TA 5972: REG. Promotion of Renewable Energy, Energy Efficiency and Greenhouse Gas Abatement (PREGA)

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Presentation on Pre-feasibility Studies

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Projects for Pre-feasibility Studies(completed)

1. Pre-feasibility study for Dhaka city solid waste to electric energy project

2. Pre-feasibility study for co-generation in sugar industries

3. Pre-feasibility study for fuel switching from oil to gas for power generation.

Projection of Waste Generation in Dhaka

Year	Wastes (kilo tonnes/day)	Wastes (million tonnes/yr)
2002	5.35	1.95
2003	5.65	2.06
2004	5.97	2.18
2005	6.30	2.30
2006	6.66	2.43
2007	7.03	2.57
2008	7.43	2.71
2009	7.84	2.86
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2021	15.11	5.52

Composition and Calorific Values of the Solid Wastes of Dhaka

Contents	Share by weight
Water (moisture)	50%-70%
Carbon	6.02%-26.06%
Hydrogen	1.20%-3.53%

Calorific Values	Btu/lb	kcal/kg
As received	1386-2600	770-1444
Air dry (with moisture 5-8%)	2900-4300	1611-2389
Oven dry	3200-6200	1833-3444

Source : World Bank, 1998

Technologies available for processing solid wastes

A number of technologies are now available for processing municipal solid wastes (MSW). Popular among them are : (1) Landfill, (2) Mass Burn Incinerator, (3) Fluidised Bed Incinerator, (4) Gasification, and (5) Plasma Converter.

Figure 1: Progress of power plant installation in Bangladesh over 91/92-2001/02 and projection up to 2019

