

# INVESTMENT GRADE ENERGY EFFICIENCY AUDIT REPORT

on

## COTTON CLOTHING (BD) LTD.



sustainable solutions through innovation

# **INVESTMENT GRADE ENERGY EFFICIENCY AUDIT REPORT FOR**

## **COTTON CLOTHING (BD) LTD.**

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**Prepared by**

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**December-2016**

conservation or waste minimization opportunities involving engineering design and capital investment are found to be the recommended course of action, it is advisable to engage the services of a consulting engineering firm or other experts to do the detailed engineering work involved.

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# Preface

3R Environmental Consulting Ltd. performed the work described in this report. The objectives are to identify and evaluate selected opportunities for energy conservation and waste minimization. The recommendations developed are the result of analysis performed on client-supplied data and through a site visit, and are therefore restricted in detail due to limitations on available time. When energy conservation or waste minimization opportunities involving engineering design and capital investment are found to be the recommended course of action, it is advisable to engage the services of a consulting engineering firm or other experts to do the detailed engineering work involved.

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## Executive Summary

The following is a summary of the report. Also, contained in the report are energy conservation measures, additional considerations of utility billing information.

COTTON CLOTHING (BD) LTD. reports to use 37375 kWh from national grid, which is 37 % of total fuel. They also use 89424.78 cubic meter of natural gas for steam generation, which is 49 % of total fuel. They use 6575 liters of diesel for electricity generation which is 14% of total fuel. The company used total 7839.14 GJ energy in 2015-16.

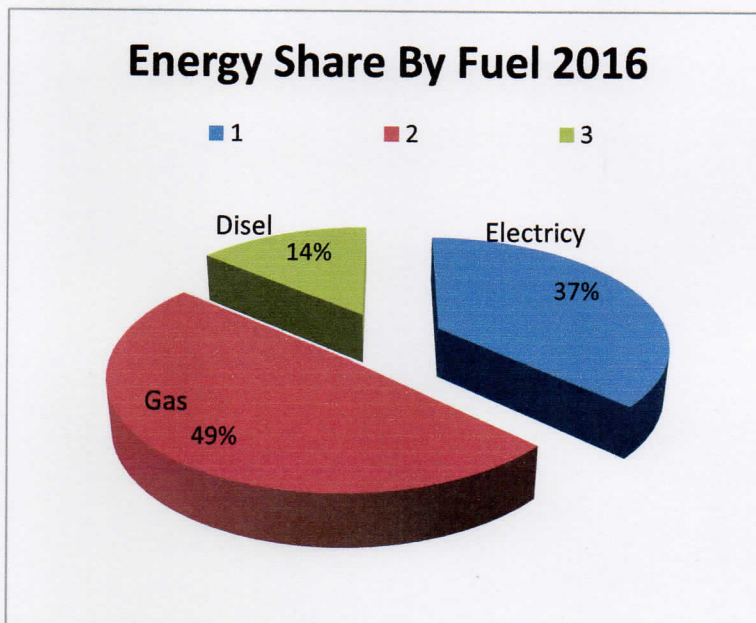


Figure 1: Energy Share by Fuel

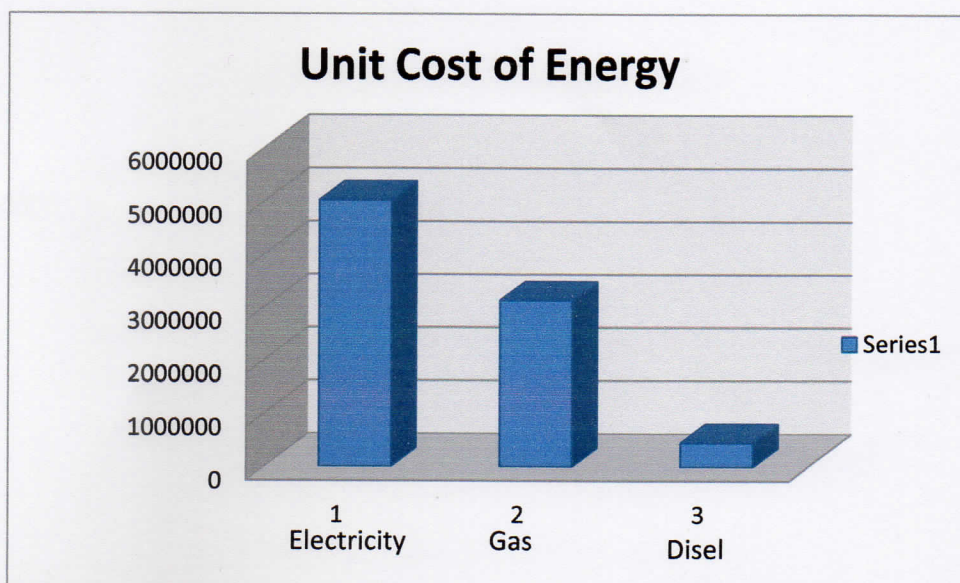


Figure 2: Unit Cost of Energy

## Observations and Recommendations

The following table prioritizes energy savings opportunities (high, medium and low energy savings potential in each area) in the facility, in terms of current energy use. The opportunities listed include their approximate annual savings for each end use.

