. Fossil fuels which are the reason of global warming that are one of the biggest concerns all over the world [29]. Non-renewable energies are drawn on finite resources that will eventually diminish, becoming too expensive or too environmentally damaging to retrieve. The use of renewable energy has risen considerably in recent times, both in developed and in developing countries. REN21's Renewables 2014 Global Status Report indicates that renewable energy provided an estimated 19% of global energy consumption in 2012 compared to 16.7 % in 2010. More than hundred countries now have renewable energy policy of one kind or the other 10]. In contrast, the many types of renewable energy resources-such as wind and solar energy-are constantly replenished and will never run out. Improving the uptake of renewable energy technologies in developing countries may be classified through different issues such as policy measures, market demand, production places and so on [28-31]. According to the Global Status Report which had been published through REN21 international policy network, renewable energy sources (including hydro power) now cover 19 percent of global final energy use. In additionally, the World Energy Outlook 2013 estimated that rage will be reached to more than 30 percent worldwide by 2035, and to considerably over 40 percent in the EU. The EU, in particular, is investing extensively in electricity generation from renewable sources. According to the REN 21, the fossil-fuel power plants are around 80 percent of new electric generation capacity in the EU plus Norway and Switzerland. Moreover, in 2013, around $249.4 billion were invested in renewable sources worldwide reported from REN21 [13, 29].

In Bangladesh, the importance of using renewable energy is dramatically increased for electricity production where included some plans of natural and policy based such as five Year Plan, Power System Master Plan, National Energy Policy, Industrial Policy 2010 underscored renewable energy. Development of renewable energy has been identified as one of the programmers of Bangladesh Climate Change Strategy and Action Plan. Renewable energy options are also included in the Bangladesh National Building Code. From 2009 to now, A dedicated policy, Renewable Energy Policy of Bangladesh, has been in Bangladesh. Hence, 5% power from renewable energy sources by 2015 and 10% by 2020. The government has established Sustainable and Renewable Energy Development Authority (SREDA) to promote renewable energy and energy efficiency as well. To strengthen international cooperation, Bangladesh became one of the initial members of the International Renewable Energy Agency (IRENA), the only inter-governmental agency working exclusively on renewable energy. Those actions manifest Bangladesh's commitment towards development of renewable energy [30]. To achieve a sustainable model of Bangladesh by 2020, government and other energy sectors have been taken initiative steps to reach more and more people for transforming Bangladesh into a solar nation by 2020 where 75 million Bangladeshi will be included [31].

2.2. Non-renewable Energy

Non renewable energy such as Natural gas, Oil from minerals and other sources, Coal and coal like substance and so on [32]. Oil is one of the major sources of non renewable energy in the world and it seems to be a positive for reserving high amount of proven oil globally. Around 1200 to 1266 billion barrels of oil has reserved at British where this information has been collected from IEA [33]. In additionally, the reservation of global oil reserves is almost 60% larger today compared to 20 years ago, and production of oil has gone up by 25%. If the alternative oil resources, including oil sands, oil shale, natural bitumen and extra heavy oil are taken into account, the global oil reserves will be around four times larger compared to the current conventional reserves. Oil still relics the leading energy resource with a wide range of possible applications. From 2000 to 2009, the oil resource assessments have increased which is very low and about a half of this incline is due to the reclassification of the Canadian oil sands and the revisions undertaken in major OPEC countries: Iran, Venezuela and Qatar. Compared to the 2010 survey, the proved oil reserves increased by 37% and production by 1% [34]. Natural gas is another fossil fuel resource which is highly contribution to the world energy economy. The cleanest of all fossil-based fuels, natural gas is overflowing and flexible. It is increasingly used in the most efficient power generation technologies, such as, Combined Cycle Gas Turbine (CCGT) with conversion