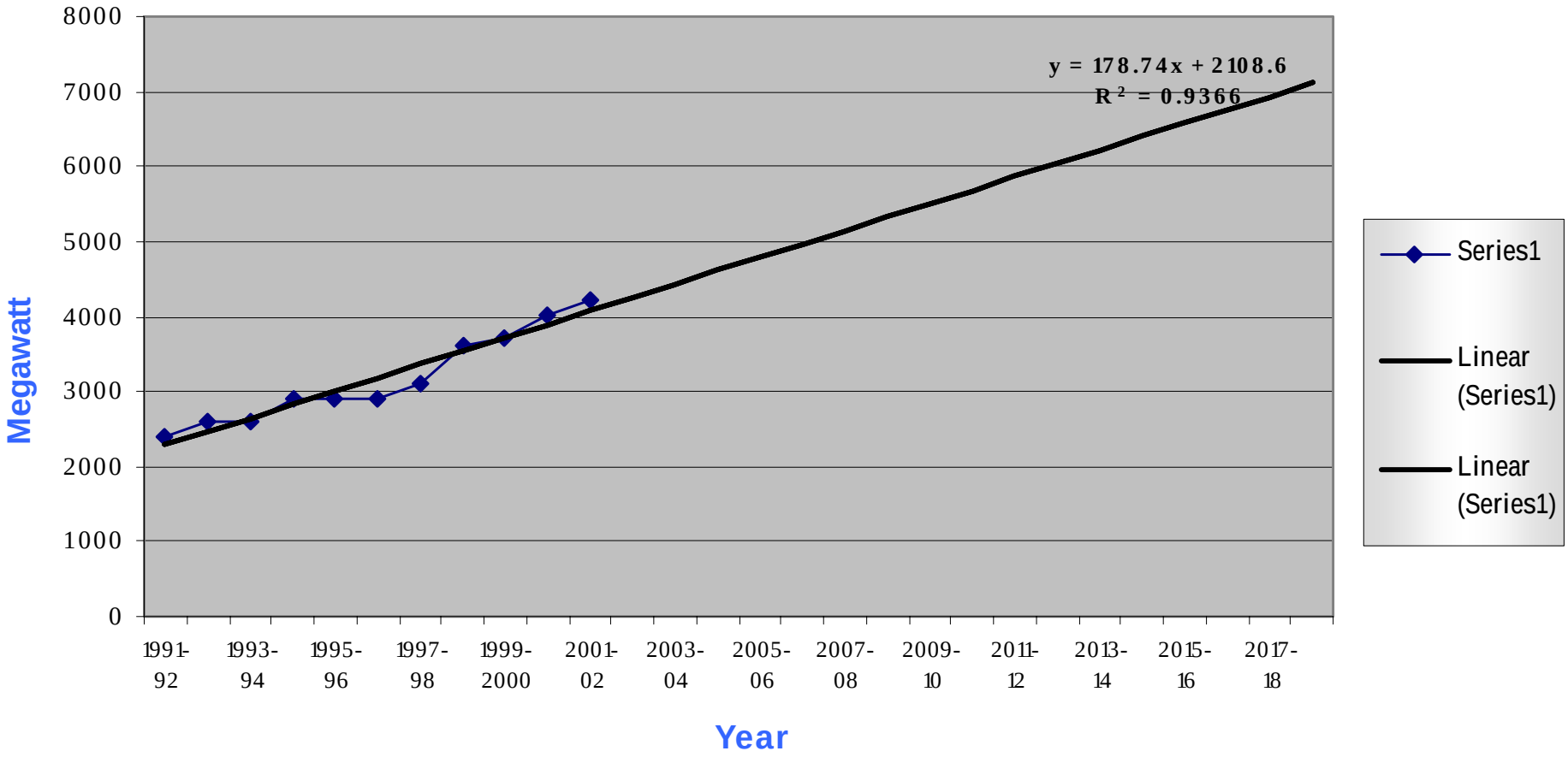
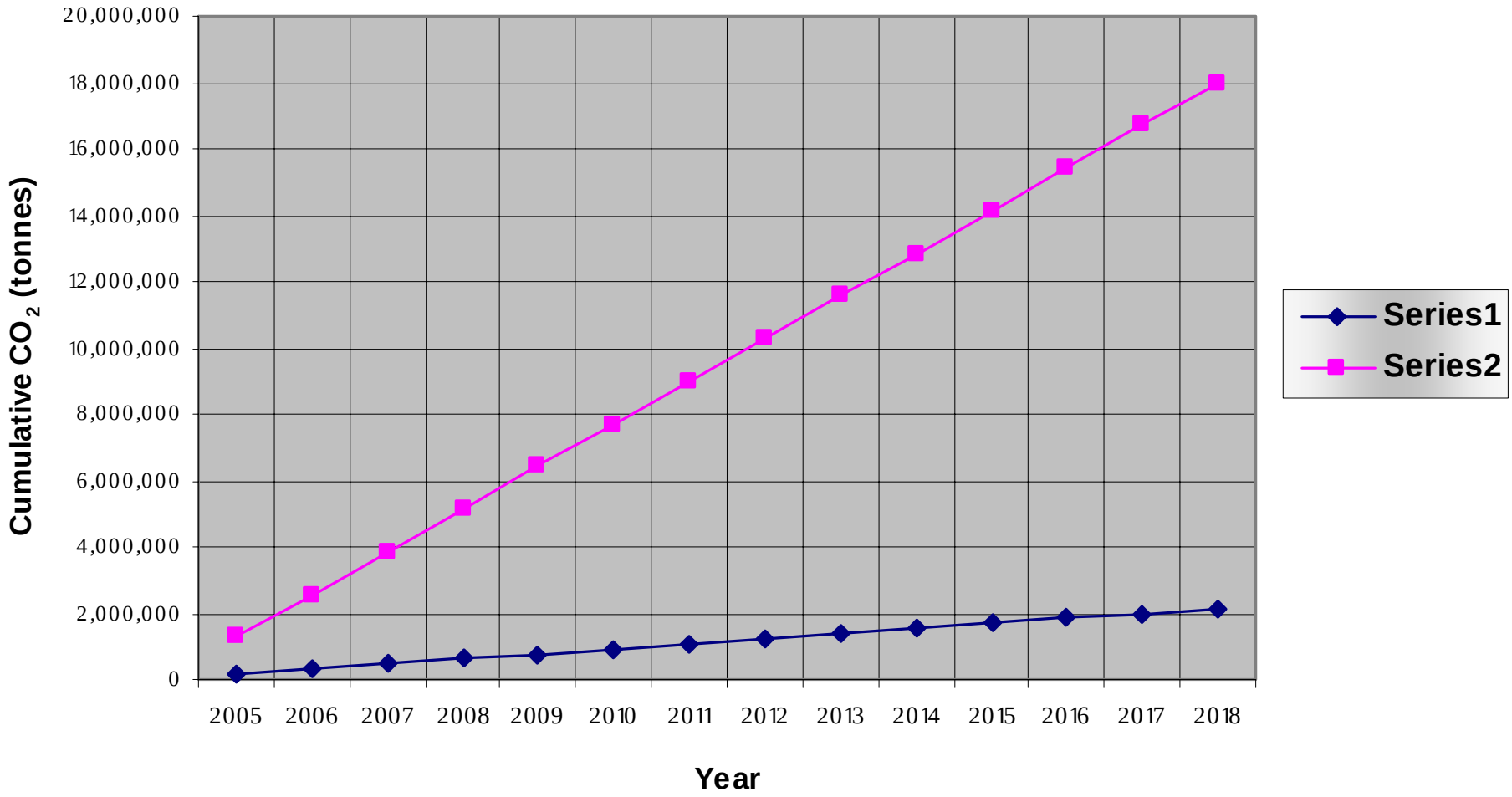


Figure 2: GHG (CO_2 equivalent) Production without (Series 2) and with (Series 1) the project activity(MSWEE)



Proposed Project

1) 50 digesters, 8500m^3 capacity each, are constructed.
2) 20-MW capacity generator is installed.
3) Generated electricity is fed into the national grid thus displacing equivalent power generation based on natural gas by BPDB.
4) Fresh wastes containing all the components including the recyclables such as metals, glasses, etc. will be fed into the digesters, After digestion, when the digested materials will be dug out, scavengers with necessary safety measures will be employed to pick up the recyclable materials. After anaerobic digestion, the residue becomes completely odourless and mostly germ-free. The sorted-out residue will be disposed of for land filling.
5) Methane produced in otherwise open dumping will be trapped and burnt for power generation
6) With the project activity, total yearly CO_2 production is 153, 670 tonnes