**Table I: Energy Management Opportunities**

| Description                                      | Maximum Potential Savings <sup>1</sup> | Annual Savings    |                        |                            | Relative Implementation Cost |
|--------------------------------------------------|----------------------------------------|-------------------|------------------------|----------------------------|------------------------------|
|                                                  | %                                      | Electricity (kWh) | Gas (nm <sup>3</sup> ) | Equivalent <sup>2</sup> GJ |                              |
| Lighting Improvement                             |                                        |                   |                        |                            |                              |
| 1. Replace 4 feet T8 Tube by 2 feet Tube         | 8                                      | 38,889            |                        | 1,557                      | High                         |
| 2. Replace T8 tube by T5 tube                    | 30                                     | 194,444           |                        | 7,777                      | High                         |
| 3. Reduce tube by fitting stand on linking table | 1.5                                    | 9,444             |                        | 377                        | High                         |
| 4. Reduce T8 tube by LED at sewing section       | 0.5                                    | 3,056             |                        | 123                        | High                         |
| 5. Reduce unnecessary tubes                      | 4                                      | 26,389            |                        | 1,057                      | Low                          |
| 6. Switching of unnecessary tubes                | 1.5                                    | 8,333             |                        | 333                        | Medium                       |
| Steam Generation and Distribution                |                                        |                   |                        |                            |                              |
| 7. Using economizer to heat make up water        | 4                                      |                   | 8,564                  | 350                        | High                         |
| 8. Improve steam pipe insulation                 | 1                                      |                   | 2,202                  | 90                         | Low                          |
| Electricity Generation & Distribution            |                                        |                   |                        |                            |                              |
| 9. Stop vacuum table                             | 3                                      | 44,444            |                        | 1,777                      | Low                          |
| 10. Attach PFI for generator set                 | 15                                     | 116,667           |                        | 4,667                      | Low                          |
| 11. Energy Management                            | 10                                     | 140,000           | 21,924                 | 5,896                      | High                         |

Total avoidable carbon emission is estimated to be 1,489 Ton per year.

<sup>1</sup> Each percentage is calculated on section wise e.g. lighting, boiler, compressor etc. as described in ECM

<sup>2</sup> 1 kWh= 12,000 kJ

1 nm<sup>3</sup> Natural Gas = 40,869 kJ

1 liter Diesel = 11.07 kWh

1 KG LP Gas = 12.86 kWh

## Introduction

COTTON CLOTHING (BD) LTD. has one of the 100% export oriented Garments Manufacturer in Bangladesh, which is situated in **Kazi Tower, Satatis, Gazipura, Tongi, Gazipur, Bangladesh**. The factory runs 8 hours in a day and 302 days in a year. The factory has monthly capacity will 703545 pieces. In 2016 factory produces total 10759056 pieces of and consumes total 3729067 GJ of energy. The factory uses electricity from BREB and natural gas from Titas Gas Transmission and Distribution Company Ltd.

## Production Process

The main raw material of COTTON CLOTHING (BD) LTD. is fabrics and to produce ready-made garments through washing. The production flow diagram is given below.

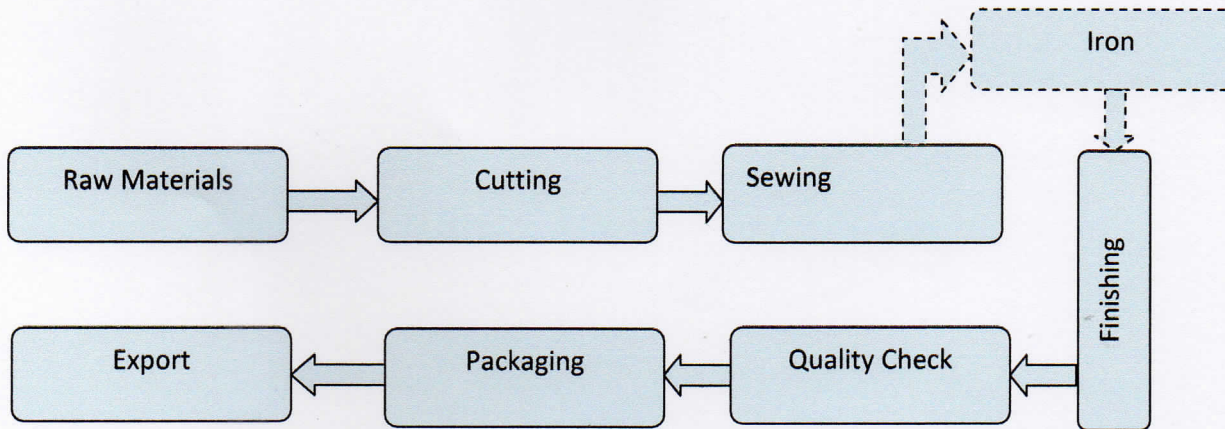


Figure 3: Process Flow Diagram of COTTON CLOTHING (BD) LTD.

## Energy Utility System

COTTON CLOTHING (BD) LTD. uses Electricity, Gas and Diesel as energy sources. They use 666,024 cubic meter of Gas for boiler, which is 35% of total energy consumption. They use 2,372,401 kWh for electrical load from national grid, which is 33% of total energy consumption. Rest 32% is used from own generation.