efficiencies of about 60%. The reserves of conventional natural gas have grown by 36% over the past two decades and its production by 61%. Compared to the 2010 survey, the proved natural gas reserves have grown by 3% and production by 15% [34]. The world natural gas reserves at the end of 2004 were 179.5 trillion m3. Additionally, production of natural gas has been rising at an average rate of 2.5% over the past 4 years. If production continues to rise because of additional use of gas for transportation and increased power production, the reserves would last for fewer years. Of course, there could be additional new discoveries. However, even with additional discoveries, it is reasonable to expect that all the available natural gas resources may last about 50 years with a peak in production occurring much earlier [33]. Coal is the most wide-spread fossil fuel around the world, and more than 75 countries have coal deposits. The current share of coal in global power generation is over 40%, but it is expected to decrease in the coming years, while the actual coal consumption in absolute terms will grow. Although countries in Europe, and to some extent North America, are trying to shift their consumption to alternative sources of energy, any reductions are more than offset by the large developing economies, primarily in Asia, which are powered by coal and have significant coal reserves. China alone now uses as much coal as the rest of the world [33-34]. Clean Coal Technology is based on an integrated gasification combined-cycle (IGCC) that converts coal to a gas that is used in a turbine to provide electricity with CO2 and pollutant removal before the fuel is burned (Hawkins, Lashof and Williams). According to an Australian study (Sadler), no carbon capture and storage system is yet operating on a commercial scale, but may become an attractive technology to achieve atmospheric CO2 stabilization [34].

Bangladesh is quite rich in natural gas. Although the actual reserve of this most important fossil fuel of Bangladesh has not yet been ascertained, a recent study made with the help of experts of the US Geological Survey shows that there is as much as 33 TCF (trillion cubic feet) of proven probable natural gas reserves in the country. Some coalmines have also been discovered in Bangladesh. At present the country has 2,041 million tons of coalreserve. However, petroleum is mostly imported from the Middle East [35]. In Bangladesh, non-renewable resource is a natural that cannot be remade or re-grown at a scale of comparable to its consumption. In Bangladesh, there are many natural resources such as: renewable natural resources are Energy, Water, Fish, Forest etc. and Coal, petroleum, oil, natural gas Rock, Sand etc. are considered non-renewable natural resources. Bangladesh occupies a bigger part of the Bengal basin and the country is roofed by Tertiary folded sedimentary rocks (12%) in the north, north eastern and eastern parts; uplifted Pleistocene residuum (8%) in the north western, mid northern and eastern parts; and Holocene deposits (80%) consisting of unconsolidated sand, silt and clay. In Bangladesh 25 gas fields have been discovered with the rate of success ratio is 3.1:1 of which two of the gas fields are located in offshore area. Gas is produced from 20 gas fields (79 gas wells), 15 are state owned and the remaining operated by international oil companies. On the other hand, the oilfield of the country has been discovered at Haripur in 1986 that is located in near Haripur in the eastern hilly district of Sylhet, but these have yet to be developed. The Haripur reserves are estimated at 40 million barrel [mbbl], with a recoverable reserve of about 6 million barrels and the total resource is likely to be much higher. Coal reserves of about 3.3 billion tons comprising 5 deposits at depths of 118-1158 meters have been discovered so far in the north-western part of Bangladesh. The name of these deposits are-Barapukuria, Phulbari and Dighipara coal field in Dinajpur district, Khalashpir in Rangpur district and Jamalganj in Joypurhat district [35-36].

3. NRE Based Power Station And Its Production In Bangladesh

In the Table 1 has shown the power station details in tabular form where has discussed the name of different power stations with power production capacity in MW range and mentioned the fuel types as well as output power capacity in GW range. In the same table has shown the CO2 emission as well as intensity in MWH. After analyzing the full table it can be said clearly that in Bangladesh, most preferable power producing non renewable source is natural gas and some places used oil.