Flowchart – 1

Flowchart with Calculation for Yearly GHG (CO_2) Production From the 20 - MW Power Plant Based on Natural Gas without the Project Activity

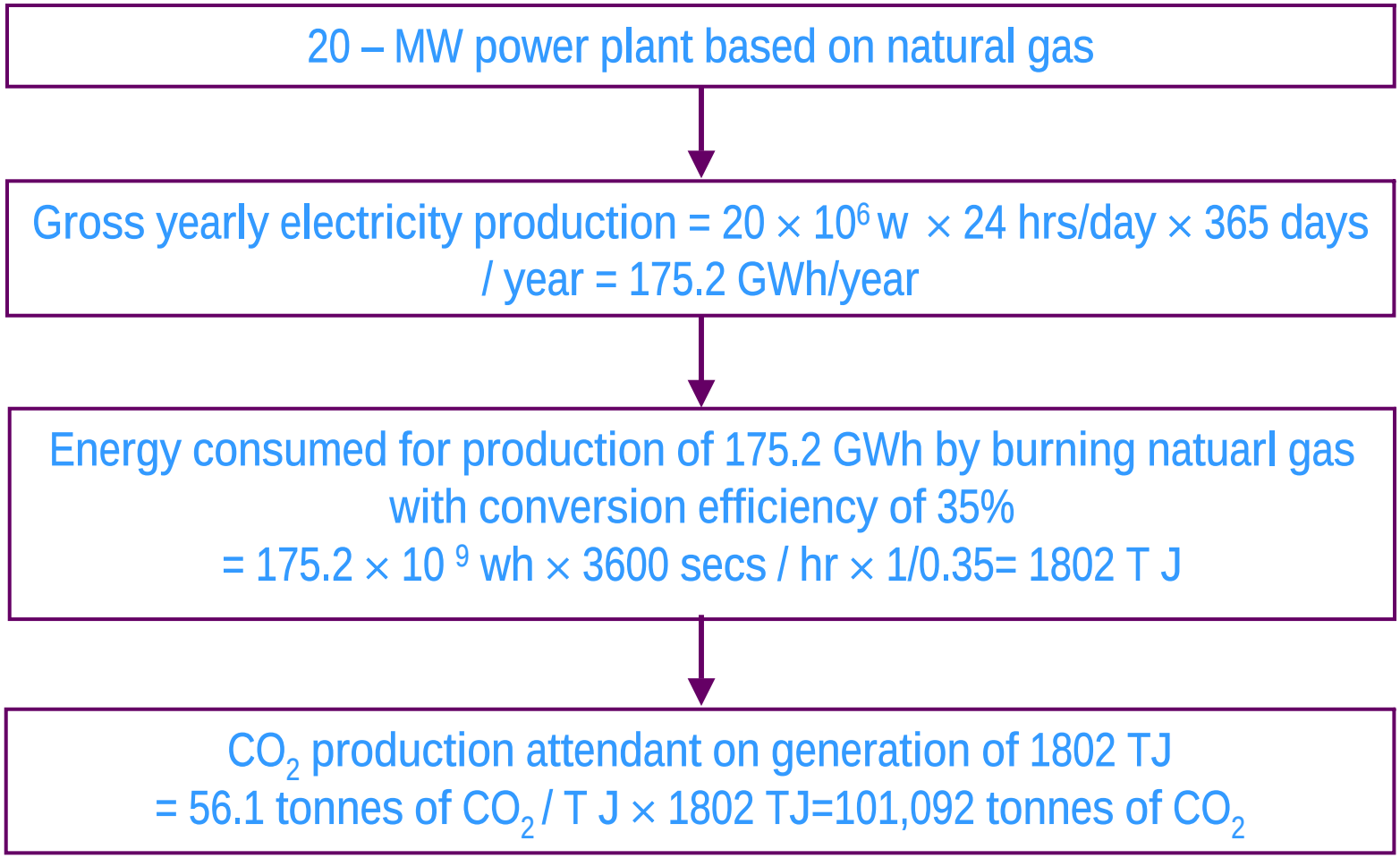


Table 1: Yearly Total Production of CO_2 Equivalent from the Matuail Site and 20-MW Power Plant Based on Natural Gas in the Absence of Project Activity

Yearly Production of CO_2 from 20-MW Power Plant	=	101,092	Tonnes
Yearly Production from the Matuail Dumping Site (With daily unloading of 5000 tonnes of Wastes)	=	1,183,076	Tonnes
Total	=	1,284,168	Tonnes

Table 2: Yearly Abatement of CO_2 Equivalent due to the Project Activities

i)	Yearly total production of CO_2 equivalent in the absence of the project activities	=	1,284,168	Tonnes
ii)	Yearly total production of CO_2 with the project activity	=	153,630	Tonnes
	Yearly Abatement of CO_2	=	1,130,538	Tonnes

Figure 3 : Cumulative Reduction of CO_2 over the Project Period(MSWEE)