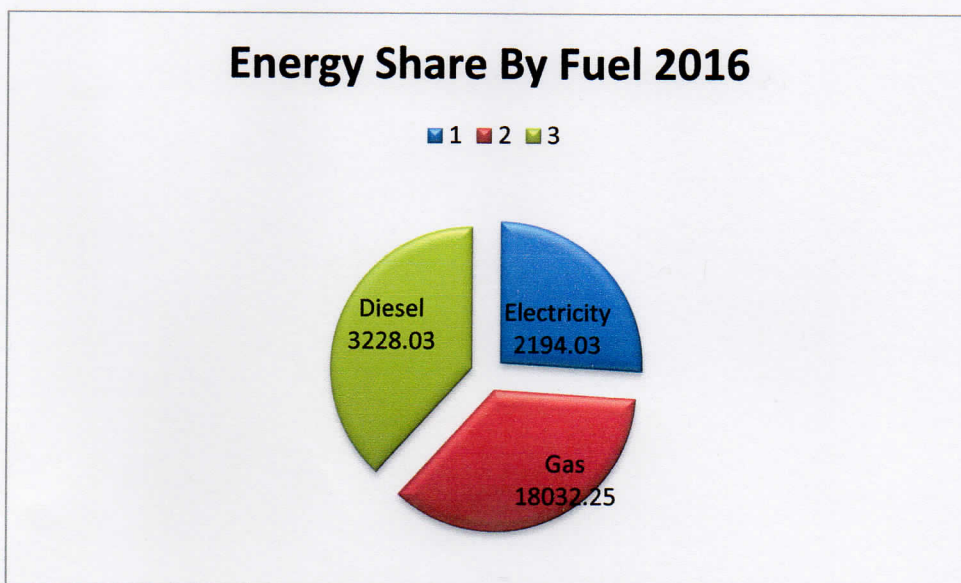


Figure 4: Energy Share by Source

## Energy System and use

COTTON CLOTHING (BD) LTD. use national grids their main source. When it fails they use the diesel generator. They have three pole transformers and the capacities are 50 kVA, 50 kVA&15 kVA respectively. They have one diesel generator and the capacity is 300 kVA. The factory's average load is 150 KW. Electrical load distribution chart is prepared as based on connected load. A single line diagram of the factory is given in the annexure.

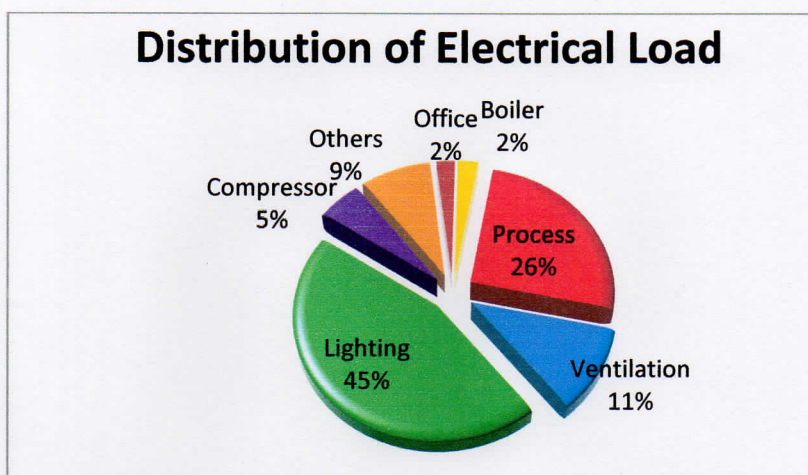


Figure 5: Distribution of Electrical Load

The company has used around 609664 kWh of electricity in 2016 out of which 73% came from the BREB. They used electricity in various sections in the production process and for utility operations. The above figure shows the distribution of electrical load in different major sections of the factory. The figure shows that the maximum portion of electrical energy is used for washing machine.

### Steam System and use

COTTON CLOTHING (BD) LTD. has one Boiler of is 500 kg. These can be operated by natural gas and LP Gas. In 2016 COTTON CLOTHING (BD) LTD. uses 89424.78 nm<sup>3</sup> of natural gas for steam generation. Steam is used for ironing and washing. The safety pressure is 12 bar and they produce steam at 8 bar. No pressure gauge was found in the distribution line. A schematic diagram for steam lines is given in annexure.