Table 1. Power Plants in Bangladesh

Power Plants	Capacity MW	Fuel types	Output GWh	CO2Mkg	Intensity KgMWh
Ghorasal	950	Fuel Oil, Natural Gas	3,938.9	1,732.3	440
Ashuganj	720	Fuel Oil, Natural Gas	3,311.1	1,444.44	436
Meghnaghat-1	450	Natural Gas	2,579.3	1,031.1	400
Chittagong Raozan	420	Natural Gas	1,362.7	647.8	475
HaripurGlobeleq	360	Natural Gas	2,064.5	820	397
Haripur-2	360	Natural Gas	0.0	0.0	0.0
Siddhirganj	260	Natural Gas	759.98	377	496
Barapukuria	250	Coal	979	1,234.7	1,261
Siddhirganj Egcb	240	Natural Gas	0.0	0.0	0.0
Karnafuli	230	Hydro	1,280	0.0	0.0
Mymensingh	210	Natural Gas			
Shahjibazar	183	Natural Gas, Oil	480.857	246.6	513
Golapara (khulna)	170	Fuel Oil	619	307	496
Haripur Barge	120	Diesel Oil	206.407	112.61	546
Baghabari	110	Oil	261.135	114	436
Tiger Barge	110	Heavy Fuel Oil, Natural Gas	132.053	61.1	463
Tongi	105	Fuel Oil	65.314	38.8	593
Madanganj	102	Natural Gas, Oil	0.0	0.0	0.0
Gopalganj	100	Heavy Fuel Oil	0.0	0.0	0.0
Fenchuganj	97.0	Fuel Oil, Natural Gas	524.623	232.64	444
Haripur	96.0	Natural Gas	244.1	131.53	539
Narsingdi Doreen	66.0		44.767	41.25	463
Chittagong Sikalbaha	60.0	Fuel Oil, Natural Gas	125	58.1	465
Bheramara	60.0	Diesel Oil	99.2	47	474
Gazipur Evince	52.2	Natural Gas	0.0	0.0	0.0
RaozanRpcl	52.2	Natural Gas	0.0	0.0	0.0
FenchuganjBedl	51.3	Natural Gas	128.1	71.2	278
Maona	35.0	Natural Gas	0.0	0.0	0.0
Saidpur	20.0	Diesel Oil	47.04	23.8	505
Rangpur	20.0	Natural Gas	28.1	14.8	528
Dhaka Caustic Soda Plant	10.5	Natural Gas, Diesel Oil	12.1	8.2	671
Mymensingh Barge			818.071	332.8	407
Chittagong Urea			418	207	495
Ngf Factory			315.4	135.4	429
Karnafuli Mill			250	109.3	438
Uf Factory			228	123.4	542
Khulna Newsprint			210.2	93.4	445
Shahjibazar Power			200.1	78.30	195
Zia Fertilizer			191.4	85.74	448
Baghabari Barge			186.325	102.42	550
JamunaFertilzer			167	92.7	557
Sikalbaha Barge			135.8	76.4	562
Chhatak Cement			129	70.5	546
AshuganjPel			125	72.5	290
Barisal			73.3	35.6	486
Madhabdi			56.03	33.62	600
Sylhet			47.5	29	607
Tsp Complex			42.7	22	509
Chandina			40	24.5	615
Polash Urea			38	23.4	617
Sylhet Pulp			31.54	19.73	626
North Bengal Paper			28.032	14.81	528
Eastern Refinery			25.7	13.68	532
Sitakunda Mill			22.1	14.2	642
MohipalDorwin			21.2	19.5	463
Kanchpur			20,1	13.0	647
Dhaka Usp			20.0	12.93	647
East Chandora Factory			19.45	10.6	545
Monno Factory			18.3	12.0	651
Thakurgaon			18.1	10.0	548
Dhaka Rak			17.87	11.65	652
Chittagong Kabir			15.72	10.35	658
ChhatakSurma			15.01	10.0	667
Shameen Factory			13.7	9.13	665
Chittagong Kafco			11.1	7.5	675
Bashundhara Paper			10.83	7.325	676
Narayangonj R&k			9.83	6.70	681
Daeyu Dhaka			9.14	6.3	685
Beximco			8.61	5.03	584