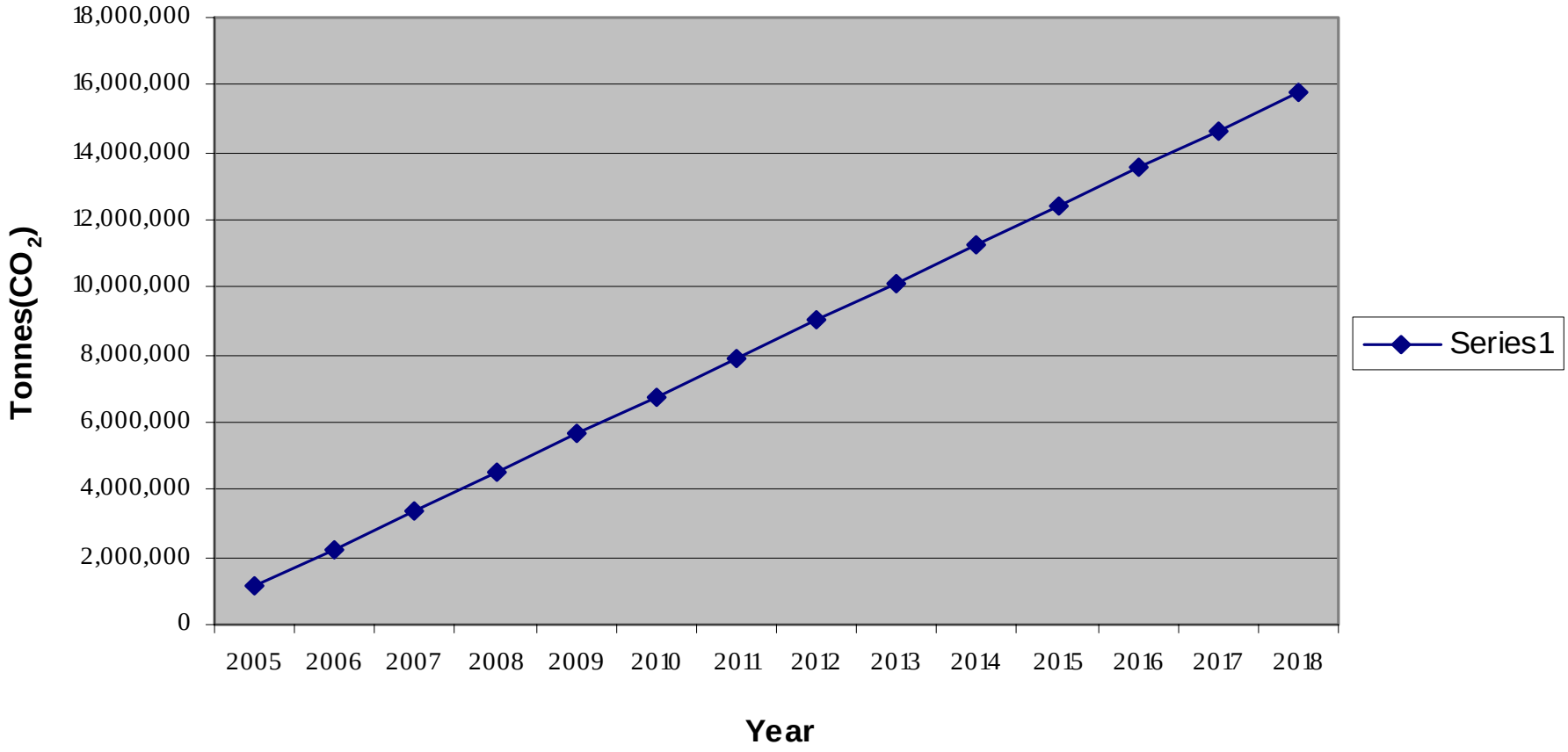


Table 3: Project benefits(MSWEE)

Issues	Explanation
Local Environmental Benefits	- Local air quality will be improved. - The project will deliver more electricity to the grid reducing load shedding - The project will help solve waste disposal problem
Socio-economic Benefits	- The project will lead to employment generation. - The project will improve the quality of life of people living in areas adjacent to the project site.
Capacity Building	- This project will be a first CDM project in the country and thus help capacity building related to CDM projects.

Issues	Explanation
Technology Transfer	- This will be a new technology in the region and as such successful implementation will result in replication leading to further emission reduction.
Host Country Criteria	- GOB is still in the process of defining requirements for CDM projects.
Government Priority	- This project is in the priority list of GOB and has already been placed under MOEF.
EIA	- EIA will be carried out as per Law.

Financial Aspects(MSWEE)

Base case

Investment cost	:	1573.66 million Taka
Annual operating cost	:	61.8 million Taka
IRR	:	–6%
NPV (at 10%)	:	-77.57 million Taka
B-C Ratio (at 10%)	:	0.81

Financial Analysis with Carbon Benefit (1.13 million tons of CO_2 Reduction per annum) -MSWEE

With 5 dollars per ton of CO_2

IRR	=	84.02%
NPV (at 10%)	=	2136.99 million Taka
B-C ratio (at 10%)	=	6.2

with 3 dollars per ton of CO_2

IRR	=	54.73%
NPV (at 10%)	=	1251.79 million Taka
B-C ratio (at 10%)	=	4.4

(MSWEE)

15% Fall in Revenue (with Carbon Benefit)

IRR	=	39.62%
NPV (at 10%)	=	801.25 million Taka
B-C (at 10%)	=	2.95

15% Increase in Investment Cost (with carbon benefit)

IRR	=	43.24%
NPV (at 10%)	=	1050.25 million Taka
B-C Ratio (at 10%)	=	3.21

Benefits from local Environmental Improvement (MSWEE)

Dump Site

Affected Group 4,500 Households

Sample	:	50 Households.