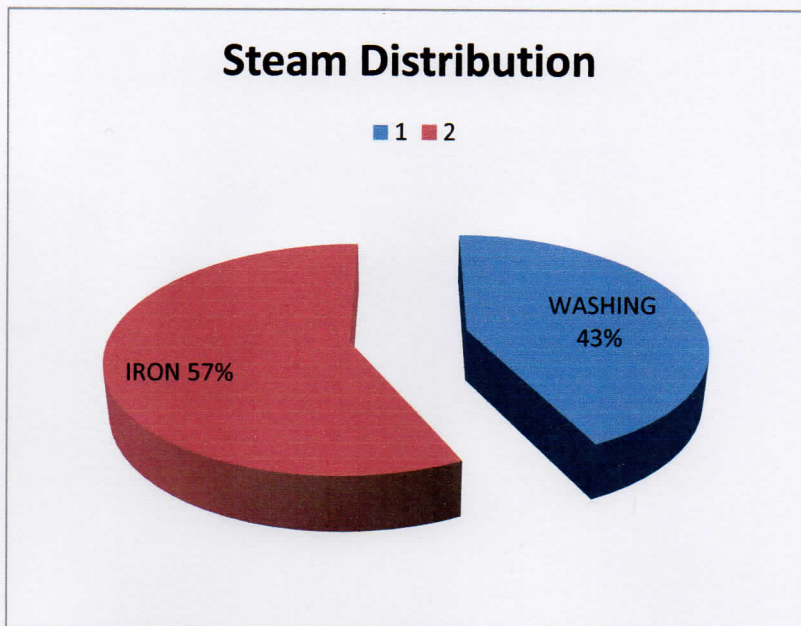


Figure 6: Steam Distribution

## Energy Use Analysis and Benchmark

Energy is a valuable commodity. From the business point of view it is important to know the consumption per unit production. Information on consumed energy and production can be used to calculate Specific Energy Consumption (SEC) for production. It reflects the energy usage per unit of production. It is helpful for comparative analysis within an industry. If it is known, the management will be in a position to control the energy consumption by taking various necessary steps. For this reason 3R Environmental Consulting Ltd. team summarizes the present consumption scenario and it's SEC. From the figure, it reveals that the highest SEC is 119.5676MJ/piece in October'16 while the lowest SEC is 60.99536MJ/piece in January'16.

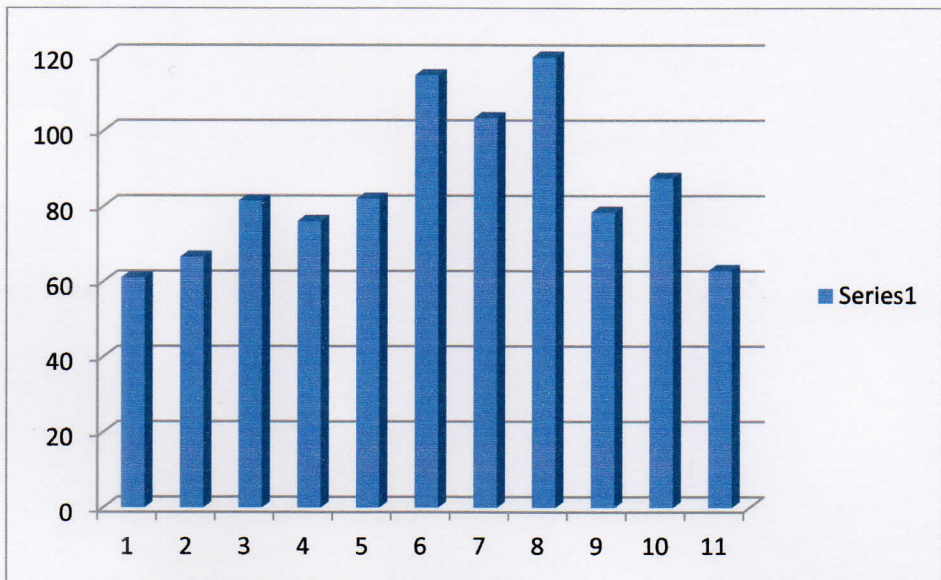


Figure 7: Specific Energy Consumption

Based on the available data, we cannot conclude the exact benchmark. There are many factors beyond this problem; such as: political stability, labor unrest, lack of resource, raw material, energy source etc. On that note, we can standardize the benchmark as the average SEC as it is 84.88 MJ/piece. Because, it very challenging to target the lowest SEC instantly for a factory. So, it should maintain only on those months where it exceeds the range of average SEC. Otherwise, it will be difficult to maintain the average benchmark implemented. If the proposal is accepted then the factory could save at least 36,32 GJ in their last year of operation.

### Energy Conservation Measure (ECM)

Energy consultants of 3R Environmental Consulting Ltd. conclude these ECM based on their assumption using the data provided by the factory personnel. If all the ECM will be implemented, then the cumulative savings may not be same as every ECM is focused individually, due to possible interactive effects between ECMs.

## ECM 1- Replace 4 feet T8 Tube by 2 feet Tube

### Current practice

In knitting section, tube lights are installed on channel. Light gets a barrier for bobbin self, as a result shade falls on knitting bar. Here, the factory is using 4 ft tubes but a little LUX is found on knitting bar.



### Proposed Measure

Thumb rule is, light source/tube should be installed as near as work place. But BD Technology team found that, tube fixes on high place and bobbin self creates shade. If tube fixes under the bobbin self, then small tubes can give more light on knitting bar.

### Anticipated Savings

Saving up to 8% of lighting energy or equals to approximately 1,557 GJ of energy annually.

### Implementation Cost

Implementation cost is relatively high and payback would be found within two years.

## ECM 2- Replace T8 tube with T5 tube

### Current practice

COTTON CLOTHING (BD) LTD. used T8 tube lights with magnetic ballast. Magnetic ballast consumes more power and power Factor is also low.



### Proposed Measure

COTTON CLOTHING (BD) LTD. can replace their T8 tube lights with T5 tube lights (Industrial grade) and keep weekly cleaning practice which gives them higher LUX with low consumption.

### Anticipated Savings

Savings up to 30% Electrical energy equals to approximately 7,777 GJ of energy annually.

### Implementation Cost

Implementation Cost is high and payback would be found within three years.

### ECM 3- Reduce tube by fitting stand on linking table

#### Current practice

For linking table tubes are set on lighting channel. These lights focus on head which cause operators headache.

#### Proposed Measure

Tube setting change can save lighting energy. Here every table contains light stand which sets on center lines of round tables. Every 2 round machine needs one 4 ft tube and one 2 ft tube for 1 machine. This arrangement saves one 4 ft tube for six machines set table. This also relieves operators from headache.

#### Anticipated Savings

Savings up to 1.5% Electrical energy equals to approximately 377 GJ of energy annually.