Kailash Gas Field		8.6	5.89	688
BholaBpdb		8.2	4.8	587
Narayangonj Parity		7.8	5.4	693
GazipurSilverline		7.3	5.1	696
Rajshahi		7.2	4.3	594
Square-sarah Factory		6.85	4,.8	699
Salgaria Factory		6.85	4.8	699
ShafiulAlam Steel Mill		6.85	4.8	699
Naheed Factory		6.85	4.8	699
Pabna Sugar	Biomass	6.71	0.0	0.0
Chittagong Cement Plant		6.04	4.4	706
GazipurJamuna		5.91	3.6	604
Dhaka Mill		5.03	0.0	0.0
KanchpurSinha		4.62	3.324	720
ShinepukurFactory		4.6	3.3	720
Kakrail Plant		4.4	3.20	722
Dhaka Padma		4.4	2.7	620
Dhaka FaizunNesa		4.23	2.63	621
Kornopara Plant		4.1	2.54	623
Meghna Cement Plant		3.8	2.4	627
Shamsher Nagar Estate		3.58	2.63	733
Madumahti Plant		3.21	2.04	636
Dhaka Mother		3.2	2.6	406
Ananta Paper Mill		3.02	1.93	639
Bogra		3.0	2.0	641
Rangamati		2.8	0.0	0.0
Dhaka Gulshan		2.42	1.82	755
Sonali Paper Plant		2.4	1.6	652
Manikgonj Plant		2.35	1.8	756
Dacca Tobacco		2.33	1.5	654
Beol Plant		2.12	1.4	659
Rana Factory Powerplant		2.12	1.4	659
Muhuri		2.1	0.0	0.0
Reliance Inquilab		1.8	1.21	668
Chittagong Unitex		1.8	14	772
Bof Plant		1.5	1.1	676
Dhaka Palmal		0.894	0.73	811
Giaspur		0.84	0.0	0.0
Khulna Plant		0.5	0.4	746
BarkalSadar		0.343	0.0	0.0
Bangladesh Broadcasting		0.22	0.2	801

In the Table 2 has shown the power consumptions in the different industry at Gazipur district where also shown the fuel types and the production capacity in KW. In additionally here shows the possible KW that an industry can be produced.

Table 2. Power consumptions in selected area (Gazipur Dhaka)

Serial NO.	Name of Company	Using Technique	How Much Intended to produce (KW)	How Much possible to produce (KW)
1	Walton Hi-Tech Industries Limited	Diesel & Gas	13700	12000
2	Walton Micro-Tech Corporation Limited	Diesel	4000	3000
3	Mahmud Denim Limited (Unit-01)	Gas	3090	2200
4	Mahmud Denim Limited (Unit-02)	Gas	5040	4000
5	Nahid Cotton Mills (Unit-01)	Gas	2700	2400
6	Nahid Cotton Mills (Unit-02)	Gas	4220	3700
7	Nahid Cotton Mills (Unit-03)	Gas	4500	4200
8	Nahid Cotton Mills (Unit-04)	Gas	6000	5400
9	Nahid Cotton Mills (Unit-05)	Gas	1800	1600
10	Nahid Cotton Mills (Unit-06)	Gas	4616	3900
11	Nahid Cotton Mills (Unit-07)	Gas	2960	2800
12	Bengal NFK Textile Mills Limited	Gas	3090	2300
13	Korotoya Spining Mills Limited	Gas & Diesel	1780	1500