82% willing to pay Tk.30 per month

Demand Curve	:	D = a-1.67p
Annual benefit	:	1.6 million Taka (1)

Garbage Collection Point

4,920 Garbage Points

Affected group 23,800 Households

Sample size 50 Households

68 percent would pay 50 Taka per month

Demand Curve D = a – 1.56p

Annual benefit = 28.3 million Taka (2)

Total Annual Benefits (1+2) 1.6 + 28.3 = 29.9 million Taka

Economic Analysis

Health, Environment Benefit, (Taka 30 million per annum) and adjustment with appropriate shadow pricing

IRR = 14.5%

NPV (at 10%) = 114.92 million Taka

B-C Ratio (at 10%) = 1.25

(MSWEE)

15% reduction in Benefit

IRR	=	1.26%
NPV (at 10%)	=	-191.37 million Taka
B-C Ratio (at 10%)	=	0.58

For 15% increase in Project Cost

IRR	=	6.10%
NPV (at 10%)	=	-106.17 million Taka
B-C Ratio (at 10%)	=	0.8

(MSWEE)

Other Economic and Social Benefits

- Job creation : New jobs will be created through landfill project.
- Income generation : Incremental wage increase at land-fill energy plant compared to alternative jobs.
- Trade Balance : Positive trade balance due to reduction of fuel import.
- Efficient use of land : Density of waste in land fill project is higher than present dump-site. The higher the density, the better is the land use.
- Renewable Energy : It is renewable.
- The project will lead to technology transfer and which can be replicated.

2. Co-generation in Sugar Industries

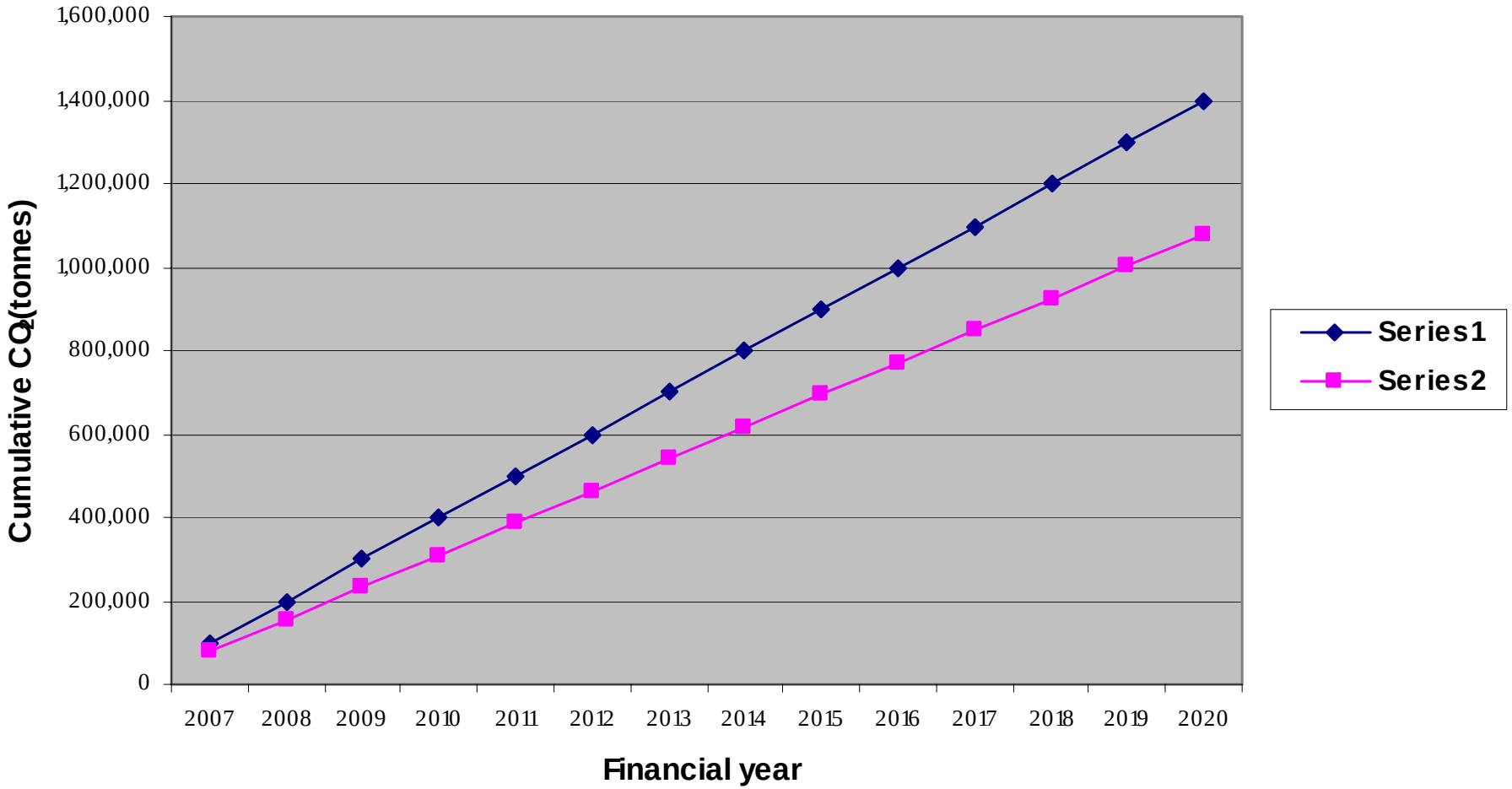
- To produce both electricity and process heat using the same fuel, bagasse
- Now a days, trigeneration, by which electricity, heating and cooling are achieved through burring the same amount of fuel
- At present 15 sugar mills are in operation processing annually about 2.5 million tonnes of sugarcanes and producing about 0.9 million tonnes of bagasse. Location and production capacities of these sugar mills are given below :