#### Implementation Cost

Implementation Cost is high and payback would be found within four years.

## ECM 4- Reduce T8 tube by LED at sewing section

### Current practice

COTTON CLOTHING (BD) LTD. uses T8 tube lights which are installed on channel through sewing machines.



### Proposed Measure

Source of light is at a high place and causes headache for operators. But this source of light can set near the needle of sewing machine, where 2 watt LED light is enough for every machine. By setting LED lights 2/3 tubes can be removed from each lighting channel.

### Anticipated Savings

Savings up to 0.5% Electrical energy equals to approximately 123 GJ of energy annually.

### Implementation Cost

Implementation Cost is high and payback would be found within three years.

## ECM 5- Reduce unnecessary tubes

### Current practice

BD Technology team found so many tube lights are set on walkways. In many sections as ironing tables, finishing sections tubes set on ceiling which is high for workplaces. In knitting inspection tables tubes set in three step as ceiling, above & under of the tables.



### Proposed Measure

Remove tubes from walkways and unnecessary places. Reduce tubes by lowering tubes height from ceiling which helps factory to get same lux. For knitting inspection tables remove ceiling tubes. Replace 4 ft tubes by 2ft tubes and set stand middle of the tables which helps worker from headache create by tubes.

### Anticipated Savings

Savings up to 4% of lighting load or equals to approximately 1,057 GJ of energy annually.

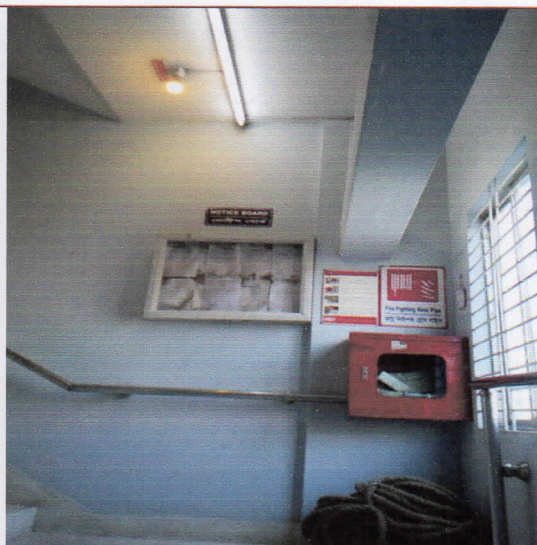
### Implementation Cost

Implementation Cost is high and payback would be found within three years.

## ECM 6- Switching off unnecessary tubes

### Current practice

In many places it is found that worker leaves his place but tubes remain on.



### Proposed Measure

Factory management can start campaign for energy savings. Instruct supervisor to practice tubes off before leaving his place. Its saves little but sum is big.

### Anticipated Savings

Savings up to 1.5% lighting load equals to approximately 333 GJ of energy annually.

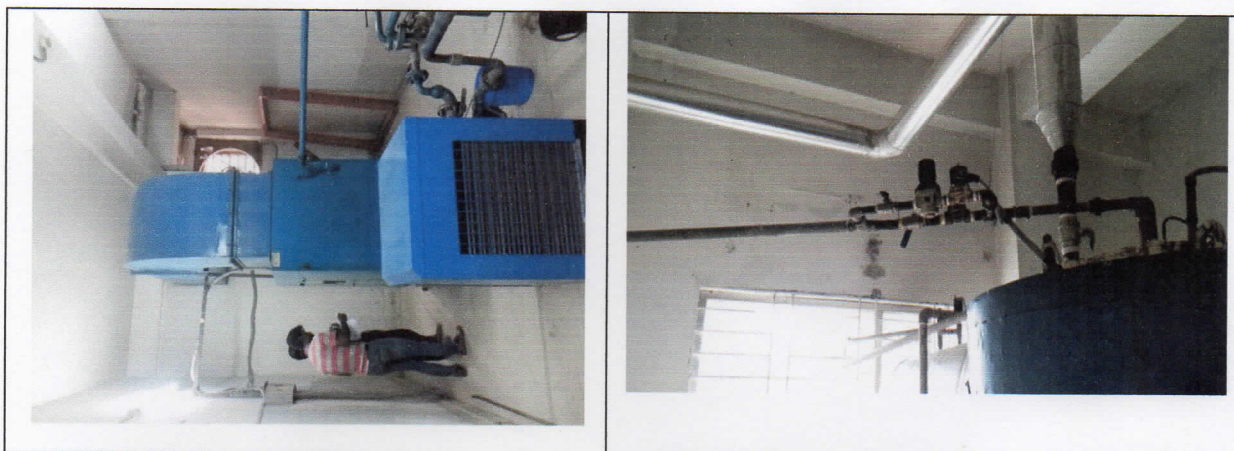
### Implementation Cost

Implementation Cost is medium and payback would be found immediately.

## ECM 7- Using economizer to heat make up water

### Current practice

Flue gas comes out from boiler with high temperature as 220°C.



### Proposed Measure

Flue gas temperature can be lowered to 120°C at low heating feed water. Here management can pass make-up water through economizer. So, easily feed water can be heated through economizer. In this process existing feed water pump need not to be changed but feed line needed modification.

### Anticipated Savings

Savings up to 4% of heat as thermal energy or equals to approximately 350 GJ of energy annually.

### Implementation Cost

Implementation Cost is high and payback would be found within four years.