14	Jumjum Spining Mills Limited(Unit-01)	Gas	1030	850
15	Jumjum Spining Mills Limited(Unit-02)	Gas	900	800
16	Uttara Spining Mills Limited (Unit-01)	Gas	3680	3400
17	Uttara Spining Mills Limited (Unit-02)	Gas	1800	1600
18	Dekko Diesign Limited (Unit-01)	Gas	750	700
19	Dekko Diesign Limited (Unit-02)	Gas	2328	1950
20	Maksons Spining Limited (Unit-01)	Gas	5150	4500
21	Maksons Spining Limited (Unit-02)	Gas	5150	4250
22	Knit Plus Limited	Gas	2089	1400
23	Karim Spining Limited	Gas	3680	3100
24	PSRM Limited	Gas	7200	5000
25	Hanif Spining Mills Limited	Gas	3600	3300
26	Apex Holders (Unit-01)	Gas & Diesel	6540	5200
27	Apex Holders (Unit-02)	Gas	4120	3500
28	Asia Composite Limited (Unit-01)	Gas	5850	4600
29	Asia Composite Limited (Unit-01)	Gas	4630	3900
30	Asia Composite Limited (Unit-02)	Gas	5850	4700
31	Asia Composite Limited (Unit-03)	Gas	7800	6500
32	Jamuna Group Limited (Unit-01)	Gas	6490	5200
33	Jamuna Group Limited (Unit-02)	Gas	6180	5000
34	Jamuna Group Limited (Unit-03)	Gas	6180	5400
35	Jamuna Group Limited (Unit-04)	Gas	3090	2600
36	Jamuna Group Limited (Unit-05)	Gas	1030	850

After analysis the overall data which has shown in Table 2 that can be said easily that most preferable source in industry is gas.

4. Cost Analysis

1. For 5 MW Gas power plant
Total plant capacity =5000 kwh.
plant produce =(80%)4000 kwh.
Building construction cost+ Generator (5 set)cost + Substation cost
=3000000+(25000000*5)+5000000= BDT 133000000.
Salvage value= BDT 8000000.
Depreciation =133000000–8000000=BDT 125000000.
Life time=20 year.
Per hour depreciation cost=125000000/(20*365*24)= BDT 713.47/hour.
1 kw = 0.113 m3
4000kwh=0.113*4000=452 m3
1 m3=BDT 7.49.
Total kwa cost =452*7.49=BDT 3385.48.
Employ cost =206000 taka/month.
Employ cost/hour=206000/(30*24)= BDT 286.11/hour
Maintenance & spare parch cost = BDT 1200000.
Maintenance & spare parch cost/hour=1200000/(30*24)= BDT 1666.67/hour.
Total cost=3385.48+286.11+1666.67+713.47= BDT 6051.73.
Per unit cost=6051.73 /4000= BDT 1.51.

2. For 5 MW Diesel power plant
Total plant capacity =5000 kwh.
plant produce =(80%)4000 kwh.
Building construction cost+ Generator (10 set)cost + Substation cost
=3000000+(7000000*10)+5000000= BDT 78000000.
Salvage value=5000000 taka.
Depreciation =78000000–5000000= BDT 73000000.
Life time=20 year.
Per hour depreciation cost=73000000/(20*365*24)= BDT 416.67/hour.
1 kw = 0.315 lit.
4000kwh=0.315*4000=1260 lit.
1 lit= BDT 68.
Total kwa cost =1260*68= BDT 85680.
Employ cost = BDT 206000/month.
Employ cost/hour=206000/(30*24)= BDT 286.11/hour
Maintenance & spare parch cost = BDT 1400000.
Maintenance & spare parch cost/hour=1400000/(30*24)= BDT 1944.44/hour.
Total cost=416.67 +85680+286.11 + 1944.44 = BDT 88327.27.
Per unit cost=88327.27/4000= BDT 22.08.

In above has shown the calculation of fuels cost that has been used dramatically high in Bangladesh there are diesel and gas. After calculating of overall cost, it has proved that the per unit rate for gas is more effective in Bangladesh.

5. Conclusion

Electricity demand is increased day by day which can be done through either renewable sources or non renewable sources. For the developing countries most common issue is cost effectiveness and maintenance where non renewable energy sources are more preferable even through these sources fully environmentally unhealthy and non friendly. Here main purpose is data collection in different areas in Gazipur district especially in industry side due to the electricity consumption rate which has done properly. Moreover, different power plants in Bangladesh have shown here with CO2 emission and electricity production. At the end has shown the cost analysis in different fuel types and the reason of choosing effective fuel due to less cost.

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