Current Practices in Sugar Mills

- Major portion of the bagasse is burnt in the boiler to produce electricity and the waste steam is used as process heat. Depending on the capacity of the sugar mills 0.2 – 2.0 MW is produced. Working period of the sugar mills is 120 – 150 days (sugarcane cultivation season).
- Calorific value of bagasse containing about 50% moisture is 2300 kcal/kg.
- At present 35 – 40 kgs steam is needed to produce 1 kWh of electricity where with efficient co-generation, steam needed per kWh is only 5 – 6 kgs.
- In this pre-feasibility-study, a 2000-tonne per day (TCD) plant has been chosen. According to the results of the study, 11 MW of electricity can be generated in place of current 2.0 MW. 2MW will be supplied to the mill and the remaining 9 MW to the Grid.
- Total investment cost is 384 million Taka. Environment additionality of the project is 22,850 tonnes of CO_2 per year.
- Financial and economic analyses will be presorted by Mr. Khandaker Mainuddin, Team Member.

(Co-generation)

Figure 5: CO_2 production without (series 1) and with (series 2) the project activity over the project period.



(Co-generation)

Table 5: Yearly abatement of CO_2 due to the project activities.

Yearly total production of CO_2 in the absence of the project activities	99,850 tonnes
Yearly total production of CO_2 with the project activity	77,000 tonnes
Yearly abatement of CO_2	22,850 tonnes

(Co-generation)

Financial Aspect

Base case

Investment cost	:	378 million Taka
Annual operating Maintenance cost	:	30.61 million Taka
Annual Gross revenue (37.62 GWh @ Tk. 2 per kWh)	:	75.24 million Taka
Analysis period	:	14 years
FIRR	:	5.59%
NPV (at 10%)	:	– 22.5 million Taka
B-C Ratio (at 10%)	:	0.77

The project in the base case is not financially viable.

Financial Analysis with CO_2 Benefit (22,850 tons of CO_2 reduction per year) with 10 dollar per ton of CO_2

FIRR	=	18.66%
NPV (at 10%)	=	50.75 million Taka
B-C Ratio (at 10%)	=	1.51

with 5 dollars per ton of CO_2

IRR	=	12.54%
NPV (at 10%)	=	14.12 million Taka
B-C ratio (at 10%)	=	1.14

The Project becomes financially viable with CO_2 Valued at 5 dollar/ton

15% Fall in Revenue (with CO2 valued at 10 $ per ton)

FIRR	=	5.11%
NPV (at 10%)	=	– 24.83 million Taka
B-C (at 10%)	=	0.75

(Co-generation)

Benefit from local Environmental Improvement

Surrounding Area of the Industry (within 2 km) : 5600 Households

Sample Households : 50

72 % Households willing to Pay Taka 10 Per month

Demand curve : D = a – 0.36 P

Annul Benefits : 3.11 million Taka

Affected workers within the mill Premises : 1200

91% are willing to pay Taka 10 Per Month

Demand carve D = 2 – 11.1 P

Annual Benefits : 0.22 million Taka

Total Annual Benefits : 3.11 + 0.22

= 3.33 million Taka

(Co-generation)

Economic Analysis

(Environmental Benefits and adjustments with appropriate shadow pricing)

EIRR = 9.58%

NPV (at 10%) = – 2.46 million Taka

B-C Ratio (at 10%) = 0.98

The economic scenario is better than financial scenario. However, the project is not economically viable.