## ECM 8- Improve steam pipe insulation

### Current practice

Overall steam distribution system is good. But need some improvements in specific areas.



### Proposed Measure

Through bare spaces a huge heat loss is occurred. So it needs immediate action to save this type of loss by insulating.

### Anticipated Savings

Savings up to 1% of heat as thermal energy or equals to approximately 90 GJ of energy annually.

### Implementation Cost

Implementation Cost is medium and payback would be found within one year.

## ECM 9- Stop vacuum table

### Current practice

Ironing is done on vacuum table. Vacuum tables main target is to remove excess steam from working area. But it is found that workers use body pattern for ironing. This pattern is made by ebonite sheet or hard board which creates a barrier for passing steam through the sweaters.



### Proposed Measure

As steam cannot pass through the table, the main reason for using vacuum table is spoiled. As vacuum table motor runs for nothing, it is better to stop table motor for this type of ironing.

### Anticipated Savings

Savings up to 3% Electrical energy equals to approximately 1,777 GJ of energy annually.

### Implementation Cost

Implementation Cost is low and payback would be found immediately.

## **ECM 10- Attach PFI for generator set**

### **Current practice**

COTTON CLOTHING (BD) LTD. has no PFI units with diesel generator as generator suppliers' suggestion. It shows generation loss of diesel generator.

### **Proposed Measure**

COTTON CLOTHING (BD) LTD. can use PFI units with diesel generator for minimizing the generation loss.

### **Anticipated Savings**

Savings up to 15% diesel generated energy equals to approximately 4,667 GJ of energy annually.

### **Implementation Cost**

Implementation Cost is high and payback would be found within two years.

## ECM 11- Energy Management

### Current practice

For Energy Management, six key points meet to check and improve. COTTON CLOTHING (BD) LTD. does not follow any Energy policy, organizing through part time responsibility, informal contacts between engineer and users for motivation, cost reporting on invoice data, no promotion for energy efficiency marketing and for investment prefer low cost.

### Proposed Measure

COTTON CLOTHING (BD) LTD. should prepare Energy Savings Team. Responsibilities of this team are to prepare energy policy and action plan give feedback on energy saving to all, produce green notice board about target, install individual energy meter in different section & boiler flow meter, focus customers on savings and invest actively for energy saving measures.

### Anticipated Savings

Hence international Energy Management table shows 5-15% savings possible but BD Technology target 10% overall energy savings possible for this year which equal to 5,896 GJ Energy.

### Implementation Cost

Implementation Cost is high and payback would be found within two years.

## Annexure

## ➤ Historical Energy and Production Data

Annexure Table 1: Specific Energy consumption

| Month         | Production (Pieces) | Electricity (GJ) | Gas (GJ) | Diesel (GJ) | Total (GJ) | Specific Energy Consumption (MJ/Pieces) |
|---------------|---------------------|------------------|----------|-------------|------------|-----------------------------------------|
| January' 16   | 672861              | 106.164          | 289.85   | 14.4        | 410.414    | 60.99536                                |
| February' 16  | 703545              | 109.692          | 343.95   | 14.4        | 468.042    | 66.52623                                |
| March' 16     | 530932              | 113.364          | 297.78   | 21.6        | 432.744    | 81.50648                                |
| April' 16     | 599237              | 116.352          | 317.96   | 21.6        | 455.912    | 76.08208                                |
| May' 16       | 651195              | 119.808          | 399.9    | 14.4        | 534.108    | 82.01967                                |
| June' 16      | 315438              | 122.652          | 232.26   | 7.2         | 362.112    | 114.7966                                |
| July' 16      | 489185              | 125.388          | 323.88   | 56.7        | 505.968    | 103.4308                                |
| August' 16    | 307764              | 128.736          | 217.65   | 21.6        | 367.986    | 119.5676                                |
| September' 16 | 583271              | 131.184          | 304.82   | 21.6        | 457.604    | 78.45478                                |
| October' 16   | 526100              | 134.784          | 303.67   | 21.6        | 460.054    | 87.44611                                |
| November' 16  | 5379528             | 137.376          | 3031.72  | 215.1       | 3384.196   | 62.90879                                |
| <b>Total</b>  | 10759056            | 1345.5           | 6063.44  | 430.2       | 7839.14    | 933.7345                                |

Annexure Table 2: Electricity Bill

| COTTON CLOTHING (BD) LTD.                    |              |              |                  |
|----------------------------------------------|--------------|--------------|------------------|
| Electricity Bill 2016(Meter no:011637209730) |              |              |                  |
| Month                                        | Off-peak     | Peak         | Total cost (BDT) |
| January' 16                                  | 2132         | 817          | 433205           |
| February' 16                                 | 2197         | 850          | 511347           |
| March' 16                                    | 2268         | 881          | 527215           |
| April' 16                                    | 2327         | 905          | 433528           |
| May' 16                                      | 2397         | 931          | 491404           |
| June' 16                                     | 2461         | 946          | 399154           |
| July' 16                                     | 2521         | 962          | 391404           |
| August' 16                                   | 2587         | 989          | 479681           |
| September' 16                                | 2637         | 1007         | 350175           |
| October' 16                                  | 2708         | 1036         | 520292           |
| November' 16                                 | 2766         | 1050         | 479681           |
| <b>Total</b>                                 | <b>27001</b> | <b>10374</b> | <b>5017086</b>   |