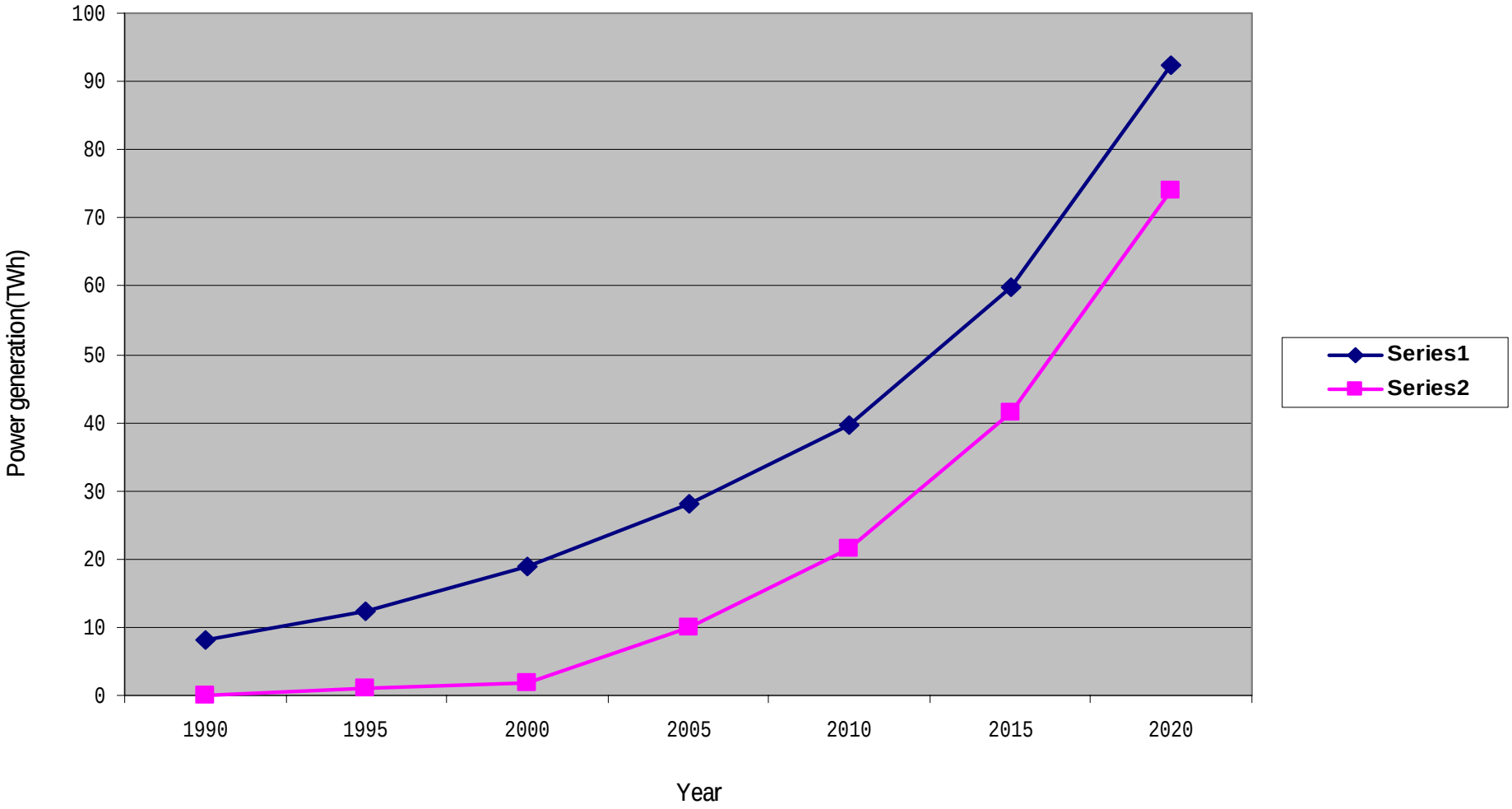
With CO_2 benefits (10 dollar per ton)

EIRR = 21.55%

3. Fuel Switching from Oil to Gas for Power Generation

- In 2001-02, BPDB and IPP together had a total installed capacity of 4230 MW out of which 494 MW was oil-based.
- In that year, oil-based captive generation in the public and private sectors was 2480 MVA.
- According to National Energy Policy (1996) projection of total electricity production and that based on oil is shown in the figure below :

Projection of total power generation (series 1) and that based on oil (series 2).

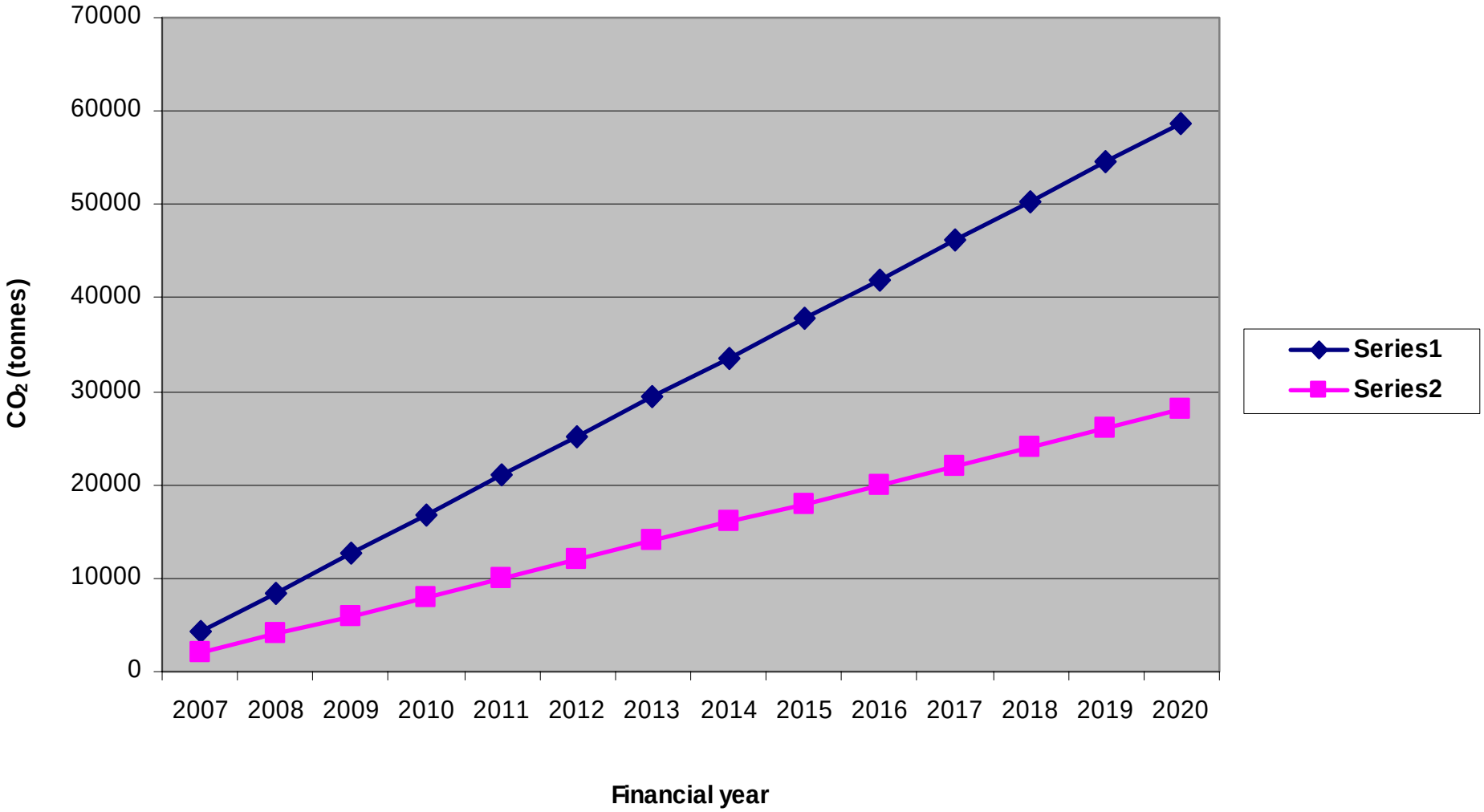


(Oil to gas)

- Since Bangladesh has sizable quantity of NG, it is advisable that oil-based generator be converted into gas-based ones.
- In this pre-feasibility study, replacement of oil-based 2362 KVA (in the monno Ceramics Industries Ltd.) with gas-based 2000 KVA has been investigated.
- This factory now produces 4200 tonnes of CO_2 per year. When replaced with a gas-based one, this will produce 2001 tonnes showing an environment additionality of 2100 tonnes of CO_2 per year.
- In addition to GHG reduction, factory premises will remain clean and fuel cost will be reduced significantly adding more profit to the factory.

(Oil to gas)

Figure - 9: Cumulative production of CO_2 without (series 1) and with (series 2) project activity from Monno Ceramics Industries Ltd. over the project period



(Oil to gas)

Table 6 : Yearly abatement of CO_2 due to the project activity

i)	Yearly total production of CO_2 in the absence of the project activities	=	4199 tonnes (Flowchart 1)
ii)	Yearly total production of CO_2 with he project activity	=	2001 tonnes (Flowchart 2)
	Yearly abatement of CO_2	=	2198 tonnes

(Oil to gas)

Financial Aspect

Base case

Investment cost	:	33.03 million Taka
Annual operating Maintenance cost	:	4.25 million Taka
Annual Gross revenue (3.45 GWh @ Tk. 2.50 per kWh)	:	8.63 million Taka
Analysis period	:	14 years
FIRR	:	12.71%
NPV (at 10%)	:	1.26 million Taka
B-C Ratio (at 10%)	:	1.15

(Oil to gas)

Financial Analysis with CO_2 Benefit (21,98 tons CO_2 reduction per year) with 10 dollar per ton of CO_2

FIRR	=	28.93%
NPV (at 10%)	=	9.87 million Taka
B-C Ratio (at 10%)	=	2.19

15% Fall in Revenue (with CO_2 period at 10 $ per day)

FIRR	=	12.60%
NPV (at 10%)	=	1.20 million Taka
B-C (at 10%)	=	1.15

(Oil to gas)

Economic Analysis

(Health & Environment Benefits Per Year : 0.99 million Taka)

EIRR	=	24.33%
NPV (at 10%)	=	8.01 million Taka
B-C Ratio (at 10%)	=	1.88

Project Sensitivity

For 15% Fall in Revenue

EIRR	:	4.57%
NPV (at 10%)	:	– 2.5 million Taka
B-C (at 10%)	:	0.72

For 15% Increase in Investment Cost

EIRR	=	15.33%
NPV (at 10%)	=	3.37 million Taka
B-C Ratio (at 10%)	=	1.32