Annexure Table 3: Gas Bill

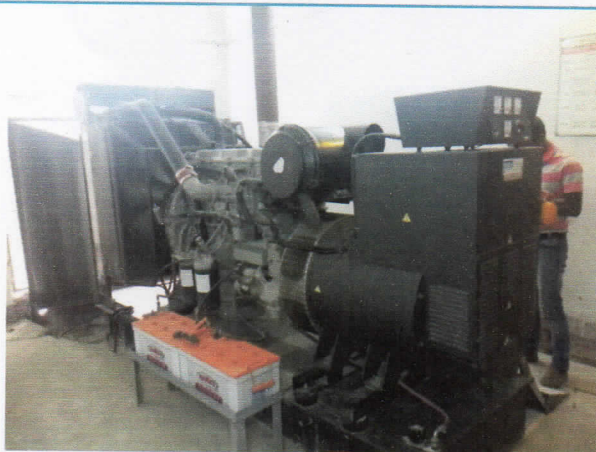
| COTTON CLOTHING (BD) LTD. |                 |                  |
|---------------------------|-----------------|------------------|
| Gas Bill2016              |                 |                  |
| Month                     | Cubic meter     | Total cost (BDT) |
| January' 16               | 8145.4          | 285089           |
| February' 16              | 7770.829        | 271979           |
| March' 16                 | 9221.114        | 322739           |
| April' 16                 | 7983.486        | 279422           |
| May' 16                   | 8524.286        | 298350           |
| June' 16                  | 10721.29        | 375245           |
| July' 16                  | 6226.8          | 217938           |
| August' 16                | 8683.057        | 303907           |
| September' 16             | 5835.086        | 204228           |
| October' 16               | 8172.143        | 286025           |
| November' 16              | 8141.286        | 284945           |
| <b>Total</b>              | <b>89424.78</b> | <b>3129867</b>   |

Annexure Table 4: Diesel Bill

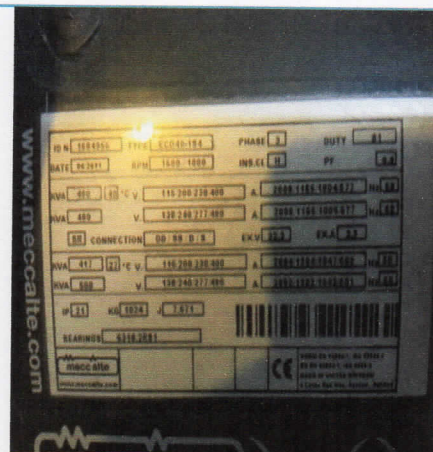
| COTTON CLOTHING (BD) LTD. |             |                  |
|---------------------------|-------------|------------------|
| Diesel Bill 2016          |             |                  |
| Month                     | Liter       | Total cost (BDT) |
| January' 16               | 600         | 39000            |
| February' 16              | 400         | 26000            |
| March' 16                 | 400         | 26000            |
| April' 16                 | 600         | 39000            |
| May' 16                   | 600         | 39000            |
| June' 16                  | 400         | 52000            |
| July' 16                  | 200         | 13000            |
| August' 16                | 1575        | 102375           |
| September' 16             | 600         | 39000            |
| October' 16               | 600         | 39000            |
| November' 16              | 600         | 39000            |
| <b>Total</b>              | <b>6575</b> | <b>453375</b>    |

## ➤ Machine Specification and Photographs

### Generator 1:



Annexure Figure 1



Annexure Figure 2

### Generator

Capacity: 500 kVA, 240 KW  
Information: 400/230V 1800rpm, PF:0.8  
Excitation Voltage & Current: 51V, 5A

### Boiler:



Annexure Figure 3



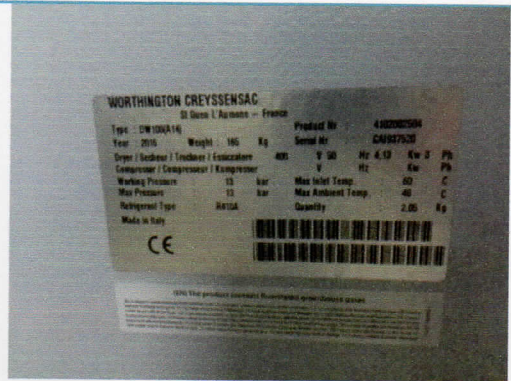
Brand Name: AIR TANK

Serial No.: 12ADC21

Air Compressor:



Annexure Figure 4



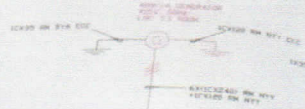
Annexure Figure 5

Compressor

Capacity:11.2 KW, 15HP

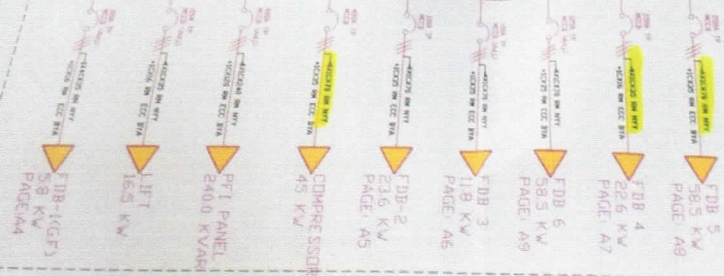
3. Insulators shall be of specification according to the standard and one standard cable for connection

LT-01  
LCC S.S. ROOM



INTERLOCK

COPPER BUS 415V, 1600A, 3P+N+G



DATE 21.04.2016  
ACCORD

SCALE N/A

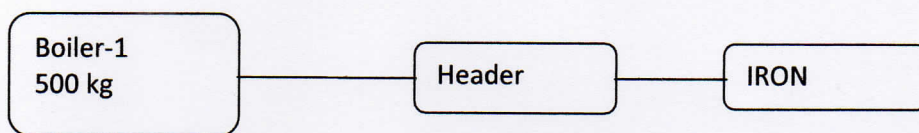
| DATE     | NAME     |
|----------|----------|
| 14.04.16 | ENGR. ZA |
| 14.04.16 | ENGR. ZA |

SINGLE LINE DIAGRAM  
LT PANEL 1

ZA002.CCBLO1

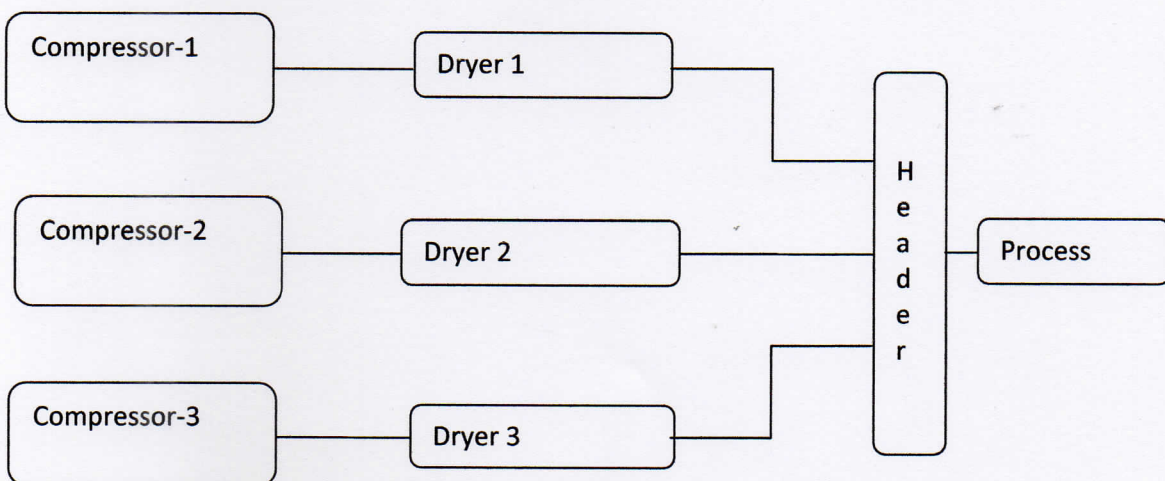
SHEET 13

### Line Diagram of Steam Distribution Network:



Annexure Figure07: Steam Distribution Diagram

### Line Diagram of Compressed Air Distribution Network:



Annexure Figure08: Air Distribution Diagram

**3R ENVIRONMENTAL CONSULTING**  
sustainable solutions through innovation

**Meeting Attendance**

Date : 11/12/2016

Factory Name : Cotton Clothing (BD) Ltd.

Factory Address: Kazi Tower, 27 Road, Gaziপুর, Tongi, Gaziপুর, Bangladesh

Product Item : Main Customer:

Visit Status : Energy Audit

**3R Environmental Consulting Representative**

| S.L | Name             | Designation | Opening Meeting Signature | Closing Meeting Signature |
|-----|------------------|-------------|---------------------------|---------------------------|
| 1   | Mr. Somwar Kabir | CTO         | <i>[Signature]</i>        | <i>[Signature]</i>        |
| 2   | Mohammad Hossain | TO          | <i>[Signature]</i>        | <i>[Signature]</i>        |
| 3   | Mr. Sahel Khan   | Engineer    | <i>[Signature]</i>        | <i>[Signature]</i>        |
| 4   |                  |             |                           |                           |
| 5   |                  |             |                           |                           |

1/F, (4<sup>th</sup> Floor), North-East Dargah Salam Road, Mirpur-1, Dhaka-1216, Bangladesh. Hotline: +88 01957799570.  
Tel: +88-02-9022861, Email: 3renvconsulting@gmail.com, service@3recbd.com, Web: www.3recbd.com  
QF 14 Rev. 00 Eff. Date: 01/12/13 Page 1 of 2

**3R ENVIRONMENTAL CONSULTING**  
sustainable solutions through innovation

**Factory Representatives**

01947902520

| S.L | Name              | Designation                 | Opening Meeting Signature | Closing Meeting Signature |
|-----|-------------------|-----------------------------|---------------------------|---------------------------|
| 1   | Mr. Mansur Rahman | Asst. Manager (H.R. & Gen.) | <i>[Signature]</i>        | <i>[Signature]</i>        |
| 2   | Nurun Nabeela     | Officer (H.R. & Gen.)       | <i>[Signature]</i>        | <i>[Signature]</i>        |
| 3   |                   |                             |                           |                           |
| 4   |                   |                             |                           |                           |
| 5   |                   |                             |                           |                           |
| 6   |                   |                             |                           |                           |

3R Environmental Consulting Representatives: In Time: Out Time:

We, \_\_\_\_\_ declare that 3R Environmental Consulting representatives visited/ Tested all Testing scope area of this factory in the premises.

Declared by Factory Representative Name & Designation

*[Signature]*  
Sign, Seal & Date

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Figure09: List of People Met in the Plant